INDEX

NAME INDEX

TITLE INDEX

ASTRONOMICAL NOTES.

CORRESPONDENCE.

DEATHS.

REVIEWS AND OUR BOOKSHELF.

Agriculture, Forestry, and Horticulture:

Anthropology and Archæology:

ology:

Chemistry:

Engineering:

Geography and Travel:

eology and Mineralogy:

lathematical and Physical Science:

Medical Science:

Meteorology:

Miscellaneous:

The various Supplements should be collated and bound with the numbers with which they were issued.

Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

NATURE

A WEEKLY JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

SATURDAY, JULY 5, 1930.

CONTENTS.

Librarianship and Scientific Research.

THE growing difficulty of the task of making the ever-expanding mass of published information readily available to workers in every branch of science is a serious problem both in scientific and in industrial research. The value of a uniform international system of classification as the only effective way of dealing with the present enormous output of scientific periodicals was emphasised by most of those who took part in a discussion on the abstracting and classification of scientific literature which followed the annual dinner of the Chemical Engineering Group of the Society of Chemical Industry. Workers on the borderline and in the newer branches of science have suffered most from the absence of a uniform classification, and would gain most immediately by the adoption of the universal decimal classification of the Institut de Bibliographie, of Brussels. This system has already been adopted by a number of reference libraries, including the Science Library, and also in industry, and is used by the Royal Society (for its 'B' papers) and other societies in Great Britain and abroad. So far, the adoption of the international system has not been favoured by the British Bureau of Chemical Abstracts. This is due not to any difficulty in applying the system to the complicated case of chemistry, for the international system allows any chemical compound to be classified, but apparently to doubts as to the value of the system to chemists already familiar with a complicated system of nomenclature.

The adoption of a uniform international system of classification is, however, only a step towards the solution of the problem. A significant feature in the present situation is that in spite of the

excellent abstracting services already available, most, if not all, of the large research associations or departments for scientific or industrial research find it advantageous to issue their own bulletins of abstracts. This is not necessarily a case of overlapping. In the first case, such bulletins will be limited not by sciences but by applications of science, and a particular bulletin of abstracts may cover engineering in several branches, physics, chemistry, and perhaps biology or medicine as they are applied to a particular field of industry. Again, the abstracts in such a bulletin will not be limited to the journals which contain accounts of original work, but will include journals describing applications of such work, etc., and valuable ideas or suggestions are often taken from the technical or trade papers, apart altogether from the commercial information, and other matter that is gathered in this way. Another feature may be the abstracts from patent literature or summaries of work carried out in the department or institution which is not published outside. A bulletin of this kind is essentially a record of current information received in the library, and rarely includes abstracts on the scale of those issued by Science Abstracts or the Bureau of Chemical Abstracts. Its purpose is to stimulate thought and to bring to the notice of those concerned the papers, patents, and other documents, internal or external, which are of immediate interest to them. For this reason, promptitude of publication is an important matter. Such library notes may be in the hands of readers several weeks before the publication even of British Chemical Abstracts, which are noted for their promptness of publication.

One of the points which Major Freeth most stressed in his recent lecture on the influence of technique on research was the isolation of the modern scientific worker. Science lives far too much in water-tight compartments, and frequently men are unaware of first-class work going on within two or three hundred yards of them in another department. This is one result of the extraordinary specialisation of industry and of science, and it persists, if it does not increase, in spite of the widening scope of the abstracting services. The issue of a bulletin of the type just indicated affords a librarian some opportunity of breaking down the isolation of the scientific workers for whom the bulletin is intended. The smaller circle of workers for whom the bulletin is intended permits the issue of a document with rather more personal and vital interest than is possible in the case of one published for scientific workers generally, or even for one class of scientific workers. The shorter abstracts or notes are another advantage. They are much more likely to be read by those to whom it is sent than the lengthier abstracts. Few engaged in scientific or industrial research have not at times been overwhelmed by the mass even of abstracted information which seems to call for attention, and fewer still have diligently and consistently examined the whole. The smaller group of workers also enables the librarian to issue special notices directing the attention of individual workers to papers or publications likely to be of special interest or service to them. In this way a librarian may be able very considerably to assist the director of research who is often responsible for considerably more than the fifteen workers whose investigations he is supposed to be able to direct at maximum efficiency.

The efficient discharge of duties of this type depends very largely upon the personality of the librarian, and a technical librarian is now generally regarded as occupying a key position. His ability to select material for indexing and for issue in bulletin form will be influenced largely by the extent of his practical knowledge of the technical and manufacturing side of the industry. Some such knowledge is fundamental to the specialised work of indexing and classification, and only when the librarian is able to use it in selecting material for his special requirements will industry reap the full value of the International Decimal Classification and improvements in the abstracts issued by the scientific societies.

Under modern conditions a well-equipped and adequately staffed library is an essential feature of any large research department. The increasing volume of scientific literature has indeed enhanced the value of a literature search, and in a recent article* W. A. Hamor and L. W. Bass point to the increasing demand for chemical bibliographers, literature indexers, and the like, as evidence that this is widely recognised. The conditions for literature searches in academic work and in industrial research often differ considerably, and various factors which are emphasised by Hamor and Bass tend to greater thoroughness in the former case, apart from the actual library resources which may be available in the two cases. There is much to be said in support of Dr. S. C. Bradford's suggestion that the preparation of bibliographies or lists of papers dealing with specified subjects should be undertaken by libraries. A literature search is

* "Bibliochresis: The Pilot of Scientific Research", *Science*, 1930, **71**, 375-378.

effected much more thoroughly and rapidly by a trained library staff than by the average research worker. The saving of time for actual research work may be quite considerable enough for the practice of entrusting literature searches to the library staff to become general in industry—perhaps more so if industrial research became organised, as Major Freeth suggests, by divisions of science instead of by divisions of practice.

The efficiency of the technical library for research purposes is, however, determined as much by the personality and enthusiasm of the librarian as by the mechanical perfection of its indexing system. His knowledge of the problems under investigation and their requirements, and his contact with the research staff, are the surest means of promoting contact and the resulting exchange of ideas and technique. The cramping or isolating tendency of the growing mass of recorded scientific information can only be countered by the play of intelligent individuality and enthusiasm.

A Century of Anatomy.

Quain's Elements of Anatomy. Eleventh edition. Editors: Sir Edward Sharpey-Schafer, Dr. Johnson Symington, and Dr. Thomas Hastie Bryce. In 4 volumes. Vol. 4, Part 3: *The Heart.* By Prof. Thomas Walmsley. Pp. vii + 152 + 2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 16s. net.

THE brief historical introduction which Sir E. Sharpey-Schafer and Prof. Bryce contribute to Prof. Walmsley's monograph on the heart makes brave but gloomy reading.

Jones Quain published his "Anatomy" when he was a lecturer on anatomy in the Medical School, Aldersgate Street, in 1828. With the fifth edition, published twenty years later, the work passed into the hands of his brother, Richard Quain, and William Sharpey, professors respectively of anatomy and general anatomy and physiology in University College, London. Viner Ellis succeeded Richard Quain in the editorship, and was in turn succeeded by Allen Thomson and John Cleland, Sharpey continuing to contribute the general and microscopical anatomy, which had been the most striking change introduced when he first became associated with the work. Although enlarged, it still appeared in two volumes in 1876, when the present publishers issued the eighth edition, which, although contributed largely by Sharpey, Thomson, and Schafer, contained a chapter by Gowers on the brain and spinal cord. Also in two volumes was the ninth edition by Thane, Schafer, and Thomson, dedicated to Sharpey, who at his death had been responsible editor for thirty-five years.

The monographic form was assumed in 1890, when the eight parts of the famous tenth edition began to appear. Since then the only new authors until now have been Profs. Symington and Bryce Godlee assisting in the preparation of an appendix on superficial anatomy in the tenth edition. Sir E. Sharpey-Schafer has been editor for fifty-three years. The War and the death of Prof. Symington interrupted publication of the present (the eleventh) edition, which commenced with Prof. Bryce's volume on embryology in 1908. Monographs on neurology, splanchnology, osteology and arthrology, and myology have appeared, and one on angeology was in preparation by Prof. Bryce. "But the greatly increased cost of printing and engraving has, in the judgment of the publishers, rendered it necessary to postpone indefinitely the publication of this part. As the section upon the Heart . . . was ready for publication, it has been decided to make this the last portion of the edition." Although postponed indefinitely as a part of "Quain's Anatomy", Prof. Bryce's angeology may be published separately, and a volume on the lymphatic system by Prof. Blair will be. As the sole difference in the "cost of printing and engraving" would concern the titles of these works, it seems evident that for the time being publication of "Quain's Anatomy" now ceases in the middle of an edition the first parts of which are already urgently in need of revision.

There is nothing in the English literature of anatomy that will fill the gap. The work began a century ago as a students' handbook, and has developed along lines which, familiar enough on the Continent, are too little valued in England. Rather than a mere inventory of facts, it gave, and might have given increasingly, just that summary and discussion of ascertained knowledge that is necessary to serve as a link between it and the problems of the present. It has served the writers of text-books well on occasion, and a reference to its pages will continue to save many a practitioner from the hasty assertion that "there is nothing in the text-books about it". It is the only modern book on anatomy not written with an eye chiefly on examination papers. These surely are good qualities. In a generation in which medical practitioners look for inspiration to the empiricism of chemistry, therapeutical and metabolic, rather than

to morphology, it is intelligible that an anatomical work more compendious than the standard text-book will not find shelf-room in many studies; but it is to be regretted that the matter should end there.

The distinctive features of the parent work are well illustrated in Prof. Walmsley's contribution. The chapter on the comparative anatomy of the heart is discriminating. The heart is one of the most significant links between vertebrates and invertebrates, and as the heart of the latter has lately received much attention, this part of the subject might have received fuller treatment. The great problems are here. The reviewer agrees with Prof. Walmsley's view that a discussion of the comparative anatomy of the connecting systems of the heart is "perhaps as yet hardly profitable", but not altogether with the statement that the manner in which delay in conduction is produced is not primarily a structural problem. This is, however, not the place to discuss the intricacies of the considerable amount of work which has been done on the development of the conducting mechanisms. Prof. Walmsley recognises that the "whole question of the relation of nerve and muscle is involved" in the interpretation of the facts now known. His presentation of the matter, and indeed the whole section on the structure of the heart, is admirable.

Mathematical Genetics.

Variations- und Erblichkeitsstatistik. Von Prof. Felix Bernstein. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann. Lieferung 8, Band 1.) Pp. iv + 96. (Berlin: Gebrüder Borntraeger, 1929.) 14·40 gold marks.

AS the sciences develop, they acquire an associated mathematics, and the young science of genetics is evolving a mathematical side at a rate which some of its exponents find disconcerting. Mathematical genetics falls primarily into two sections, which may be called synthetical and analytical. The former deals with the results to be expected on a given hypothesis, but in most cases the populations considered are infinite. The latter is essentially concerned with the theory of sampling, and the inferences which may legitimately be drawn from a given finite sample. Hence their problems are, in general, quite different.

On the synthetical side we meet with dynamical and statical problems. For example, we may wish to know what will be the effect on a population, the variation of which is due to a number of Mendelian genes, of a given type of inbreeding or selection. If generations are separate, we may be faced with anything from one to a series of 22 simultaneous finite difference equations, which may or may not be linear, connecting the values of variables in successive generations. An example of the non-linear type is $\Delta u_n = k f(u_n)$, where f is a known function. In this case u can be expanded as a power series in k. When successive generations overlap, as in man, the difference equations become integral equations. In their solution, functions of a complex variable appear for perhaps the first time in a purely biological problem. Often the dynamical problem is very intractable, but the population considered reaches an equilibrium which can be calculated. Such is the equilibrium between the production of new genes by mutation and their removal by natural selection, which, as Fisher showed, accounts quantitatively for Pearson's results on the inheritance of human stature, if this variation is due to the cumulative action of a large number of genes.

The analytical theory is, of course, very largely the work of Pearson and centres round the properties of the Gaussian error function and related functions. In the case where the population consists of a finite number of classes, his measure of divergence, χ^2, is an intellectual tool of extraordinary simplicity and value, as it enables the geneticist, with great rapidity, to answer two quite different questions. First, can my data, for example, records of a number of families, be regarded as samples of the same population, and therefore legitimately be grouped together? Secondly, with what degree of plausibility can these data be regarded as a sample of a population obeying a given law? A much more difficult type of problem arising from populations of the same type is that of the estimation of a parameter such as the cross-over value. Here there is no royal road to the solution. Bayes' theorem and Fisher's method of maximum likelihood are generally valuable, but cases occur where *ad hoc* methods are preferable.

Finally, we come to populations in which a character exhibits continuous or approximately continuous variation. Here the error function meets us both in the theory of the population itself and in that of samples of it. In spite of the very great labour devoted to this problem by Pearson and his school, we are still far from a really satisfactory mathematical organon, partly owing to

earson's reluctance to admit the application of endelism to such problems.

In the book before us Prof. Bernstein covers a ider ground than any previous author, and does in a remarkably short space. After two intro- ictory chapters on probability and statistical ieory, he describes the application of statistical ethods to data, with special reference to those ises where experiment is impossible, for example, ie inheritance of human disease. A good deal, iough by no means all, of the ground in this ction is covered in Fisher's "Statistical Methods r Research Workers", and the reviewer confesses a preference for Fisher's methods in many cases. early half the volume is devoted to Mendelian opulations, and is the only attempt so far made unite the more important work on this topic in ie book. No student of genetics who is concerned ith the wider bearings of his subject and has even slight knowledge of mathematics can afford to eglect reading it.

There are many defects in this book. For cample, it contains no tables, and a regrettable umber of errors. Thus, four papers by Robbins e attributed to Pearson. But it is the only book f its kind, and much may be forgiven to a pioneer. Ve venture to hope that in the near future Prof. ernstein, who is one of the three or four persons ualified to do so, will give us a full-length book on subject which is already beginning to have bear- igs on the theory of evolution, on hygiene, sychology, and politics.

J. B. S. H.

Huygens' Work in Statics and Dynamics.

Œuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome 16: *Percussion, Question de l'existence et de la perceptibilité du mouvement absolu, Force centrifuge, Travaux divers de statique et de dynamique de 1659 à 1666.* Pp. iv + 500. (La Haye: Martinus Nijhoff, 1929.)

THE appearance of another volume of the superb edition of the complete works of Huygens, in ourse of publication by the Dutch Society of ciences, is an event to be welcomed unreservedly. lited with care and learning, it forms a most luable and interesting contribution to the history science in the seventeenth century.

The work here presented falls into three main visions: (1) impact, (2) centrifugal force, and) various researches on problems of statics and namics, dating from the period 1659–66. These last have been hitherto unpublished; and none of the work was published in the lifetime of Huygens himself. But each of the first two divisions contains a considerable memoir given to the world in the posthumous edition of 1703. These are entitled "De motu corporum ex percussione" and "De vi centrifuga" respectively.

Huygens observed the first rule for success in life by selecting his father most judiciously. It was under the paternal roof that he came in contact with the learned world, in particular with such men as Descartes, at an early age. But the glamour of Descartes' vivid personality receded as his own critical power developed, and so early as 1652 his researches led him to reject the French author's rules of impact and to supersede them by his own theory. On a visit to London in 1661, Huygens explained his method to some of the leading members of the Royal Society, but though the subject was of recurrent interest at the time, he published nothing beyond a few rules without demonstration in 1669. It appears that the reason for this reticence is to be found in a hope, never abandoned, that he would ultimately succeed in penetrating deeper into the true nature of percussion. It was not due to any dissatisfaction with the memoir prepared in 1656: and, in fact, his literary executors were explicitly instructed to publish this treatise.

It was otherwise with the memoir "De vi centrifuga", which was written in 1659 and published by Huygens' executors in 1703 on their own judgment. These two memoirs are now supplemented by a considerable amount of manuscript material, and linked by a series of notes left in a similar form and dealing with the question of absolute motion. In all this work there is conspicuous a sense of relativity, not of course in its modern meaning, but as a dynamical principle serving the purpose of research. In this respect Huygens made an important advance on the ideas of his predecessors. At first he was mainly concerned with the problem of rotation as a practical inventor, and it was only later that he considered it from a more metaphysical point of view. Adopting the attitude of an observer carried on a rotating disc and supporting a weight by a thread, he assimilated the centrifugal force to the force of gravity. The difficulty of reconciling this view with the Newtonian, which interprets the same phenomena from the point of view of the external, fixed observer, was strongly felt at the time and long after; the two aspects are practically united in d'Alembert's principle.

In any event, the work of Huygens must have exercised a profound influence on the development of dynamical theory, for in his work are to be found clear references to the principles of momentum and of energy. It cannot be an easy task to disentangle the achievement of Newton in this field from the debt which he owed to his contemporaries and predecessors. Perhaps his pre-eminence is to be seen in the generality and sufficiency which he divined in simple principles, and the intellectual confidence which was founded on sure insight, but appeared in a different light to others. The impression recorded by Huygens is instructive and may be quoted :

"Je m'estonne que Mr. Newton sur une hypothese si peu probable et si hardie, se soit donné la peine de bastir tant de Theoremes et comme une theorie entiere des actions des corps celestes. Je dis son hypothese qui est que toutes les petites particules des divers corps s'attirent mutuellement, et cela en raison double reciproque des distances. Il a pu estre conduit a sa theorie des orbites elliptiques par le livre de Borelli du mouvement des satellites de Jupiter, qui . . . n'a pas sceu penetrer les vrais fondements comme Newton qui a eu l'avantage de connoitre la mesure de la force centrifuge par les Theoremes que j'en ay donnèz" (p. 250).

Among the few notes by Huygens on statical problems is one on the breaking of a beam (1662), in which perhaps for the first time a moment is used in its modern sense as the simple product of a force and a distance, a concise notion which only recurs in the work of Varignon in 1687. The dynamical notes refer chiefly to two problems, the tautochronous property of the cycloid and the length of the simple equivalent pendulum for bodies of different shape. On the first of these subjects a complete series of notes makes it possible to trace the idea from the germ to the form finally developed in the "Horologium oscillatorium" in quite unusual detail. Huygens' interest in the second subject was aroused by Mersenne (vir—according to Huygens père—omnigenae sed indigestae eruditionis), who had arrived at the identity of the centres of oscillation and percussion, apparently as the result of experiment. Huygens calculated the position of the centre of oscillation in a number of cases, and reached a certain limited degree of generality by his methods of integration. The term 'moment of inertia' was only introduced later by Euler (1765), to whom we also owe the convenient symbol Σ (1755).

As the work of Newton is marked by a bold and penetrating generality, so the work of Huygens has its own quality apart from the particular results achieved. This appears in a greater attention to exact definition and an appreciation of the value of precise formulæ, leading to a more concise form of statement than that generally attained to by his predecessors. To quote two of his aphorisms from this volume :

Nisi principium ponatur nihil demonstrari potest.
Non est mathematicœ difficilis materia, sed physicœ aut hyperphysicœ (metaphysicœ).

Hence, as the present editors remark, to Huygens may be traced a distinct influence on the development of mathematical style in the following century. But it was a slow growth, as various passages in the works of Euler may serve to suggest, and it was reserved to the French mathematicians, Lagrange in particular, to set such a standard as can scarcely be surpassed. H. C. P.

Primitive Art.

The Childhood of Art, or The Ascent of Man: a Sketch of the Vicissitudes of his Upward Struggle based chiefly on the Relics of his Artistic Work in Prehistoric Times. By Herbert Green Spearing. Second and revised edition. Vol. 1. Pp. xxxvi + 254 + 62 plates. Vol. 2. Pp. iv + 255-548 + 56 plates. (London: Ernest Benn, Ltd., 1930.) 42*s*. net.

THE first edition of this book was published so long ago as 1912. It was then rightly acclaimed as a book which no student of early art could afford to be without. It gave a balanced sketch of primitive art as then known with a wealth of illustration. It was up-to-date and truly 'the last word on the subject'.

From 1912 to 1930 is, however, a gap of eighteen years. In the preface to the new edition the author admits that "since 1912 . . . there have been notable archæological discoveries in many parts of the world"; but he adds that "most of them . . . have only added picturesque details to the connected story". I fancy by no means everyone will agree with the author in this statement. Surely the new finds at Ur and the Copper Age art of Spain—to give but two examples—have both enriched and complicated the story: they should certainly have been allotted their due space in a revised edition. Even such a discovery as that of the 'sorcerer' at the Trois Frères cave enlarges our ideas of prehistoric man and is therefore important in a study such as this, which professes to deal

with the ascent of man, traced mainly by studying his artistic achievements. These two volumes are really only a reprint of the original work with the addition of a short preface and the names of a few recent books in the bibliography. It was careless, however, to give Sollas's "Ancient Hunters" as published in 1911 instead of citing the third edition issued in 1924!

It is difficult to understand why the second edition of this work should not have been very largely rewritten. When a second edition of a book is called for soon after its first publication, or when the subject matter is purely an account of observed facts, such as a monograph on some excavation, it is reasonable to reissue what is in reality the same work with the same outlook on the subject. But in the case in question, not only have many recent startling discoveries been made, but many of the problems interesting in 1912 now strike the reader as rather out-of-date. Why quote at length Piette's dogma that sculpture must have preceded line engraving? The fact may have a grain of truth in it (though such Aurignacian line engravings as those found at the abri Labatut have to be taken into account), but Piette, though, in his own time, a pioneer, can no longer be considered as the great authority. He never realised the existence of the Aurignacian culture, and still less did he appreciate that the late Palæolithic art cannot be taken as a single entity, but forms two distinct cycles, one Aurignacian, the other Magdalenian, the evolution of each of which has to be treated separately. What Sumerian authorities will think of the paragraphs dealing with the Sumerians and their art will scarcely be complimentary. Wooley's name does not appear; it is relegated to a few notes in the preface; nor is such a find as the queen's diadem mentioned.

To sum up, the "Childhood of Art" was a good, well-balanced book in 1912. The revised edition is really only a reprint where even the page numbering is the same, and where the only striking differences in the main text are that several plates formerly coloured are now reproduced in black and white; that the table facing page 5 is much abridged; and that the final map is on a far smaller scale than before. Of course there is much that was interesting in 1912 that remains so in 1930, but in the case of a rapidly advancing subject it might have been kinder to have let the author rest on his well-earned laurels without bringing him once again into the arena armed only with the ancient panoply of war.

M. C. B.

Our Bookshelf.

The Flutter of Aeroplane Wings. By R. A. Frazer and W. J. Duncan. (London: H.M. Stationery Office, 1929.) 12*s.* 6*d.* net.

A CRITICAL examination of the causes of a large number of aeroplane accidents, undertaken by the Accidents Investigation Sub-Committee of the Aeronautical Research Committee, has brought out the fact that in many of them a rapid and unusually large movement or flutter of the wings had been apparent. The sub-committee immediately undertook a thorough investigation of the vibration of aeroplane structures, both from the theoretical and experimental point of view, to provide data from which designers could ensure the avoidance of this instability. The work has been undertaken mainly by Messrs. R. A. Frazer and W. J. Duncan at the National Physical Laboratory, and their provisional conclusions and practical recommendations are published in this monograph.

The theoretical part of the volume deals with the equations of motion of the wing-aileron system, with stability criteria, and critical flutter speeds, and with a graphical treatment of binary flutter problems, involving only two degrees of freedom. In the experimental investigation the authors had to develop a special technique for the measurement of the derivatives on flexible wings, due to torsion and flexure of the wing itself, and to aileron movement. The agreement between the observed and calculated critical speeds was sufficiently good to warrant the conclusion that the theory is adequate for the discussion of aeroplane wing flutter; but its real value lies in the methods it suggests for preventing flutter.

The third part of the monograph deals with various recommendations for prevention of each special type of flutter. Cantilever monoplanes, stayed monoplanes and biplanes are separately discussed, and the influences of elastic hysteresis, of friction, and of abnormal wing incidences are thoroughly dealt with.

The monograph has a number of appendices dealing with specialised matters, contains an annotated list of references, and a list of the principal symbols used with their significance. An adequate index for the whole volume is included. It is an excellent record of a very valuable series of investigations.

Ultra-violet Light and Vitamin D in Nutrition. By Katharine Blunt and Ruth Cowan. (The University of Chicago Home Economics Series.) Pp. xiii + 229. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 11*s.* 6*d.* net.

RECENT work on vitamin D and nutrition has been so extensive and so important in practical application that the appearance of an up-to-date monograph on this subject is most welcome. This book provides a convenient account of widely scattered researches, and also includes judicious summaries

of such practical conclusions as are justified in the present state of knowledge.

The first chapter describes some studies on the effect of diet on growth, which are at least encouraging, and confirm the opinion that civilised nations need not deteriorate in physique in spite of urban life. There follows a brief historical chapter, and then an account of the methods of producing and studying experimental rickets in rats in order to detect or estimate vitamin D. This chapter would perhaps be improved by including a fuller account of the radiographic study of rickets in rats, since this method has appreciable advantages over the line test when used for quantitative estimations. There follow chapters on the complex problems of calcium and phosphorus metabolism, on teeth and vitamin D, and on irradiated foods and ergosterol. There is also a section describing some of the physical aspects of ultra-violet radiation, with a well-balanced summary of the advantages and limitations of ultra-violet transmitting glasses intended for the windows of buildings. A further section on the results of actinotherapy is less satisfactory, possibly because of the great difficulty of justly appraising these results at the present time. Each chapter concludes with a bibliography of the more important papers concerned, which adds greatly to its value.

The book can be recommended not only to medical men and others interested in nutrition, but also to research workers who may need a summary of branches of work allied to their own special subjects.

R. B. B.

(1) *Air Defence.* By Major-Gen. E. B. Ashmore. Pp. viii + 179. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 8*s*. 6*d*. net.

(2) *La folie et la guerre de 1914–1918.* Par A. Rodiet et Prof. A. Fribourg-Blanc. Pp. iii + 194 + 10 planches. (Paris: Félix Alcan, 1930.) 30 francs.

THESE two books may be included in one notice, for they both deal with the War, though from entirely different points of view. General Ashmore, who was placed in command of the London Air Defences in 1917, succeeded in organising a very telling defence, following upon the previous feeble results recorded against German raids, particularly as regards aeroplanes. He develops his subject herein as lucidly as he developed the defences, and higher praise it is impossible to bestow. His concluding remark is worthy of note: "If we maintain an efficient air defence, we may never be attacked".

The other book details the effect of the War in producing or intensifying mental alienation in French subjects, and deals with 220 cases out of a total approximating 25,000. Investigation suggested that the syndrome known as shell-shock was not to be regarded as a special form of mental disease, but merely as the determining factor in a general condition of mental obliquity. Further, it is remarked that psychoses associated with, or succeeding, infectious diseases would doubtless have been very numerous, had it not been for the prophylactic measures taken at the commencement of the War. There are intensely interesting notes upon malingering, and altogether this is a very valuable compilation.

P. L. M.

Diet and Efficiency: a Five-year Controlled Experiment on Man. By Harold H. G. Holck. (The University of Chicago Monographs in Medicine.) Pp. ix + 72. (Chicago: University of Chicago Press; London: Cambridge University Press, 1929.) 4*s*. 6*d*. net.

THE purpose of this experiment carried out on a single individual was to determine the effect upon mental and physical processes of a fairly strict adherence to the principles of nutrition laid down by Fletcher. These principles may be stated thus: (1) Eat only when actually hungry; (2) stop when satisfied; (3) chew the food especially well; (4) if available try to secure any food for which there seems to be a craving and omit those to which there may be antagonism. Of the five years of the experiment, only about 18 months were taken up by the experiment proper, the remainder being pre- and post-periods. Very full records were kept throughout.

The results may be stated quite briefly: the eating time per 1000 cal. was doubled and the food intake was at a minimum, although its percentage composition of protein, fat, and carbohydrate was almost unchanged, as compared with the control periods. Muscular endurance, typewriting accuracy, and basal metabolism were reduced, but there was no change in blood-pressure, pulse-rate, temperature, sleeping time, mental multiplication, and typewriting speed: efficiency in solving chess problems was improved. The body weight was reduced to the accepted standard for the subject's height and age. The general conclusion appears to be that reduction in food intake in a somewhat overweight subject does not always lead to improvement in mental and physical well-being, and that the minimum intake compatible with maintenance of weight at an accepted 'standard' level may not be the optimum in all cases.

Alpine Flowers: the Most Common Alpine Plants of Switzerland, Austria, and Bavaria. By Dr. Gustav Hegi. Authorised translation by Winifred M. Deans. Pp. xiii + 74 + 38 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 7*s*. 6*d*. net.

MISS DEANS has prepared an excellent translation of Dr. Hegi's handy little book, "Alpenflora", which should be very useful to visitors to the Alps who may wish to identify the flowers they come across in their rambles on the mountains. All the plants described are illustrated, and the coloured plates are, on the whole, quite good, and allow the plants to be determined with ease. The botanist may be somewhat disappointed, since so many of the plants he would come across are not referred to in the book, but for him the larger works on the Alpine flora are available. The general flower-loving public should welcome the book.

Letters to the Editor.

'he Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Space and Matter.

REFERRING to NATURE of June 14 and to the teresting résumé on page 897 of Prof. Einstein's 'ottingham lecture, I note that he virtually agrees ith me in claiming matter as passive and space as tive. Matter is that which is acted upon; space is at which acts. Matter is inert; space is energetic. atter *does* nothing, though it serves to display the ergy of which space is full: it merely sails placidly ng the path of least resistance, like a straw in a ream or a leaf in the wind.

It used to be thought that potential or static ergy existed in the ether, while locomotive energy as possessed by matter; but we now know that omentum is electromagnetic, and accordingly exists the space around the unit of matter which displays . So, strictly speaking, all energy belongs to space. atter only affords a means of detecting and using it.

There is no objection to an inert thing being able o receive and transmit energy; and yet when we say hat matter is a form of energy, equal to mc^2, it is lear from the occurrence of c that space must really e responsible for the energy. So also for the increase f energy due to motion, which is responsible for the ind of relative kinetic energy familiar to engineers; is involved in that too. For $\frac{1}{2}mv^2 = c^2dm$. As for he irregular or statistical energy that we call heat and sually consider material, the heat motion of particles partly visible in the Brownian movement, which as emperature rises must grow in intensity. Whatever true about the locomotion of particles is true also f this irregular motion.

We know that the mass of an electron is accounted or by the energy of its electrostatic field. So matter, trictly speaking, has no active properties at all. When we say that matter is a form of energy, we mean hat its existence is the sign or symbol of certain inds of energy in space, and affords a possible means f getting at it. (It would be pedantic and inconvenient to be perpetually remembering this, so we ay still attribute momentum and kinetic energy and eat energy to matter.)

This applies to all matter. There is no discrimination between the so-called animated variety and any ther. Hence the task of the biologist or the behaviourist to explain vital activity in terms of matter must be futile. Every part of every body must be ontrolled, guided, activated, by something in space. When an organism interferes with, or in, the course of Nature, it does so because it is actuated by something utside itself; something familiar in its effects, and sually called Life, but not yet discovered or formulated in proper terms.

Although matter has no energy and never does nything, yet it is to us the conspicuous thing, because r nerves, which are themselves material, respond the perturbations of space; thereby stimulating ur sense-organs, and giving us information about hose perturbations. Matter is one of the perturbations, but it is entirely inert. Space is the primary and active thing.

Space with physical properties is usually called ether; but what those properties in themselves are, is the problem before us—a problem which must have deep-seated philosophical consequences. OLIVER LODGE.

Normanton House, Lake, Salisbury, June 20.

Absorption of Sound at Oblique Incidence.

IN the U.S. Bureau of Standards' *Journal of Research* for February 1930, pp. 289-296, there appears a description of apparatus employed by P. R. Heyl, V. L. Chrisler, and W. F. Snyder, for the investigation of the absorption of sound at oblique incidence. A plate of the material to be tested was placed at a flat elbow joining two cylindrical pipes in the way shown diagrammatically in the accompanying sketch (Fig. 1). The results obtained were compared with certain calculations made by me relating to the reflection of plane waves of sound from a flat surface.

The theory underlying the method appears to be that plane waves travelling down the pipe A will be reflected from the plate of material under test and will pass into B in accordance with the laws of rectilinear propagation as commonly employed in optics when the dimensions of the reflecting surface are large compared with the wave-length. In the experiments at the Bureau of Standards, however, the diameter of the pipes which convey the sound to and from the test plate was only a fraction of the wave-

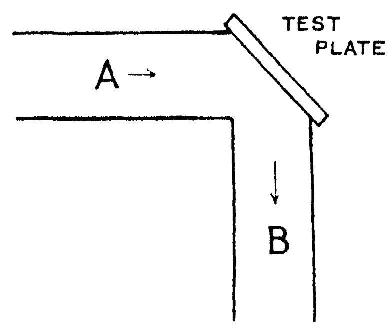


FIG. 1.

length of the sound employed, and an assumption of rectilinear propagation at the elbow seems scarcely to be justified. Part of the energy of a plane wave travelling along A will pass into B by diffraction, and also any sound reflected from the test plate will spread partly into A and partly into B. For these reasons I am inclined to think that very little value can be attached to the coefficients of absorption at oblique incidence which are given in the paper referred to. At any rate, they are certainly not the coefficients for plane waves at oblique incidence.

One of the substances tested at the Bureau of Standards was 'akoustolith', an acoustic tile similar to certain acoustic plasters concerning which I have made theoretical deductions leading to the conclusion that the coefficient of absorption for plane waves at oblique incidence would, except near grazing incidence, be greater than at normal incidence (*Proc. Roy. Soc.*, A, **115**, pp. 417-419; 1927). Heyl, Chrisler, and Snyder found with their apparatus that the absorption of akoustolith (at 512 and 1024 cycle/sec.) was less at 45° and 60° than at normal incidence, and less at 45° than at 60°. To explain the discrepancy between their observations and the theoretical conclusions, they invoke the aid of "a thin layer of air close to the absorbing surface" where the "differential equation for sound motion in air is not valid" (loc. cit., p. 290). In this layer they imagine there is a rotational motion of the air particles, and conclude that "it is unsafe to apply to such a region mathematical analysis involving the assumption of the existence of a velocity potential. Theoretical conclusions based on such reasoning are invalid" (p. 295). There appears to be no evidence that this layer exists (or that, even if it exists, it exerts any perceptible effect on sound absorption) apart from the discrepancy referred to

above, and this could equally well be explained by the falsity of the assumption that the observed coefficients are those for plane waves at oblique incidence.

In the theory which I have attempted to develop of the absorption of sound at oblique incidence by substances such as akoustolith, it is assumed that air is forced into and out of the pores by the pressure variations at the reflecting surface, and that this in-and-out motion is accompanied by the degradation of sound energy into heat. I believe that this degradation takes place inside the pores and is due to the working of viscous forces, but it may be remarked that this view is not shared by Heyl, Chrisler, and Snyder, who think that there may be degradation due to viscous forces just outside the reflecting surface. Thus they say (p. 290) that "even with glass which has no sensible pores, there is an appreciable amount of absorption of sound which must arise from friction of some kind, probably of a sliding nature". It would be interesting to know the reason for supposing that the absorption (that is, loss at reflection) must necessarily be due to friction. The fact is that there is a loss of energy at reflection amounting to some 2 or 3 per cent, and I suggest that this could be accounted for by the transmission of sound into and through the glass test plate.

In the theory of sound absorption at oblique incidence it is assumed that the mass-flow of air into the pores (dm/dt) per unit area of reflecting surface is connected with the pressure variation (p) at the reflecting surface by the equation $dm/dt = \Omega p$, where Ω is a complex quantity (the acoustical admittance per unit area) which is constant for a given surface and wave-length of sound. The incident and reflected waves were, for convenience, represented by velocity potentials, but the motions inside the pores were not taken into consideration. The quantity Ω can be measured with the usual type of stationary wave apparatus, and the absorption at any angle of incidence could then be calculated by means of a formula given in the paper quoted above. The mechanism by which the loss of energy from the incident wave occurs (apart from the fact that it is associated with the motion of the air into and out of the pores) need not be known.

The late Lord Rayleigh, in his paper on "The Resonant Reflexion of Sound from a Perforated Wall" ("Sci. Papers", **6**, p. 662), used potentials to represent the incident and reflected waves and also the wave transmitted into the pores, this last potential being chosen so as to represent the dissipation of energy by viscosity in the pores. I see no objection to such a treatment, and there seems to be no reason for doubting the general truth of the formulæ which he obtained for the reflection of sound waves at oblique incidence.

In their "Discussion of Results", Heyl, Chrisler, and Snyder advance theoretical reasons (p. 294) for supposing that the coefficient of absorption will "diminish steadily with increasing obliquity of incidence". They begin with a statement that "a sound wave is not a convection current". No one is likely to quarrel with this premise, but I have been quite unable to follow their subsequent line of thought. It is considered that the amount of absorption is closely connected with the 'average pressure' over the reflecting surface. Except for the second order 'radiation pressure', I should have thought that the average pressure over a reflecting surface would be atmospheric pressure no matter what might be the angle of incidence. Certainly this would be so in the case of plane progressive waves reflected from a flat surface.

The interest attaching to the determination of the coefficient of absorption for plane waves at oblique incidence is partly due to the fact that if the coefficient for some material were known for all angles of incidence, an experimental test could be made of the theory of reverberation. In this theory, which was developed by W. C. Sabine to account for his experimentally established laws of reverberation, rectilinear propagation of sound is assumed, and, if the theory is true, it is possible to calculate the coefficient of sound absorption, as it would be measured in a reverberation experiment, from the values of the coefficient at oblique incidence. The method of calculation is given in *Phil. Mag.*, **5**, pp. 489-497; 1928. The theory that absorption increases with angle of incidence does at least offer an explanation, on the basis of reverberation theory, of why the reverberation coefficients of acoustic plasters, etc., are found to be greater than their coefficients at normal incidence. I cannot see any reason why, if, as Heyl, Chrisler, and Snyder suppose, the absorption decreases with angle of incidence, the absorption in reverberation should be greater than when the waves are incident normally. I should have expected exactly the opposite.

One of the conclusions reached at the Bureau of Standards is that "in the practical measurement of absorption coefficients the reverberation method should be the only one trusted for absolute values of the coefficient". It would be of interest to know what is meant by the 'absolute' value of the coefficient and how it differs from any other value. The method adopted must surely depend on the quantity it is desired to measure. Coefficients at normal incidence can best be determined with stationary wave apparatus, while reverberation coefficients are at present most suitably found by reverberation experiments. It is, however, at least possible, and even probable, that reverberation coefficients could be calculated from observations made with stationary wave apparatus.

E. T. PARIS.

Shortlands, Kent,
May 20.

Origin of Asymmetry in Gastropods.

IN his review of Dr. de Beer's "Embryology and Evolution" (June 14, p. 883), Prof. MacBride appeals to readers of NATURE to decide between two theories of the origin of asymmetry in Gastropods. He supports the opinion that the weight of the shell stretched one side of the animal and crushed the other, thus initiating an inequality of growth. On the alternative view "a sudden and miraculous mutation" twisted the visceral hump and shell through 180°.

Now the first theory postulates the transmission to the offspring of the effects of injury, to wit, stretching and crushing. Whatever may be the case with other acquired characters, attempts to prove the inheritance of the effects of mechanical injury have been conspicuously unsuccessful. On the other hand, "miraculous mutations" resulting in asymmetry of symmetrical animals have been reported. Thus Bridges and Morgan [1] describe a mutant form of *Drosophila melanogaster* in which the abdomen is rotated to the left through 60° to 90°. This type has a poor viability, and cannot mate, hence the mutation is disadvantageous to *Drosophila*. If it were advantageous it would be perpetuated by natural selection.

While I see no reason to adopt either of these theories, which are not mutually exclusive, as to an event which took place in pre-Cambrian times, I find

ie second more attractive because, unlike the first, is based on analogy with facts which have actually een observed.

J. B. S. HALDANE.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
June 17.

Bridges and Morgan: *Carnegie Inst. Pub.* 327.

IN the above letter, Mr. Haldane misinterprets the ieory of the origin of Gastropoda as a consequence f the sagging of the visceral hump to one side. The igging of the visceral hump no more 'injured' the ncestral mollusc than does the weight of her pro- iberant abdomen a pregnant woman. It con- nually stimulated the skin of one side by stretching and what was transmitted to posterity was not ie passive stretching but the altered *habit of growth* illed forth in response to it. That such altered habits f growth do become hereditary has been proved by very relevant experiment on the subject. As I have iid elsewhere, Przibram enumerated at least six xamples of this. I have just returned from a northern niversity where pioneering genetical research is going n. I think it probable that in the near future 'rzibram's six examples will become at least ten.

Mr. Haldane instances a *Drosophila* with distorted bdomen as giving an example of the sudden miracu- ous mutation which De Beer postulated as the origin f the Gastropoda. He admits that this individual 'as so enfeebled that it would not mate, much less ive rise to offspring. He overlooks the fact that the 'ant of viability of the mutants of *Drosophila* is 1 direct proportion to their divergence from the ype; and the idea that an enfeebled mutant would e preserved by 'natural selection' when all its ormal bilaterally symmetrical fellows perished is one hat cannot be entertained. No competent systema- ist, palæontologist, or embryologist would agree with Ir. Haldane, and it is these people who have the final rord on the causes and course of evolution.

E. W. MACBRIDE.

Royal College of Science,
South Kensington, S.W.7,
June 23.

The Position of Fundamental Research.

IN the interesting leading article in NATURE of Iay 31, a lament is sounded that pure research of the ind fostered in colleges and universities is no longer ble to attract the best of the younger scientific tudents. The cause is attributed to the relatively oor salaries which colleges can offer: and this opinion substantiated by comparison between the financial ewards of commerce and industry on one hand, and f the teaching and research profession on the other.

Although lack of money may be a powerful con- ributory reason, it would seem that the real cause of he shortage lies deeper. Surely pure research is done est by persons who are inspired in their work, and apported best by institutions to whom their work is iseful.

The universities fostered research because teachers ould not, in general, remain in the forefront of their espective fields unless they were creating as well as tailing knowledge. It was recognised that research vas necessary to inspire teaching; and later the nteresting belief became common that teaching, with ts continual summarising of existing knowledge, its egular routine, and the stimulus of irksome duties nd of question and of answer, was equally necessary o fertilise research. That was when the preponder- ance of scientific knowledge was situated within the university campus.

At the present time much of scientific learning is housed within the walls of industry, and it is to industry that even your pure scientist looks for the greatest inspiration. Industry in America has known for years that works laboratories stocked with tech- nicians, inventors, and trouble tracers soon become sterile unless pure research, with its right to publish and its consequent prestige to the individual, is care- fully fostered. This does not mean necessarily that a few privileged persons are permitted to pioneer scientifically in a building where others are kept strictly to the kind of work bearing immediate profit. It means often that those who have the mental equip- ment use part of their time on industrial problems, part in pursuit of their scientific hobby—pure re- search. One has only to cite Langmuir's work on adsorption, Sheppard's discoveries in photographic sensitivity, or the scientific publications of the Bell Telephone Laboratories, to see how amazingly industry has stimulated scientific minds in the pursuit of knowledge for its own sake.

The old academic feeling that there was something vaguely discreditable in a discovery which could be put to practical use is passing. Those who love know- ledge for its own sake now often have the double satis- faction of securing an advance of understanding, and at the same time seeing this advance aiding the manu- facture of some product in enormous quantities.

The tragedy, one feels, is not that the colleges can no longer attract young men for research, but that they cannot provide the whole environment of research, leisure, and remuneration which is necessary to secure the best men to train those other keen young scientists who will later find their opportunity in the industrial research laboratories.

K. HICKMAN.

Eastman Kodak Company,
Research Laboratories,
Rochester, N.Y.

Triatomic Hydrogen.

IN recent years various observers have investigated the formation of active hydrogen in discharge tubes at pressures ranging from two centimetres to atmo- spheric. The evidence has been both positive and negative.

In the formation of atomic hydrogen by R. W. Wood's method, it is considered that the water vapour poisons the glass walls and prevents the reversion to molecular hydrogen. Lewis (*Jour. Am. Chem. Soc.*, **51**, 654; 1929), in a study of the influence of surface upon the after glow in nitrogen, found that water vapour or paraffin poisoned the walls of the glass bulb to such an extent that the life period of the glow was doubled or tripled.

A study has been made of the influence of surface upon the formation of triatomic hydrogen based upon Wood's theory. We have repeated the work of Urey and Smallwood (*Jour. Am. Chem. Soc.*, **50**, 620; 1928) dealing with corona and vacuum tube discharges. We find that their results are correct under their experi- mental conditions. No appreciable activation of hydrogen is observed. However, when we introduced a trace of oxygen before the gas mixture reached the discharge tube, the results were positive as shown by the lead sulphide formed on the lead acetate paper.

To test Wood's theory still further, we poisoned the walls of the discharge tube with stearic acid and omitted the oxygen from the stream of pure hydrogen. The results were again positive, showing that hydrogen is activated in discharge tubes above 2 cm. pressure. During the latter part of this work, fresh plastic

sulphur was used in place of flowers of sulphur. The flowers of sulphur were treated to remove volatile sulphides. A large number of blanks were run wherever there was any doubt existing about results being influenced by sulphur blown back into the discharge tube. We found tubes easily contaminated until we used plastic sulphur.

During the course of this work a paper by Wartenberg and Shultz was published (*Zeit. Physik. Chem.*, **6**, 261; 1930) showing that orthophosphoric or metaphosphoric acid may be used successfully to poison the walls of a Wood's discharge tube in the production of atomic hydrogen.

Our experimental evidence further supports R. W. Wood's theory, and offers an explanation of the discrepancies existing regarding the production of triatomic hydrogen in discharge tubes.

We can duplicate the work of Urey and Smallwood if we remove the oxygen from the gas stream. If we introduce a trace of oxygen we check the results of Wendt and Landauer (*Jour. Am. Chem. Soc.*, **42**, 930; 1920. *Ibid.*, **44**, 510; 1922).

We wish to express our appreciation to the Canadian National Research Council for aid during the course of this work.

J. L. BINDER.
E. A. FILBY.
A. C. GRUBB.

University of Saskatchewan.

Pleochroism and Crystal Structure.

IN a very important paper (*Phil. Mag.*, vol. 33, p. 521; 1917), Silberstein developed a theory of molecular refractivity based on the idea that the electric doublets induced by the field of the light wave in the atoms composing the molecule influence each other, the result of such atomic interaction largely depending on their relative distances and the geometric form of the molecule. One important consequence of Silberstein's theory, namely, that gaseous molecules should in general be optically anisotropic, is supported by observation, and has been worked out in detail by Ramanathan, Havelock, and others; it also forms the basis of W. L. Bragg's well-known and successful attempt to compute theoretically the birefringence of the solid carbonates and nitrates from their known crystal structure.

In the present note we desire to direct attention to another important consequence of Silberstein's theory, namely, that atomic interaction induces pleochroism in ions or molecules: such pleochroism would become accessible to observation when they are regularly oriented as in a crystal. In a recent paper (*Ind. Jour. Phys.*, vol. 4, p. 1; 1929), Sir C. V. Raman and S. Bhagavantam have indeed suggested that the colour and pleochroism of solid organic compounds arise in this way. We have made some observations on the absorption of *polarised ultraviolet light* in crystals of sodium and potassium nitrates which appear to be very significant in this connexion.

It is known from the X-ray evidence that the NO_3 ions form a plane structure normal to the trigonal axis in sodium nitrate and to the pseudo-hexagonal axis (' c ' axis) in potassium nitrate. We have found that the selective absorption at about 3000 A. which appears in aqueous solutions of the nitrates manifests itself in the solid crystals only when the vibrations are in the plane of the NO_3 ions; vibrations of this frequency perpendicular to the plane of the NO_3 ions are freely transmitted by the crystals. Further, beyond about 2600 A. begins another region of strong absorption in the crystals which is also polarised in the same direction as the 3000 A. band. It is also found that while the refractive index of the ordinary ray shows a rapid increase even in the visible region with diminishing wave-length, the corresponding increase in that of the extraordinary ray is much slower. These observations taken together with W. L. Bragg's work on the birefringence of the nitrates appear to indicate that the basic ideas of Silberstein's theory are substantially valid.

K. S. KRISHNAN.
A. C. DASGUPTA.

Physics Laboratory,
Dacca University,
Dacca, May 19.

Sense of Smell of Longicorn Beetles.

IN the notice of Ivar Trägårdh's paper on the pine-sawyer pest in Sweden, which appeared in NATURE of April 5, page 546, doubt is expressed that longicorn beetles are attracted by means of their sense of smell "to trees in the condition they require for oviposition". The writer of the notice cites an opinion held some twenty years ago that the Indian sal heartwood borer, *Hoplocerambyx spinicornis*, discovers newly felled trees by an unerring 'instinct' ("Indian Forest Insects", p. 323).

Recent field-work on the biology of *Hoplocerambyx* supports the contention of Tragardh, for the beetles (of both sexes) react immediately to the smell of a newly felled *Shorea robusta*, and in particular to that of the sap freshly liberated by the act of felling. If beetles happen to be near at hand, they discover the tree in the course of a few minutes. By cutting isolated sal trees in open country, it is possible to attract beetles in less than an hour from forest at a distance of at least half a mile. I have observed that the beetles approach upwind, flying low, and in a remarkably straight course towards their objective; with an appreciable breeze no beetles appeared from the forest to the windward. Arrived at the tree they drink the sap. As this species is on the wing during the monsoon season, they are not attracted to the tree for the sake of water only.

In the course of a day or two the attraction of the felled tree diminishes considerably and the beetles disperse; but by logging the tree or by stripping off the bark, or by otherwise exposing fresher sap, the attractiveness of the tree can be renewed for a further short period, and new beetles appear.

This principle has been used in the control operations against the sal heartwood borer during the recent serious epidemic in Central India; by means of trap-trees felled at appropriate periods and inspected systematically, millions of beetles have been collected and destroyed.

C. F. C. BEESON.

Forest Research Institute,
Dehra Dun, India, May 20.

Kekule and Kolbe.

I WRITE Kekule without an accent, as he was a descendant of old Bohemian nobles, the Kekule de Stradonice, whose ancestors, being Bohemian brothers, had to emigrate after the battle of the White Mountain (1620); it is he whom we thank for the reform of organic chemistry. As a man of Slavonic origin Kekule was a 'romanticist' and arrived at his doctrine of the chemical structure more by genial intuition than by experimental investigation (see Brauner: "Collection" II., 225). On the other hand, I agree with my old friend, Prof. Armstrong, who said in his excellent review (NATURE, May 31, 1930, pp. 807-810) that the rôle played by Kolbe in our science is often

sufficiently appreciated. This is probably due to the circumstance that not all teachers of chemistry stick to the principle that special lectures on the evolution of chemical theories ought to be given to advanced students, as I did for many years. Kolbe as the type of a 'classicist' of German origin. His work was done under the influence of his great teacher, Bunsen, another 'classicist'. I wish only to direct attention to the constitution of carbonic acid, $C_2O_2{}^{OHO}_{OHO}$, and its derivatives, which, though written in Gmelin's equivalents, was, according to my modest opinion, the first correct structural formula and in which the carbon atom C_2, translated into our modern views, appears as *tetravalent*. For the same reason it follows his formula of sulphuric acid, $S_2O_4{}^{OHO}_{OHO}$, that is a structural formula containing *hexavalent* sulphur. Both geniuses retain their value.

BOHUSLAV BRAUNER.

Bohemian Academy, Prague,
June 8.

Flint Implements of Lower Palæolithic Age from Yorkshire.

IN NATURE of June 7 appears a letter from Mr. J. P. T. Burchell stating that Mr. Dewey and myself have made an official examination for the Geological Survey of the sites in Yorkshire from which Mr. Burchell has obtained implements. His letter gives the impression that we are substantially in agreement with him on the claims made in NATURE of Feb. 15, where the implements are said to be from "the base of the Uppermost Boulder Clay of the area"; whereas Mr. Burchell is fully aware that both Mr. Dewey and I deny that the deposit is a Boulder Clay.

As several Yorkshire geologists have expressed their surprise at the views which Mr. Burchell's letter has led them to attribute to me, I wish to state that in my opinion the deposit containing worked flints, though it may belong to the latest stage of the Pleistocene, is of much later date than the latest Boulder Clay. Reasons for this opinion will be given in the detailed report shortly to be issued. I am content, as a geologist, to leave the cultural stage of the flints to be settled by the archæologists; if there should be general agreement that they are Palæolithic I can accept the overlying deposit as latest Pleistocene; but I am equally ready to accept it as Recent or Holocene, if the flints are Neolithic or later. I also consider that the flake mentioned in the last paragraph of Mr. Burchell's letter as having been found at Burstwick in my company may "from its stratigraphical position" be much "later in date than the early Mousterian period".

C. N. BROMEHEAD.

Geological Survey Office,
York, June 19.

Spectrum of Inert Gases in their Second Stage of Ionisation.

ARGON, krypton, and xenon when they are excited to their second stage of ionisation give rise to spectra which should theoretically come under quintet and triplet systems. The position of different transitions can without difficulty be predicted with the help of the 'irregular doublet' law and the 'horizontal comparison' law (*Ind. J. Phy.*, vol. 3, part 1; 1928). Thus, with the knowledge of the nature and the position of the spectra we could identify certain lines and finally classified lines arising from the transitions below:

$$\begin{array}{ccc} & M_3 & \\ & \uparrow & \\ N_1 \leftarrow & N_2 & \leftarrow N_3 \\ & \uparrow & \\ & O_1 & \end{array} \qquad\qquad \begin{array}{ccc} O_2 & & \\ & & \\ P_1' \leftarrow & P_2 & \leftarrow \\ & \uparrow & \\ & Q_1 & \end{array}$$

Argon. Xenon.

The following chart shows the details:

	Argon.	Xenon	
$X_3{}^5D_4 \leftarrow Y_2{}^5P_3$	29964·5	25479·8	where X, Y, Z
$Y_1{}^5S_2 \leftarrow Y_2{}^5P_3$	30424·2	26437·5	correspond to
$Y_2{}^5P_3 \leftarrow Z_1{}^5S_2$	33058·3	34393·1	M, N, O for
$Y_2{}^5P_3 \leftarrow Y_3{}^5D_4$	41248·4	36788·0	argon, and
diff. ${}^5P_2 - {}^5P_1$	86	291	O, P, Q for
„ ${}^5P_3 - {}^5P_2$	148	415	xenon.

For krypton, Prof. Acharya identified the line 30800·0 as ${}^5S_2 - {}^5P_3$ due to the transition $(O_1 \leftarrow O_2)$, (NATURE, Feb. 16, 1929); but from the consideration of the differences $P_2 - P_1$ and $P_3 - P_2$, as well as from the intensity, we see that the probability of the line 30858·8 is greater for the transition than that previously identified by Mr. Acharya. The differences $P_2 - P_1$ and $P_3 - P_2$ are 162 and 273 respectively.

S. C. DEB.
A. K. DUTT.

Physical Laboratory,
University of Allahabad,
May 2.

Band Systems Associated with Selenium.

A LARGE number of heads in the band spectrum attributed to selenium have been carefully measured by Messerschmitt.[1] A number of these can be identified with heads in the absorption and fluorescence spectra analysed by Rosen.[2] These form a system which I have called the α system. Nearly all the remaining heads fall into two other singlet systems, the β system, consisting of a number of very diffuse bands in the blue, and the γ system, consisting of a large number of bands in the green and yellow. The heads of the three systems can be represented by the following formulæ:

α system —

$$\nu = 27371 + [254{\cdot}7(\nu' + \tfrac{1}{2}) - 2{\cdot}42(\nu' + \tfrac{1}{2})^2] - [387{\cdot}8(\nu'' + \tfrac{1}{2}) - 0{\cdot}63(\nu'' + \tfrac{1}{2})^2]$$

β system—

$$\nu = 21945 + [431{\cdot}1(\nu' + \tfrac{1}{2}) - 0{\cdot}83(\nu' + \tfrac{1}{2})^2] - [373{\cdot}5(\nu'' + \tfrac{1}{2}) + 0{\cdot}66(\nu'' + \tfrac{1}{2})^2]$$

γ system—

$$\nu = 18342 + [336{\cdot}3(\nu' + \tfrac{1}{2}) - 0{\cdot}19(\nu' + \tfrac{1}{2})^2] - [386{\cdot}5(\nu'' + \tfrac{1}{2}) - 0{\cdot}59(\nu'' + \tfrac{1}{2})^2]$$

It is probable that the α and γ systems have the same final level. It does not seem possible to come to any definite conclusion whether this is also the final level of the β system, as the measurements are probably not very accurate, owing to the extremely diffuse nature of the bands.

Work on the fine structure which is at present in progress indicates that the α system is due to a ${}^3\Sigma \rightarrow {}^3\Sigma$ transition.

It is hoped to publish full details in the autumn.

THOMAS E. NEVIN.

Imperial College of Science and
Technology,
South Kensington, S.W.7.

[1] Messerschmitt: *Zs. wiss. Photographie*, vol. 5, pp. 249-278; 1907.
[2] Rosen: *Zeits. f. Phy.*, vol. 43, p. 95; 1927.

History of Research in Cosmic Rays.*

By Dr. ROBERT A. MILLIKAN,
Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena.

IN general, discussions of priority, save perhaps in the hands of the historian of science, seem to me to serve no useful purpose, since they represent, in the main, the *ex parte* statements of persons who are not in position to form scientific, objective judgments. The task properly belongs to posterity. The real scientific worker, whose primary interest is in the progress of science, can scarcely take the time to enter into these discussions even when he himself is badly misrepresented for the time being. In any case he may usually count on the facts ultimately coming to light.

In order, however, that the uninformed public may not be too long misled by the quite unusual number of incorrect statements and implications that have been made in recent discussions in both the popular and the scientific press upon the subject of 'cosmic rays' (and I have never, directly or indirectly, by implication or suggestion used or authorised any other name, and I know of no other designation which is as appropriate). I am now issuing, at the urgent request, especially of some of my German friends, this single statement, partly to direct attention to some facts quite generally overlooked, and partly for the sake of requesting anyone who is interested in forming an unbiased judgment to read for himself first the articles that I have written, either alone or in collaboration, rather than to depend for his impressions upon reviews or newspaper headlines of any sort. For these latter, whether unduly favourable or unfavourable (and both sorts have appeared), I obviously have no sort of responsibility and I cannot possibly find the time to correct all the erroneous statements that appear.

My own articles, on the other hand, and those published in collaboration with others (and the chief ones here involved and for which I have any responsibility are those represented by the subjoined references (1-9), have been written with the most careful effort to give the correct historical perspective to the field as it existed at the time our own results reported in these articles were obtained, in so far as the brevity necessitated by the nature of the articles permitted, and my attention has not yet been directed to any erroneous statement, implication, or oversight in our presentation of the essential history of the subject. Indeed, before these particular articles were submitted for publication, they were read and approved (as my more important papers usually have been) by three of the best informed physicists of my acquaintance, one of them an outstanding European, for the very purpose of getting the most trustworthy possible judgments as to essential correctness of statement and implication.

In spite of these precautions, misunderstandings seem to have arisen and a spirit of unfriendliness and suspicion of motives to have been engendered which I can account for only upon the assumption that it is another unfortunate aftermath of the War. This spirit, illustrated by the title "Zu Abwehr . . ." of an article found on p. 705 of *Physikalische Zeitschrift*, **19**, has led the authors to make altogether unjustified charges, to which my German friends have urged me to make some reply so as to prevent, in so far as it is still possible to do so, the further spread of misunderstandings. I can do so in a brief article only by presenting again the most essential elements in this history and by referring for more complete bibliographies to such excellent treatments as are found, for example, in Meyer and Schweidler's "Radioactivität" (Teubner, 1927), Chapter vii. pp. 546-624. These authors show an admirable objectiveness in their presentation, and give quite as complete a bibliography as could be expected, though the present article will perhaps add a few more to their list of references useful for succeeding editors.

The most significant contributions of my associates and myself to this whole field of cosmic rays have consisted (1) in obtaining experimental ionisation-depth curves that show that the cosmic rays have the structure of spectral bands of such frequencies or penetrating powers as to be interpretable, if Einstein's equation and Aston's curve are correct, not at all in terms of radioactive or disintegrating atomic processes, nor yet in terms of many-million-volt electronic impacts (up to 400,000,000) as we had earlier thought likely, but rather, as we interpret the evidence, in terms of definite atom-building processes; (2) in obtaining *experimental evidence* as to where these atom-building processes seem to be going on.

I have never even attempted in preceding articles to trace the origin and history of the *speculative* idea of atom-building in cosmic processes—a difficult matter, since it has been well nigh universal property for more than twenty years, but if it will assist the historian of this field I shall be glad to recount here the history of my own knowledge of the subject.

So early as 1904, when I was engaged in a study of the ratio of the radioactivity and uranium content of certain ores,[10] Prof. F. R. Moulton came to me at the University of Chicago with the statement that, if the sun had been originally pure uranium, it would not have been able to pour out so much energy as was demanded by what he regarded as trustworthy estimates of its minimum lifetime, and that therefore cosmogony demanded some thus far unknown source of stellar energy.

Now, this source had, in fact, already been found, though I myself was not at that time wise enough to appreciate it, for the interconvertibility of mass and energy had, in fact, been experimentally demonstrated for special cases by the Kaufmann experiments of 1901, and the facts of radiation

* This article is one of which I sent a German translation to the *Physikalische Zeitschrift* more than a year ago, but at the date of writing, April 1930, it had not appeared.

pressure, discovered a little earlier, were equally significant. Einstein a couple of years later set up this interconvertibility as a general consequence of the special theory of relativity,[11] and from that time forth it was available to every one who like Prof. Moulton was seeking a new source of energy for interpreting stellar lifetimes. Certainly within less than a decade from that time it had become the subject of common table talk about the University of Chicago. Further, so soon as in 1913-14 the Moseley relations and the facts of isotopes became established, atom-building within the stars with the transformation into radiant energy of the 0·0078 gm. which disappears for every gram-atom of hydrogen that goes over into helium, then thought because of alpha-ray phenomena to be the intermediary by which hydrogen is built into the structure of the heavier elements, became universally recognised source of stellar heat. Harkins (*Phil. Mag.* **30**, 723, 1915) discussed at great length this loss of mass, or 'packing effect', in atom-building. I reviewed it in the first edition of my little book "The Electron", p. 203, published in 1917. Its insufficiency to account for the whole of stellar energy was pointed out later. In a letter to NATURE (**99**, 445; 1917) Eddington mentions the idea of the entire annihilation of matter by the falling together and the complete overlapping of the fields of positive and negative electrons and ascribes the idea to Jeans (NATURE, **70**, 101; 1904).

Thus, certainly so early as 1915 the idea of atom-building out of hydrogen as a source of stellar energy and, so early as 1917, the idea of atom annihilation as a more potent source of such energy, had found their way definitely into the literature of physics and had presumably been current in physical laboratories other than that at Chicago from still earlier periods, for they are both obvious deductions from the Einstein equation (1905) and the facts of isotopes (hydrogen having an atomic weight of 1·008 instead of 1).

In our discussions at Chicago, W. D. MacMillan in particular always insisted on going one step farther and on abolishing the idea of the 'heat-death' by assuming that atom-building took place *in outer space* through the condensation there of radiant energy into atoms. He discussed this with me fully in 1915, and in July 1918 [12] he published these ideas in full. Any one interested in the history of this subject should read his other articles,[13] for he has been the chief advocate from the theoretical side of the idea of the evolution of cosmical energy through atom-building processes.

These three ideas, then, (1) atom-building out of hydrogen, (2) atom annihilation, and (3) the possibility of the condensation of the energy of radiation into atoms, especially the first two, are the ideas which we have subjected to certain sorts of *experimental* tests in our cosmic ray work. We have heretofore not been concerned at all with assigning priorities as to their *speculative* inception, and have made no attempt to do so, since our task has been merely to show how our experimental results bore upon these now widely current conceptions. We put forward the first bit of quantitative experimental evidence from the point of view of the cosmic rays when in 1925 we pointed out that our highest observed wave-length corresponded, according to our mode of computation used at that time, exactly to the energy resulting in accordance with Einstein's equation to the formation of helium out of hydrogen, and in February 1927 we discovered much more trustworthy evidence that this process, and also certain other atom-building processes, are the actual cause of the cosmic rays.[14] Furthermore, we presented evidence to show that contrary to all preceding assumptions, so far as we can discover, unless it be MacMillan's, *these particular atom-building processes do not appear to be taking place in the stars at all, but rather in the depths of space.* If there is any one in the world, next to Einstein, who pioneered in developing the *theoretical* ideas for which we have found a certain measure of experimental support, it is W. D. MacMillan. Every one who after 1918 has attempted or shall attempt to record the history of speculative ideas about atom-building in cosmic processes should certainly make reference to his work.

So much for the early history of atom-building ideas as I have personally come into contact with them. They may have been developed independently in other places also, but if so I have known nothing of it.

Now as to the experimental history of the penetrating radiation, a part of which is now known to be due to cosmic rays. This was what Dr. Cameron and I presented as accurately and as fairly as we knew how to do in the brief time available in the particular address published in NATURE in 1928 that is criticised in the foregoing reference, and I hope that my readers will all read it for the sake of judging both of its spirit and its facts. Any additions that need now to be made can best be grouped about the answers to the criticisms.

The address itself was one which I was asked to give as a popular evening lecture before the British Association for the Advancement of Science at Leeds in September 1927. It consisted in a report upon the then recent work of Dr. Cameron and myself on cosmic rays. In presenting our "New Results", I was very careful to avoid giving the impression that our work stood all by itself, and to emphasise this point I told my audience that my subject presented "a very beautiful illustration of the slow step-by-step process by which most advances in science are made, each experimenter building upon the past, but pushing on, if he is fortunate, a little beyond where his predecessors had gone", etc. I did this solely for the sake of disclaiming undue credit to ourselves for the work that was to be presented, and at the same time of stating a profound truth generally overlooked by the public, and actually one extraordinarily well illustrated by this subject, as even a superficial familiarity with its history will reveal to any unprejudiced observer. I had no thought of discrediting, and did not in any way discredit by that statement, as I am assumed in the foregoing review to have been attempting to do, the work of any of

my predecessors, the essential elements of whose contributions I then proceeded to state precisely as the record, as I read it, reveals them.

Dr. Kolhörster was in the audience, and afterward in friendly private conversation suggested no corrections and made no adverse comment of any kind, so that whether he was in complete agreement with my reading of the records or not I had every reason to suppose that his spirit was friendly. Also, so far as the historical introduction to that address is concerned, the spoken address was essentially the same as the written address, save for the insertion of the references in the footnotes. Since that time, however, the spirit of distrust and suspicion seems to have developed to such an extent as to call forth the exceedingly ungenerous and untrue charge that we have deliberately borrowed ideas from Nernst and from v. Schweidler without giving them credit. ("Die Ergebnisse dieser beiden Autoren werden von Millikan and Cameron Duchweges benutzt aber nirgends citiert.")

Now, the facts are that I have never seen a word written upon this subject by my friend and former teacher, Prof. Nernst, and knew only from Dr. Kolhörster's articles, and very recently from Prof. v. Schweidler's excellent book "Radioactivitat", page 607 *et seq.*, published in 1927, that Prof. Nernst had suggested a localised origin of the rays, which was not in keeping with our own findings of their uniform distribution throughout the heavens. Therefore, for the sake of not directing attention to a divergence of views as to origins, or asserting the incorrectness of any one's conclusions, I contented myself with merely stating briefly the experimental fact that Dr. Cameron and myself had brought to light thus far "no directional effect in cosmic rays at all", which is "at variance with results reported by Büttner and Kolhörster". It would be difficult to find anywhere a more complete inversion of fact or of motive than that existing between the real situation and the situation implied in the critique of Dr. Kolhörster *et al.*

Further, as to borrowing theoretical ideas from Prof. v. Schweidler's able writings, we have not only never attempted to advocate or even discuss the view attributed to him of a "gleich mässig verteilten strahlender materie", but also we were not pretending in the article in question to be doing anything more than presenting our *new experimental evidence* which we, at least, had found very helpful in enabling us to differentiate definitely between the three possible theoretical hypotheses which had been discussed so repeatedly as to have become common property so early as 1909, and were variously favoured by different competent workers [15] up to 1926, namely:

1. The hypothesis of an extra-terrestrial origin;
2. That of a radioactive stuff spread through the upper atmosphere; and
3. That of a radioactivity spread through the earth's crust.

It is hoped that any one who is interested in the history of this field will read the long summary and review, citing some scores of preceding articles that had already appeared by 1909 (*Physik. Zeitschr.*, **10**, 836; 1909). The reviewer, Kurz, discarded the first hypothesis, which he correctly attributed to Richardson, 1906, and also the second, and adopted the third as satisfying all the then known requirements, a conclusion which for the first time became completely untenable because of Gockel's balloon observations in 1910 and 1911, observations in which in three different balloon flights, all yielding results in substantial agreement, it was definitely shown that the ionisation within an air-tight vessel is larger, as we stated, at high elevations (up to 4500 metres) than at low, while Kurz and others had by 1909 presented definite tabulated computations showing that with the earth as the source the ionisation would have to fall to practically zero in going up as much as a thousand metres. Gockel's actual readings taken in two flights with electroscopes definitely arranged to maintain the pressure of their surroundings, in the third presumably doing so unintentionally, and so interpreted by him,[16] were sufficient completely to justify as a whole the statement which we made and which our authors criticise. Indeed, we took this statement directly from Gockel himself, as well as from Hess,[17] for the latter says, "Gockels Messungen ergeben, wenn man auf normalen Luftdruck korrigiert, sogar eine schwache Zunahme der Strahlung mit der Hohe".

Further, the point of real significance here is simply the fact that the readings did *not* fall at all to zero at altitudes above 1000 metres, as they were obliged to do, as shown repeatedly so early as 1909, if the earth were the source of the observed effect, thus definitely disproving the hypothesis most generally favoured up to this time and forcing a return to one or the other of the hypotheses rejected by Kurz. We certainly then did not do anything but state the simple fact in saying that this was "the next important step" after 1903. Gockel is now dead and cannot state his own case, but this is the more reason for urging all interested to read the record and let it speak for itself. The next year Hess,[18] after repeating and checking Gockel's experiments, extending them to 5200 metres and making them more *quantitative*, spoke definitely in favour of a return to hypothesis No. 1, although suggesting also the possibility of No. 2,* and Kolhörster also favoured No. 1, in interpreting his experiments of 1913 and 1914.[19]

There were no more observations of any kind significant for this history, at least that I know of, until March and April 1922 when Bowen and I [20] made our high sounding balloon flights (15·5 km) for the sake of subjecting to a severe and crucial test hypothesis No. 1 now supplemented by v. Schweidler's [21] definite calculation from Hess and Kolhörster's most consistent data of $\mu/P = 0{\cdot}57$ per metre of water on the hypothesis that the rays

* Wigand in a comprehensive and admirable review (*Physik. Zeitschr.*, **25**, p. 13; 1924) summarises the situation up to 1924 as follows: "Die Hypotesen über den Ursprung der durchdringenden Höhenstrahlung sehen die Strahlungsquelle entweder ausserterrestrisch im Kosmos oder in den höheren Schichten der Erdatmosphäre (Hess, 28, 33), v. Schweidler, Seeliger. Aus dem mannigfachen Für und Wider lasst sich noch kein klares Bild erkennen, und man muss vorerst noch mit mehreren Möglichkeiten rechnen." Those interested in understanding the facts developed up to 1924 should read this article in full.

(*Continued on p. 29.*)

Supplement to NATURE

No. 3166 JULY 5, 1930

The Metal Crystal.*

By Sir HAROLD CARPENTER, F.R.S.

WHEN prepared by one of the usual methods, metals and alloys consist of an aggregate of small allotriomorphic crystals. Pure metals usually consist of a large number of similar crystals. Alloys are sometimes composed of one type of crystal, though usually they contain two or more different kinds. In both cases metals as ordinarily prepared contain anything from about one hundred thousand to several millions of crystals per cubic inch. In all metals, however, the individual crystal is the unit of which the aggregate is built. It is therefore the simplest form of metal.

The size and shape of the crystal depends on the type of mould in which the fluid metal is cast and on the rate of cooling, and in any given casting crystals of various types may be obtained. In the casting of a steel ingot, for example, a layer of 'chill' crystals form in contact with the surface of the mould. Attached to these columnar crystals grow nearly at right angles to the surface, while in the interior, equiaxed crystals result, which are due to the separation of minute crystals in the liquid which grow and form interference boundaries (Fig. 1). In addition to these, skeleton crystals grow on the surface and sometimes also in the cavity produced by shrinkage in the upper part of the ingot. During the subsequent mechanical treatment to which the metal is subjected, these crystals change their shape. If the mechanical work is severe, they are fragmented and eventually complete recrystallisation takes place with the birth of new crystals. Whether, therefore, a given metal or alloy is used either as a casting or in some worked form, it always consists of an aggregate of crystals.

The properties of metals and alloys in the ordinary state, accordingly, are the properties of these *aggregates*. As already mentioned, the individual crystal is the unit of which these aggregates are composed. Even if it possessed directional properties, these would not be revealed by any tests on polycrystalline material, since the individual crystals are oriented in many directions, and the directional properties would be cancelled out. In addition to this, however, the properties of the crystal boundaries themselves have to be considered. The finer the aggregate, the larger the area occupied by the boundaries. It has long been known that the boundaries in a crystal aggregate are stronger than the interiors of the crystals. For example, a metal fractures under tensile test through and not round the crystals. One of the commonest methods of increasing the strength of a metal or alloy is to diminish its crystal size and increase its boundary area by suitable thermal and mechanical treatment. The properties of any given metal, therefore, are the resultant of those of the very numerous individual crystals of which it is composed, oriented in many positions, modified by the properties of the crystal boundaries.

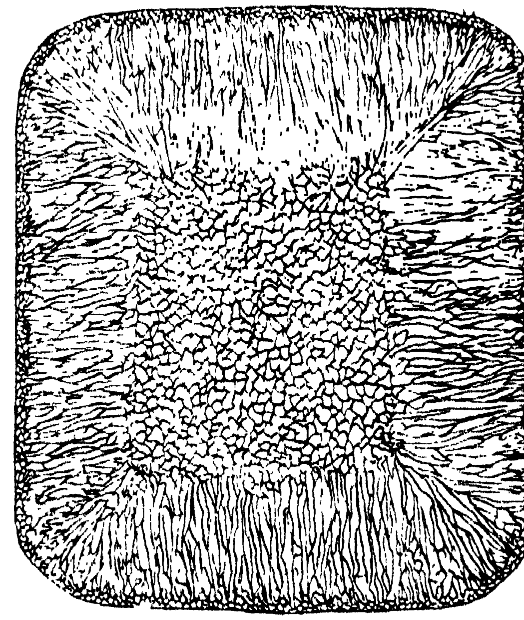


FIG. 1.—Section of steel ingot showing three types of crystals. Outside layer, small chill crystals. Intermediate layer, columnar crystals. Inside layer, equiaxed crystals.

If it were possible to study the properties of the individual metal crystal, the variables which have just been mentioned would be excluded, and the observations made would be of fundamental scientific value. Any particular property of the metal crystal itself could be studied, the only

* Discourse delivered at the Royal Institution on Friday, May 30.

variable being its orientation. It would thus enable the test to be made whether the property in question was directional. From a scientific point of view, therefore, the study of individual metal crystals should precede that of aggregates. Owing to the fact, however, that special conditions have to be observed if a metal is to be obtained in the form of a single crystal, the order of investigation has in practice been just the opposite.

It was the realisation of this fact which gave rise about twelve years ago to definite attempts on the part of investigators to prepare single metal crystals. Considering its great scientific importance, it is perhaps surprising that the attempt was not made earlier, but it is clear that it could not have been made with any real prospect of success until the technique of metallographic research had reached the necessary stage of perfection.

Looking at the problem of preparing a given piece of metal in the form of a single crystal, it is theoretically capable of solution in at least three different ways:

(1) By production of the crystal from the vapour phase.

(2) By its production from the liquid phase.

(3) By the conversion of the solid metal in the ordinary polycrystalline aggregate into a single crystal.

Success has been achieved in each of these ways. To-day there are nine methods of producing single metal crystals—two from the vapour, three from the liquid, and four from the solid phase. Each of these is an example of what may be called *controlled* crystallisation, and the investigation of any particular metal divides itself into three parts: (*a*) The production of the crystal itself; (*b*) the determination of its orientation; and (*c*) the study of its properties. The last category may be divided into two sub-categories, according as the investigation either does or does not involve the distortion of the crystal.

Production of Single Crystals from the Vapour Phase.

Two methods are available, each of which is based upon the technique developed in the incandescent lamp industry for depositing tungsten metal on a glowing wire. One is due to Koref,[1] the other to Van Arkel.[2] Both methods start with a single crystal obtained by another method. This serves as a nucleus and grows to a large single crystal. As an example the production of single crystals of zirconium by J. H. de Boer and J. D. Fast[3] may be described. There is a special interest about this method in that not merely has it enabled this metal to be produced in the monocrystalline form, but also that it has for the first time led to its production in the pure state, in which, whether mono- or polycrystalline, it is ductile, whereas as previously prepared it has always been found to be brittle. This is now known to be due to small traces of impurities.

The principle of the method is the deposition on a glowing metal filament of the metal in question by the thermal dissociation of a volatile compound. The essential condition for success is that below the melting point of the metal to be prepared a temperature range must exist in which the vapour pressure of the metal is smaller than the partial pressure of the metal in the vapour phase. In this particular case the metal filament consisted of tungsten and the compound in question was zirconium iodide. It is not necessary to prepare the iodide at the outset. A mixture of zirconium and iodine will do equally well. The tungsten filament, the diameter of which is about 40 μ, is heated by an electric current to a black-body temperature of 1800°, as read by an optical pyrometer. The reaction vessel made of pyrex glass is then placed in an electric furnace and heated to about 600° C. The zirconium powder and iodine combine to form the iodide and this compound then sublimes. It is decomposed by the filament at 1800° C. and the zirconium deposited on it. Free iodine is than available to combine with a fresh quantity of zirconium in the reaction vessel and the cycle of changes is repeated until sufficient metal has been deposited. The filament is cooled by the solidification of the zirconium and from now on the temperature has to be measured through the strongly coloured vapours of iodine and the iodide. The success of the experiment depends upon depositing zirconium at the correct temperature. This has been found to be about 1800° C. The current rises from an initial value of 0·25 for a filament of 40 μ to 200 amp., when the metal has grown to a diameter of 5 mm. Whether the temperature of the filament falls or rises during the experiment depends upon the external resistance. If this is small the strength of the current is determined by the filament itself. As this grows its resistance falls in proportion to the square of the diameter, whereas cooling by radiation is proportional to the diameter. Therefore, the temperature of the filament tends to rise, and this must be prevented by increasing the external resistance. Conversely, if the external resistance is large, this determines the current, and the zir-

conium rod, which is continually becoming thicker, tends to cool.

If the temperature of the filament is kept at 1700° C., the zirconium deposited is polycrystalline. Between 1750° and 1850° C. the crystals of zirconium are so large that only one occurs in the cross-section of the wire and the built-up rod consists of a series of single crystals of from 0·5 cm. to 1·5 cm. long built round the tungsten nucleus. The crystals thus formed are found to be hexagonal prisms. If the temperature is allowed to rise to 1900° C. the zirconium grows very rapidly at first, but before long it reacts with the tungsten filament and forms a eutectic.

This method is suitable for preparing single crystals of the high-melting lamp filament metals. Van Arkel and de Boer have applied it to titanium, hafnium, and thorium. Koref in co-operation with Fischvoigt [4] has succeeded in preparing single crystals of molybdenum, tantalum, iron, zirconium, and titanium by his method. It is possible, therefore, by either of these methods to prepare single crystal wires and thin rods of high-melting metals, provided the vapour of the compound of the metal with iodine satisfies the condition described above.

Production of Single Crystals from the Liquid Phase.

Brief mention may be made of two of the methods available. These have been used mainly for preparing single crystals of low-melting metals in refractory glass containers, but they can also be applied to metals and alloys of higher melting points in suitable containers.

The first method is that devised by Czochralski,[5] who prepared long thin threads of crystals by drawing them out at a particular rate from the molten metal contained in a crucible just above the freezing temperature. The metal is drawn upwards by means of an auxiliary wire moving vertically at a uniform rate. At some millimetres above the surface of the molten metal solidification begins. The rate of movement of the auxiliary wire has to be the same as the speed of crystallisation. If it is too quick, the single crystal wire breaks ; if too slow, polycrystalline wires are produced. In this way single crystal wires (0·5 mm. diameter) of tin, lead, and antimony have been prepared. This method was developed further by Gompers (1922) and Mark, Polanyi and Schmit (1923).

Single crystal rods up to one inch in diameter can be grown by the second modification due to the work of Tammann (1923), Obreimow and Schubnikow (1924), and Bridgman (1923–25). In Bridgman's method the molten metal contained in a suitable closed tube of refractory glass or quartz is slowly lowered through a tubular electric furnace in a vertical position, and kept at a temperature somewhat above the melting point of the metal in question. The lower end is tapered to a point, which is the first to emerge from the furnace. Solidification starts here and proceeds slowly upwards. Provided the rate of lowering is less than the velocity of crystallisation and sufficiently slow for the latent heat of solidification to be dissipated by conduction, the metal usually crystallises as a single crystal, and in this way Bridgman prepared single crystal bars of tin, cadmium, zinc, antimony, bismuth, and tellurium.

This method depends for its success upon the formation of only one nucleus, upon which the solidifying metal crystallises uniformly. If, however, crystallisation starts from more than one centre, then some means must be found of confining the growth to one crystal. The best way to meet this difficulty was found to be by drawing the lower part of the tube out into a separate chamber separated from the main part by a capillary 0·1 mm. in diameter. This acts as a filter and allows only one of the several crystals which may have formed initially in the lower bulb to get through into the main part of the tube. It is this crystal which then grows and forms the single crystal test-piece.

Bridgman's experiments were carried out by allowing the crystal to form *in vacuo*, and the elimination of all dissolved gas is therefore an essential condition of the success of this method. The rate of lowering depends both on the metal and the size of the tube. In the case of bars 2·2 cm. in diameter, a speed of about 4 mm. an hour was found to be suitable. For bars of small diameter, however, speeds up to 60 cm. per hour could be employed.

The removal of the single crystal bar from the tube is an operation requiring great care. If the containing vessel is perfectly clean, the metal sticks and cannot be removed without distortion. The tube must therefore be greased. A convenient way to do this is to flush out with a heavy mineral oil and then wash this out with petroleum ether. The tube is then heated so as to remove the ether, but a thin film of oil clings to the glass and is sufficient to prevent the metal from sticking.

Davey [6] modified Bridgman's method by using a graphite tube, and succeeded in making single crystal copper test-pieces six inches long and nearly

one inch in diameter. Miss Elam[7] has shown that single crystals of copper, silver, and gold can be grown in graphite tubes in an atmosphere of nitrogen. This has proved to be an advantage, since when grown in this way the metals are quite sound, whereas if melting is carried out *in vacuo* there is a liability for the resulting rod to contain blow-holes. Here also the greatest care is required in removing the crystals, particularly of soft metals, from the containing tube. On one occasion it was found on removing a single crystal rod of gold that it was twisted into a spiral showing three complete turns.

Production of Single Crystals from the Solid Phase.

The problem here consists in the conversion of a polycrystalline into a monocrystalline metal. Success has been reached in this case by the utilisation of an observation made by Sauveur[8] in 1912. He showed that by carefully straining and afterwards heating certain metals, crystals of a larger size could be produced, and suggested that there was a *critical stress* which produced the largest crystals. Later, Ruder,[9] Chappell,[10] Jeffries,[11] and Hanson[12] have shown that if a metal is locally deformed and then heated, exceptionally large crystals form at some distance from the point at which the stress is the severest. If a tapered test-piece is used, a strain gradient is obtained, and the largest crystals always form within the strained region, but farther from the area of greatest strain the higher the temperature. Seligman and Williams[13] stretched aluminium sheet which had previously been heated to various extents and found on heating that, up to a certain point, a small deformation had no effect. Beyond this point, however, large crystals were formed, and as the deformation was further increased the crystal size was diminished. The crystals produced by these methods were very large compared with those in the original metal, some of them being 0·5 in. long.

Single crystal test-pieces were first produced from the polycrystalline metal in the case of aluminium by the following series of treatments:[14] (1) The metal has first to be softened completely, recrystallised, and converted into new equiaxed crystals so far as possible of uniform size. The most suitable size has been found to be 36 per square millimetre. This condition was produced by heating the metal for six hours at 550° C. (2) These crystals must then be strained to the required amount. The precise degree of strain for the aluminium used was an elongation of 1·6 per cent on three inches, produced by a tensile stress of 2·4 tons per square inch. (3) The strained crystals have afterwards to be heated in such a way that the potentiality of growth conferred by strain can be brought fully into operation. This final heat treatment was begun at 450° C., and the temperature raised about 25° C. per day up to 550° C. It was finally raised to 600° C. for one hour in order to complete the absorption of small crystals on the surface which persistently remained at lower temperatures.

The boundary of the single crystal thus produced extends at each end in the form of an irregular surface into the head of the test-piece (Fig. 2), and by

A B

Fig. 2.—A. Test-piece consisting of two crystals, end to end. B. Test-piece consisting of single crystal. The boundary extends at each end into the broad head of the test-piece. One-third natural size. (Reproduced by courtesy of the Institute of Metals.)

this means single crystal bars of aluminium have been prepared, the diameter of which was 0·564 in. and length about 8 in. Polycrystalline bars 0·798 in. in diameter have been converted into single crystals over a length of 4 in. In this way, upwards of seven million of the original crystals can be caused to coalesce into a single crystal. How delicate the process of adjustment of strain is may be judged from the fact that its precise value has to be determined for each fresh batch of aluminium even though the metal is of the same 'works' composition. On an average, one experiment in four succeeds in producing a single crystal test-piece. To give one illustration: the result of

treating a batch of twenty polycrystalline test-pieces was that seven were converted into one crystal, eight into two crystals, four into three crystals, and one into four crystals.

This method has been successfully applied by Edwards and Pfeil[15] to the production of large crystals of iron. It has also been utilised by Miss Elam[16] in the production of single crystals of solid solution alloys of zinc in aluminium. Schaller and Orbig have used it to prepare single crystals, wires of tungsten and molybdenum, while Altertum has prepared single crystal bars of tungsten by making use of the peculiar effect steam has on small tungsten crystals at high temperatures.

The production of single crystal test-pieces from polycrystalline metals by the method of critical straining followed by heating is a more complex process than that of the preparation of single crystals direct from the vapour or the liquid.

The deformation of a metal is possible on account of the existence of 'atomic planes' in each crystal. These are planes which can glide and slip along each other. In a single crystal bar where the orientation is uniform these planes function unhindered. In a polycrystalline bar, however, where the crystals are variously oriented, the movements are quite different. The first crystals to yield are those so oriented that they display the least resistance to stress. The degree of this is limited since they are held in a rigid matrix of other crystals. Hardening takes place along the slip planes and the movement is finally arrested. Limited slip then takes place on other crystals which now present the least resistance to the stress, and they in their turn are hardened. The process is then repeated in other crystals. The net result is that in this case the planes of slip are not uniform but bent. According to van Liempt,[17] "In this way strains are produced in the crystal because the original distance of the atoms has not remained quite the same and the electron lattice has been distorted. The deformed metal is now in a labile condition. The lability is locally the greater as the strain increases. If the deformed metal is now brought to a high temperature there will be an inclination to return to the stable condition."

The method of critical straining consists in straining the crystals of an aggregate in such a way that when it is heated only one of the crystals recrystallises and forms a nucleus. On continuing the heating, the remainder of the crystals, which are in a labile condition, gradually recrystallise and aline themselves on the single nucleus. Ultimately, therefore, a single crystal bar is obtained. If, however, the bar were heated at a higher temperature, a number of strained crystals would recrystallise forming nuclei, and each of these would act as a crystallisation centre. The result would be a bar containing as many crystals as there were nuclei. The reason why in any given set of experiments only some of the bars become monocrystalline is that it is not always possible to ensure that only one labile crystal recrystallises in the first instance. This method, in fact, permits crystals of any desired average size to be grown from a polycrystalline aggregate, since it is only necessary to adjust the degree of strain and the temperature to the requisite condition. In this respect it is the most general of the methods available for preparing large crystals. Moreover, it is quite independent of the melting point of the metal or alloy. In another sense, however, it is more restricted since it depends on the response of the crystal lattice to stress and the liability of the metal or alloy to form twin crystals on being heated. If such liability exists, single crystals cannot be prepared by this method.

Orientation of the Crystals in Single Crystal Test-pieces.

The only satisfactory method of determining the orientation of the crystals is by X-ray analysis. The original method of determining the crystal axes was worked out by Müller.[18] It involves the preparation of bars of square section and the photographing of the reflections from the crystal planes. A special arrangement is required for mounting the bar so that it can be rotated on a vertical axis and photographed in the desired positions. Müller found that the reflections from unstrained bars are perfectly clear and sharp and are obtained within a narrow setting angle, whereas, if the bars are strained, the reflections become 'fuzzy' and are spread over a wider setting angle, the width of which increases with the extent of the distortion. In Müller's method the data can only be obtained for a very thin surface layer of the test-piece. The measurements which he made, however, on the various parts of the surface, showed that this layer had the same orientation relative to the reference plane over the whole surface. It seems probable, therefore, that the same thing holds for the entire rod.

I will now deal briefly with two questions to which the method of X-ray analysis gives definite answers: (1) Are the single crystals obtained in the various ways I have described perfect crystals in the sense that the orientation of their atoms is

uniform corresponding to the crystal symmetry, and are they free from strain? It will of course be realised that owing to their method of preparation they cannot, with one exception, possess the external forms but only the internal symmetry of crystals. The particular exception to which I refer is the case in which they have been produced from vapour, and here, provided suitable conditions are maintained, the crystal wires do show the external forms of crystals. So far as they have been tested, single crystal rods and wires prepared either from the vapour or the liquid phase show themselves perfect crystals when tested by X-ray analysis. This is very much what is to be expected, at any rate in the latter case, since the crystals have been deposited from the liquid by slow cooling under conditions in which no strain should be produced. But it is interesting that the reflections obtained from aluminium single crystal test-pieces, grown from the polycrystalline solid by the method of critical straining and heating, are also perfectly sharp and indicate the complete absence of strain, at any rate so far as the external layers of the crystals are concerned. It follows from this that the small strain set up in their production is completely removed by the prolonged heat-treatment to which they are exposed. This conclusion is supported by the fact that when such bars are slightly distorted the X-ray reflections immediately become less clear.

(2) Do the crystals grow more easily in certain positions than in others; that is, do they take up a preferential orientation? As yet no evidence is available on crystals deposited from the vapour phase. Bridgman concluded that the favoured position of growth from the liquid is that in which the principal cleavage plane is parallel to the axis of the crystal, and he has stated that in the case of large crystals of antimony, no specimens were found which were oriented in any other way. This, however, does not fix the orientation of the crystal, since this plane of cleavage may have any orientation within 180° about the axis of the casting. Miss Elam has shown that in the case of rods of copper, silver, and gold, grown from the liquid, there is no particularly favoured position. Considerable variations of position have been found by her in the case of crystals grown by the method of strain and heat-treatment, and the evidence on this point is now quite extensive.[19] Twenty-nine aluminium, twelve aluminium-zinc alloy, and ten iron single crystal test-pieces have had their orientations determined. In the case of aluminium, a great variety of orientation was met with, since the positions of the axes were found to be scattered over a wide field, but the majority of the crystals favoured a position near the (110) axis, and none has yet been obtained near either the (111) or the (100) axis (Fig. 3). Moreover, this was also found to be the case for an aluminium test-piece consisting of four crystals. In the aluminium-zinc alloy, a considerable variety of orientations was also found, but here it was the (110) axis which was avoided. Five out of twelve crystals were found to be near the (100) axis. In the case of iron a wide range of positions was found among the ten crystals. The (110) axis was avoided, but no evidence was found of any preferential orientation.

Summing up the evidence, it is clear that in the case of the fifty-one crystals, the positions of which have been thus determined, the method of straining and heat-treatment does not determine to any marked extent the orientation of the crystals which grow although certain orientations are avoided. Growth appears to be equally easy in a great variety of positions. The orientations which are avoided are no doubt those in which growth is more difficult. The problem of growing a single crystal test-piece in a desired orientation has been recently taken up and a certain measure of success has been obtained.[20]

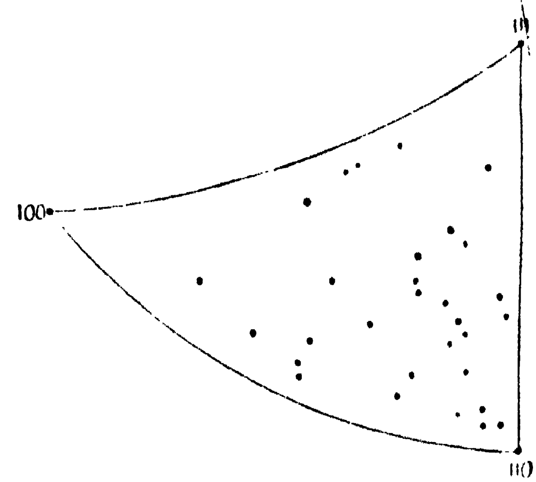


FIG. 3.—Shows the great variety of orientations met with among twenty-nine single-crystal test-pieces of aluminium. 111 (octahedral), 110 (rhombicdodecahedral); 100 (cube).

(Reproduced by courtesy of the Institute of Metals.)

MECHANICAL PROPERTIES OF SINGLE CRYSTALS.

I have already had occasion to comment on the remarkable softness of single crystal bars, which necessitates great care in their handling and machining, and differentiates them from the same metals in the polycrystalline form. This is precisely what we should expect from a metal possessing the uniform orientation of a single crystal and constitutes strong evidence that the bars really

are single crystals. It has been known since the work of Ewing and Rosenhain at the end of last century that the plastic yielding of a metal is due to slip on certain planes along which it yields more easily than in other directions. Even so, the ease with which single crystal bars of aluminium, copper, silver, and gold, and even iron, can be deformed is astonishing. Each of these metals can be bent very readily, but once it has been bent to any marked extent, a higher stress is required to make it revert to its original shape. This simply means that it has been hardened under distortion and the uniform crystal pattern of the atoms altered. Whether this is due, as Miss Elam and I have suggested, to the uniform bending of the crystal planes, or whether, as Gough, Hanson, and Wright have suggested, the distortion of the crystal plane is such that the average curvature is small and of the nature of 'rumpling', cannot as yet be decided.

The softness of single crystal bars indicates that they can only possess a very low limit of proportionality under stress, and indeed raises a doubt whether they can properly be described as possessing any limit of proportionality at all. This point has been carefully tested by Gough, Hanson, and Wright [21] in the case of the metal aluminium. The limit of proportionality in tension of a polycrystalline bar is just about one ton per square inch. These investigators found that the single crystal bars possess no primitive limit of elasticity, but plastic straining occurred under the least stress applied. Furthermore, they conclude from the slope of the stress-strain diagram, even at the 10-40 lb. range of load, that no primitive state of elasticity existed. It is clear, therefore, that the well-defined elastic limit found in the polycrystalline bar is not a property of the metal crystal, but of the crystal aggregate in the case of aluminium.

The common and useful metals belong to one of three types of crystal structure, the face-centred cubic, the body-centred cubic, or the close-packed hexagonal lattice, and it is significant that each of these represents a very high degree of crystal symmetry. These have certain structural features in common. Planes of atoms exist in which the units are closer together than they are to their neighbour in the next plane. Even in the same plane, however, there are certain lines in which the atoms lie closer together than they do in other directions. When a crystal is stretched or compressed it tends to yield on certain planes and along certain directions in which the forces binding the crystals together are the weakest.

Single Crystals of Aluminium.

The deformation and ultimate fracture of a single crystal test-piece was first carried out in the case of the metal aluminium. The first experiments were qualitative, and showed at once that the tensile properties of this metal are directional. On one hand, a round polycrystalline bar pulls out like an isotropic material. It undergoes general extension, and finally breaks with considerable reduction of area and yields a cup and cone fracture (Fig. 4).

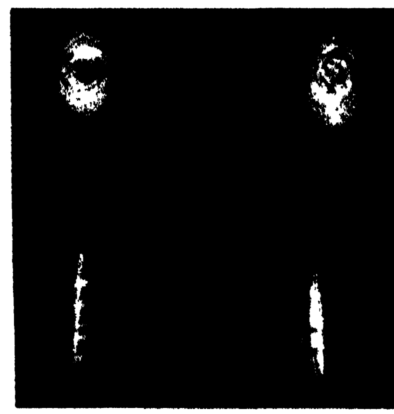


FIG. 4. Upper half, fracture of polycrystalline test-piece yielding cup and cone fracture. Lower half, fracture of single-crystal test-piece yielding 'wedge' fracture.

This is the result of bent slipping. The cross-section of the test-piece is round at any point, although the surface is roughened, due to the unequal distortion of the minute differently oriented crystals. On the other hand, when a round single crystal bar is distorted under tensile stress, it becomes an ellipse. As distortion proceeds the ellipse becomes sharper and sharper. A point is reached when a curious and characteristic lens-shaped figure, inclined at an angle to the long axis of the test-piece, makes its appearance. Finally, the bar breaks at this point with a characteristic 'wedge' fracture (Figs. 4 and 5). In this test the surface of the test-piece is not roughened, but is mechanically etched with numerous slip lines, which are known as 'glide ellipses'. Considerable variations in the ductility and ultimate stress of different test-pieces are found to be due to differences in the orientation of the single crystal, relative to the axis of the test-piece. The ductility is in some cases nearly three times as great as in the polycrystalline bar, whereas

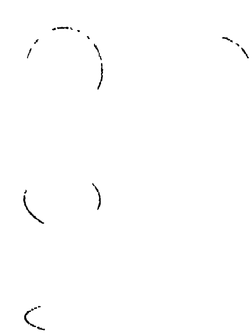


FIG. 5.—Shows stages in the reduction of a round single-crystal test-piece of aluminium in a tensile test leading to the production of a 'wedge' fracture.

the ultimate stress is considerably less and in no case exceeds 80 per cent of that of the polycrystalline metal.

The first complete mathematical and quantitative analysis of the distortion of a single metal crystal was also carried out on aluminium, and forms the subject of the Bakerian Lecture by Taylor and Elam in 1923.[22] The analysis was carried out on a square bar machined from a round bar and involved the marking of each face with a scratch parallel to the length of the axis of the specimen, and by cross scratches at 0·5 in. intervals. The dimensions of the test-piece were 1·0 cm. × 1·0 cm. × 20·0 cm. The faces were numbered 1, 2, 3, 4, so that when the specimen was placed upright in the testing machine the faces appeared in this order when the observer moved round the machine in an anti-clockwise direction. At each successive stage of the test, the extension between each pair of cross marks was measured on each face. The angles between cross scratches and longitudinal scratches were also measured. In addition, the thickness of the specimen between the pairs of opposite faces, and the angle between neighbouring faces, were also measured. These sufficed to determine the nature of the distortion (Fig. 6).

These investigators found that up to an extension of 40 per cent elongation the crystal distorted by slipping or shear on one plane. This plane was found by X-ray measurements to be an octahedral plane (111) of the crystal. The direction of shear was also determined and found to be along one of the three principal lines of atoms in the octahedral plane. When the specimen was extended beyond 40 per cent elongation, it was found that the distortion was no longer due to slipping on one plane. This was explained by the authors, who showed that the effect of the shear was to rotate the axis of the specimen relative to the crystal axes in such a way that another octahedral plane came into a position where its inclination to the axis was the same as that of the slip plane. In these circumstances it

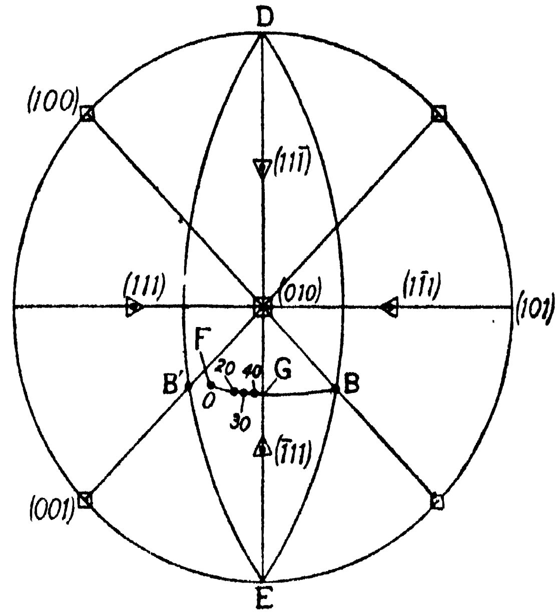


FIG. 7.—Shows the position of the axis of the specimen relative to the crystal axes at 0%, 20%, 30%, and 40% extension. (Reproduced by courtesy of the Royal Society.)

was clear that slipping might occur on both planes simultaneously, and it was verified that this was the case (Fig. 7).

This investigation furnishes the explanation of the drawing down of round single crystal test-pieces of aluminium in the tensile test into very acute ellipses. It is due to the slipping of the crystal on two conjugate planes. It also established a further important point. Hitherto, the evidence with regard to the yielding of a metal by slip had been purely qualitative. It had not been shown that the deformation when a metal crystal is strained is such as could be produced by slip. The quantitative measurements in this paper showed for the first time that this is the case, and it has been left to Taylor and Elam to complete in this way the original discovery of Ewing and Rosenhain.

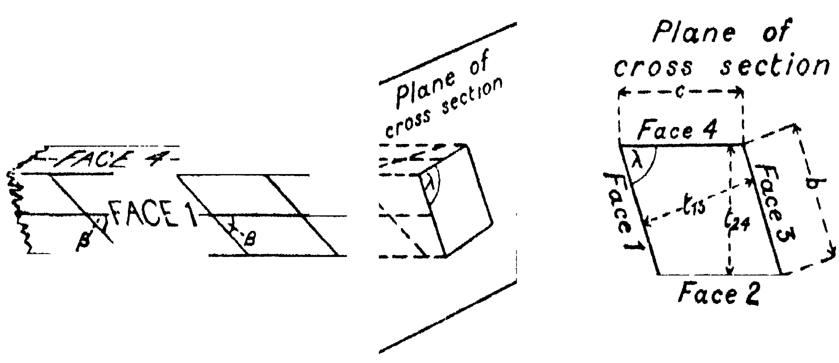


FIG. 6.—Scheme for marking and measuring the distortion of a single-crystal test bar of aluminium. (Reproduced by courtesy of the Royal Society.)

The second paper by Taylor and Elam,[23] on the plastic extension and fracture of aluminium crystals, contains a most interesting test. Previously they had analysed in a similar way the distortion of other single crystal bars in which slipping

·gins on one plane and afterwards continues on ·vo, when the bar has moved into the position of ·njugate slipping. They predicted that if the ·ystal axis of the unstrained crystal were origin·ly in the position where double slipping could ·cur, it should begin at once. Among the large ·mber of crystals grown by Miss Elam and ·yself, one was found the axis of which corre·onded very closely to this position. On dis·rting this in tension, it was found that double ·ipping began almost at once and continued ·roughout the whole of the remainder of the ·tension. Not only this, but also the amount slipping which occurred on the two planes was ·actically equal and the axis of the specimen ·arcely changed during the whole of the test. ·ne other conclusion also follows from these ·sts, namely, that whatever the original orienta·n of the crystal in the test-piece, it always ·eaks in the same position.

The question then arises, does the single crystal ·main a single crystal throughout the extension · to fracture, or does it break up? Evidence · this point is contained in Müller's paper (loc. cit.) the character of the spots reflected by X-rays. the unstrained specimen the reflected spots are ·ry small and only obtained within a small ·tting angle. When extension began the range reflection frequently increased, and the size the reflected spots became larger. Assuming ·at the material does break up into small crystals, ·is possible from the dimensions of the reflected ·ots to make a rough estimate of the maximum ·gle between the surfaces of a pair of these small ·stals. It was found that this angle amounted ·metimes to several degrees. Müller infers that ·is result shows the actual breaking up of the ·st-piece into smaller crystal aggregates. As, ·wever, these remain even after a considerable ·tension of the test-piece very nearly in the same ·sition, the test-piece can still be macroscopically ·nsidered as being a single crystal. A Laue ·otograph was taken of a test-piece at the very ·ge where the specimen was broken. The pattern ·ich resulted showed the existence of relatively ·ge crystals near the edge. It is clear from this ·at the metal crystal exhibits great resistance destruction by mechanical stress.

It is well known that when a metal is distorted tension it breaks by shear stress, and that this ·at a maximum at 45° to the long axis of the test·ce. Supposing that aluminium were a stronger ·tal and that it were possible to break it by ·ar stress on one plane, and supposing that we could find a single crystal test-piece the plane of slip of which was oriented at 45° to the longer axis, we should expect the fractured surface to be not a wedge but a plane surface inclined at 45° to the test-piece. Since we cannot do this with aluminium, owing to its weakness, it seemed interesting to discover whether it could not be hardened by the addition of alloying element which does not destroy its crystal symmetry, and that it might thus be made to have the property of slipping only on one plane before it fractured. Miss Elam succeeded in doing this by dissolving 18·6 per cent of zinc in aluminium, and this, in spite of the fact that the lattice of zinc is not face-centred cubic but close-packed hexagonal. This is a one-phase alloy. It was converted into a single

FIG. 8. Fracture of single-crystal test piece of aluminium-zinc alloy. The fracture has occurred almost wholly on one principal cleavage plane though there are signs of fracture on a second plane at 90° to it. Both planes make angles of 45° with the axis of the test-piece.

(Reproduced by courtesy of the Institute of Metals.)

crystal test-piece by the method of critical straining and heat-treatment and was then tested in tension. It pulled out almost entirely on one principal cleavage plane, although there were signs of a second plane on which slipping had occurred at approximately 90° to it. Both planes made angles of approximately 45° with the axis of the test-piece (Fig. 8). It is clear, therefore, that fracture did occur on the plane of maximum shear, which is in strict accordance with theory. So far as I am aware, this is the first time that it has been possible to test this.

Taylor and Farren, in a paper on the distortion of aluminium crystals under compression,[24] have found that this is of the same nature as that which occurs in tension. It is due to slip parallel to a certain crystal plane and in a certain crystallographic direction, and the choice of which of

twelve possible crystallographically similar types of slipping actually occurs, depends only on the components of shear stress in the material and not at all on whether the stress normal to the slipping planes is a pressure or a tension.

Single Crystals of Iron.

The study of the distortion of single crystals of iron has yielded results of quite remarkable interest. The lattice structure of this metal is different from that of aluminium. It is body-centred cubic, that is, there is an atom at each corner of the cube and one in the centre. The planes having the largest number of atoms and the largest distance between neighbouring planes are not the same as in the face-centred cubic lattice. For this reason alone, therefore, it was important to study the distortion of the single iron crystal. But there was a further reason. The slip bands of the majority of metals formed in plastic deformation are straight, whereas those of iron are nearly always curved. Nearly all previous workers in this subject have assumed that the iron crystal has a plane of slipping which is a crystal plane, and they have attempted to correlate the slip lines with the traces of crystal planes. These attempts have not met with success, but the work of Osmond and Cartaud [25] constitutes a notable exception. They pointed out that the slip lines which occur when an iron crystal is strained are curved, and they could find no relationship between these either as a whole or in their detail and the crystallographic planes.

Taylor and Elam studied the distortion in tension of single iron crystals prepared by Edwards and Pfeil.[26] They concluded that when an iron crystal is distorted in tension it does not slip along a crystallographic plane, but that the particles of metal "stick together along a certain crystallographic direction and the resulting distortion may be likened to that of a large bundle of rods which slide on one another. The rods stick together in groups or smaller bundles of irregular cross sections and the slip lines which appear upon the polished surface are the traces of these bundles on that surface." This conclusion has been tested by Gough, who subjected a single crystal of iron to alternating torsional stresses. The specimen was ultimately fractured by fatigue, precautions being taken to prevent the development of fatigue cracks to any great extent. Careful microscopical examination showed that the slip bands differed entirely in appearance at different portions of the specimen, but all bands could be described as belonging to one of the following types: (1) One set of straight parallel bands; (2) two sets of bands of differing slopes, those of each set appearing to be straight or nearly so; and (3) distinctly 'wavy' slip bands having a well-defined average slope and limits of slope but impossible to resolve into combinations of straight slip bands.

Gough's analysis led him to the conclusion that alpha iron does slip on crystal planes, but that instead of it always taking place along planes of one type, it may take place on any of the (112), (110), or (123) planes. It is only under very special conditions that any one of the planes will coincide with the plane on which the value of the shear stress resolved in the octahedral direction is the maximum. In general, therefore, slip will occur on two sets of planes simultaneously. It is this which gives rise to the generally curved nature of the slip bands and the very complicated arrangement of which the duplex and 'wavy' bands are types. This is the view of the distortion of the single iron crystal which is now generally accepted. The character of the slip accounts for a property of iron of the highest importance, namely, its tendency to break with a fibrous fracture.

Magnetic Characteristics.

Plasticity is only one of the properties of metals. It is the one of greatest importance to engineers and metallurgists, but from the general point of view of physics all properties are important. Physicists have recognised in single crystals a new approach to many of their problems, and each year this form of metal is being used to an increasing extent as a means of obtaining data on some of the fundamental phenomena of matter. Magnetic, electrical, thermal, and optical properties have been measured for crystals of many metals and of different orientations, and it is only possible to mention a small proportion of this work.

Investigations of the magnetic properties of single crystals of iron have been carried out by Honda, Kaya, and Mashiyama.[27] They prepared single crystals of iron wire 68·1 mm. × 2·4 mm. × 1·81 mm. by the method of critical straining and heating. They found that the hysteresis loss of a single crystal of iron is only one-tenth of that of ordinary transformer iron, and that it increases rapidly with increase in the number of crystals in unit volume. The initial and maximum permeabilities of iron were found to decrease with the number of crystals in unit volume.

A set of five crystal rods, of which three had heir axes approximately lying in the (100) plane, ınd two in the (110) plane, was prepared. The nagnetic expansion of these rods was measured, ,nd the following observations were made: 1) The magnetic expansion of single crystals of ron is generally very large as compared with that f ordinary iron. (2) The magnetic expansion n the direction of the tetragonal axis is always ositive, whereas in that of the trigonal axis it s always negative. (3) The magnetic expansion urves for crystals of intermediate orientations re determined by the resultant of the above xpansion and contraction. (4) The magnetic xpansion in ordinary polycrystalline iron is a ifferential effect of the expansions and contracions of the numerous crystals of random orientaions. The work of these Japanese investigators as therefore demonstrated that hysteresis loss nd permeability are functions of the number of rystals in unit volume, and that magnetic exansion is a directional property of the crystals.

A similar research was carried out by Gerlach.[28] 'he results obtained were in substantial agreeent with those of Honda and his co-workers, nd the magnetic properties of single crystals ere shown to be definitely directional. It was ound that the initial permeability is greater in ie tetragonal than in the digonal direction, and iat saturation in the tetragonal direction occurs t a lower magnetic force than in the digonal irection. This investigator found that slight eformation produces considerable changes in iagnetic properties, and attributed the small iscrepancies between his results and Honda's o the existence in the latter of slight mechanical sturbances. The effect of these was most arked in the curves connecting field intensity and tensity of magnetisation.

The longitudinal magneto-resistance effect in ngle crystals of iron has been investigated by 'ebster.[29] He measured the change of resistance a longitudinal magnetic field for three different ientations of iron crystals. He found that for the tragonal direction there is no change in resistance a longitudinal magnetic field, whereas in the igonal and digonal directions the electrical restance begins to alter when a magnetic intensity about 800 c.g.s. units is attained.

Various magnetic properties of nickel crystals ıve also been determined, principally by Kaya. ıis investigator found that up to an intensity of agnetisation of 205 c.g.s. units, nickel crystals e isotropic, but that above this intensity the magnetisation varies for different directions of the applied field. Trigonal, digonal, and tetragonal axes are in decreasing order of magnetisability, which is the reverse of the order found for iron. The same investigator measured the change in electrical resistance of single nickel crystals in longitudinal and transverse magnetic field. In a longitudinal magnetic field, every direction of the axes shows an increase in resistance, the amount of increase being in the decreasing order [111], [110], and [100]. These results differ from those obtained by Webster, who found no increase in resistance for the [100] direction in iron crystals.

The magnetic expansion of single crystals of nickel has been measured by Masiyama. He found that in a longitudinal field the magnetic expansion is always negative for all fields and in all directions, and that the absolute amount of contraction decreases in the order of the direction [100], [110], [111]. The transverse effect was found to be the opposite of the longitudinal.

Electrical Conductivity.

A considerable amount of work has been done on the electrical conductivity of single crystals, and in general it has been found that for those belonging to the cubic system the resistivity is the same in all directions, while for those in other systems the greatest resistivity is found to be in the direction of the planes on which slip most easily occurs.

In comparing the difference between single crystal and polycrystalline bars of zinc with respect to thermal and electrical conductivity over the range -250° C. to $+100^\circ$ C., Lewis and Bidwell found that: (1) The thermal conductivity decreases smoothly, but not linearly with rise in temperature. (2) Single crystals of zinc, measured in the direction of the basal plane, have 11-18 per cent better thermal conductivity at 0° C. than polycrystalline bars. (3) Single crystals of zinc have 20-30 per cent less electrical conductivity at 0° C. than polycrystalline bars.

Bridgman has conducted numerous investigations on the conductivity and thermal electromotive force of crystals of low symmetry. In 1926 he published a paper on the thermal conductivity and thermal e.m.f.[30] of single crystals of zinc, bismuth, cadmium, and tin. Both properties were shown to vary with the orientation of the crystals, and this variation was particularly marked in the case of the thermal e.m.f. Using improved methods of casting single crystals which permitted the production of a wide range of

orientations and a more accurate means of measuring the thermal e.m.f. and resistance, he was able in 1928[31] to demonstrate more clearly the relation between these properties and the orientations of the crystals. He found that the thermal e.m.f. was a linear function of $\cos^2$, where θ is the angle between the axis of the crystal and the length of the rod. This verifies the relation of Kelvin and Voigt, about which Bridgman, on the basis of his previous work, had expressed doubt.

Density.

It has been found that the density of iron single crystals is 0·037 per cent greater than that of the polycrystalline material: that that of nickel single crystals is 0·110 per cent greater than that of the polycrystalline material; and that the density of aluminium single crystals is 0·034 per cent greater than that of the polycrystalline materials.[32]

Electromotive Characteristics.

Measurements of the electrode potential of single crystals of zinc have been carried out at Yenching University, Peking, by Paul A. Anderson.[33] The results indicate that the primary cleavage plane of zinc—the basal pinacoid—yields constant and reproducible values of the electrode potential, and that this value is the same as that obtained from electrolytically deposited crystal conglomerates. This result seems to indicate that in the electrolytically deposited conglomerate the crystals have a random orientation, and that the basal pinacoid plane has the maximum electrode potential of all planes. Attempts to prepare zinc crystals with naturally developed secondary faces proved unsuccessful, and measurements of electrode potential were made on artificially prepared surfaces. The results obtained in this way indicated a qualitatively regular decrease of potential with increase in the angle between the plane under consideration and the primary cleavage plane.

An investigation of the relation between electrode potential and the density of the atom on different planes of zinc crystals has also been carried out in the University of Latvia.[34] The results obtained in this investigation did not agree with those already mentioned, and no difference could be found in the potentials of different, artificially prepared planes.

It is very probable that the electromotive characteristics of a metal vary with the orientation of the surface on which they are measured, but the variation in these characteristics is difficult to measure on artificially prepared surfaces. The Latvian investigators attributed the negative results obtained to this fact. They pointed out that polishing, filing, or rubbing with emery disintegrates the crystallographic planes and the resulting structure is indefinite and shows no differences of potential, whereas etching with dilute acids attacks the surface very unevenly, and no definite plane results. It is probable that the results obtained by Anderson were qualitatively correct, but definite confirmation of these must await measurements of the electrode potential of naturally developed faces.

It is clear from the foregoing results, and others which it has not been possible to include, that both the mechanical and physical properties of the single metal crystal are, in the majority of cases, directional. This fact is more strikingly illustrated in the mechanical tests because the single crystal test-pieces undergo distortion and assume new and striking forms. In both categories, however, the properties of the single crystal differ from those of the crystal aggregate, depending upon its particular orientation. Single crystal alloys have been investigated to a less extent, but in so far as evidence is available, it indicates that the same holds for them. The scientific investigation of metals in the future will have to take into account both the monocrystalline and the polycrystalline states, and the variations in any particular property which may be secured by varying the orientation of the crystal. This will involve the controlled production of single crystals in particular orientations, a field of investigation which is only just being opened up.

Knowledge of the mechanics and physics of the metal crystal is only in its infancy. From the point of view of pure science, it is the single metal crystal which will have to be investigated in the first instance. That of the crystal aggregate of any particular average size should follow at a later stage. Such knowledge will form the basis of the scientific manufacture of metals and alloys possessing properties which can be specified with accuracy and certainty.

[1] Koref, *Zeit. Electr.*, **28**, 511; 1922.
[2] Van Arkel, *Physica*, **2**, 56; 1922
[3] J. H. de Boer and J. D. Fast, *Zeit. fur anorg. u. allege. Chem.*, 153; 1926.
[4] Koref, *Zeit f. techn. Physik*, 296; 1925.
[5] Czochralski, *Z. physikal Chem.*, **25**, 219-221; 1918
[6] Davey, *Phys. Rev.*, **92**, February 1925.
[7] Elam, *Proc. Roy. Soc.*, A, **112**, 329-353; 1926.
[8] Sauveur, *Proc. Int. Assoc. for Testing Materials*, Sixth Congress, vol. 2, Nov. 6, 1912.
[9] Ruder, *Trans. Amer. Inst. Min. Engineers*, **47**, pp. 569-586, 1913
[10] Chappell, *J. Iron and Steel Inst*, No. 1, pp. 260-496; 1914.
[11] Jeffries, *J. Inst. Met.*, **20**, No. 2, pp. 109-140; 1918.
[12] Hanson, *J. Inst. Met.*, **20**, No. 2, pp. 141-145; 1918.
[13] Seligman and Williams, *J. Inst. Met.*, **20**, No. 2, pp. 162-165; 1918.
[14] Carpenter and Elam, *Proc. Roy. Soc.*, A, **100**, 329-353; 1921
[15] Edwards and Pfeil, *J. Iron and Steel Inst.*, **109**, No 1, pp. 129-147, 1924.
[16] Elam, *Proc. Roy. Soc.*, A, **109**, pp. 143-149; 1925.
[17] Geiss and van Leimpt, *Zeit. f. Metallk.*, July 1926.
[18] A. Müller, *Proc. Roy. Soc.*, A, **105**, pp. 500-506; 1924.
[19] Elam, *Phil. Mag.*, **50**, pp. 507-520; September 1925.
[20] Goetz, *Physical Review*, **35**, No. 2, January 1930.
[21] Gough, Hanson, and Wright, *Phil. Trans. Roy. Soc.*, A, **226**, pp. 1-30; 1925.
[22] Taylor and Elam (Bakerian Lecture), *Proc. Roy. Soc.*, A, **102**, pp. 643-667; 1923.
[23] Taylor and Elam, *Proc. Roy. Soc.*, A, **108**, pp. 28-51; 1925.
[24] Taylor and Farren, *Proc. Roy. Soc.*, A, **111**, pp. 529-551; 1926.
[25] Osmond and Cartaud, *J. Iron and Steel Inst.*, No. 111; 1906
[26] Edwards and Pfeil, *J. Iron and Steel Inst.*, Autumn Meeting, September 1925.
[27] Honda, Kaya, and Mashiyama, *Sci. Rep. Tôhoku Imperial University*; 1926.
[28] Gerlach, *Zeits. f. Phys.*, 1926-27.
[29] Webster, *Proc. Roy. Soc.*, A, **113**; 1927.
[30] Bridgman, *Proc. Amer. Acad. of Science*, **61**; 1926.
[31] Bridgman, *Physical Review*, **31**, No. 2; 1928.
[32] Seiji Kaya, *Kinzoku no Kenkyu*, **5**, 10; 1928.
[33] Anderson, Nature, Jan. 12, 1929, p. 49.
[34] Straumanis, Nature, July 13, 1929, p. 56.

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

came in from outside. Kolhörster himself had computed $\mu = 0.55$ as reported in Meyer and von Schweidler's book, p. 606. Bowen and I had at that time no other observations to guide us, nor did any more appear for more than a year thereafter. Since all conceivable sources of error would make our results come out too high, the fact that our balloons came down with a discharge of approximately one-fourth the expected value was definite unambiguous proof to us that a radiation of such a coefficient as we had assumed in our computations did not come in from outside, that rather, if the observed effects were due to extra-terrestrial rays at all, these rays had to be very much harder than had been supposed, and we so reported at the meeting of the National Academy of Sciences held in Washington in April 1922. In doing so, we did not reflect in any way upon our predecessors. We obviously had no choice but to report our findings. Indeed, we had so much confidence in Hess and Kolhörster as observers that we felt that the very large discrepancy between their results up to 9 km. and ours up to 15·5 km. cast so serious doubts upon the adequacy of hypothesis No. 1 that we spent a year preparing new experiments on absorption coefficients of the penetrating rays to enable us to differentiate sharply between hypothesis No. 1 and hypothesis No. 2, since No. 3 had already been definitely eliminated by Gockel's experiments, now checked by Hess, Kolhorster, and ourselves.

It was eighteen months later, after Dr. Otis and I had made our absorption experiments with lead and water on top of Pike's Peak, that we found that these discrepancies between Bowen and Millikan's and Hess and Kolhörster's balloon findings, discrepancies which had caused us so much concern and raised so much doubt about the interpretation of the penetrating rays, had been removed by Dr. Kolhorster's 1923 work in the Alps, which yielded $\mu/P = 0.25$ per metre of water, a result which is in substantial agreement with our sounding balloon data, as we have definitely shown.[22] The difference in the ionisation to be expected at the top of the atmosphere between $\mu = 0.25$ and $\mu = 0.57$ is enormous, and the sounding balloon flights were the first to reveal the untenableness of the last figure. I believe that all recent work is in substantial agreement with the first figure. We have never thought it necessary to contradict or to answer at all the critiques of our sounding balloon experiments, for the simple reason that the data obtained in these balloon flights appear to speak for themselves since the result yielded is now generally accepted.

Our critics charge Dr. Cameron and myself with misrepresentation because we said that "up to this time the increasing rate of discharge was the sole phenomena upon which the hypothesis of rays of cosmic origin rested", *but they insert the year* 1925 *instead of the correct year*, 1922, and then quote Kolhörster's 1923 data to show our error. The table given in Meyer and v. Schweidler's "Radioactivitat" (1927), p. 606, actually records no absorption coefficient obtained up to 1922 in any way except from measurements in air.

The only remaining point of criticism of our article is in our statement that our observations at great depths in the water of high-altitude snow-fed lakes, definitely shown by long tests to be free from radioactive impurities, represent the first time that the zero of an electroscope had been definitely determined. Our critics think that Bergwitz succeeded in doing the same thing when he in 1915 took an unsealed electroscope into a salt mine and *assumed* the non-existence of any radiations from radioactive impurities in the surroundings. For the purpose of assuredly eliminating completely both local and cosmic radiations, it scarcely seems to us that Bergwitz's procedure in 1915 can be called a trustworthy determination of the zero of an electroscope. In an instrument of a litre capacity containing air at atmospheric pressure, his reading was 8 ions at the surface, 4 ions in the salt mine. With an instrument of the same volume and pressure our reading at the surface is 7 ions, under 150 feet of water it is 1·6 ions. The larger difference in our case probably means that we are better screened from local effects. In any case, unless careful tests for such screening were made, we doubt if Dr. Bergwitz himself would call it a zero determination. However, we are very glad to be informed of his experiments, which we had in fact overlooked.

The worst case of misunderstanding and misstatement that I have seen, however, is met with, not in connexion with articles on cosmic rays, though probably due to misconceptions engendered by these articles, but in a review of a short article I wrote by request for the American Philosophical Society on "The Last Fifteen Years of Physics"[5] which is abstracted in the *Physikalische Berichte*, April, vol. 8, p. 465, No. 7; 1927. In so short a review as I had to give here of so huge a field, it is of course impossible that any two people would select precisely the same group of advances to emphasise, but if there was any national bias in the list selected I was completely unconscious of it. Furthermore, such bias was not noticed by the best informed European physicist of my acquaintance, who actually viséd this particular article before it went to press. The reviewer's misunderstanding and misrepresentation of the article is presumably due to preceding misconceptions, and barely possibly in part to the fact that in this necessarily very sketchy enumeration of a number of important advances, I repeatedly inserted references to my book on "The Electron" or to my more extended articles like those on cosmic rays, merely for the sake of giving the reader opportunity to look up, if he wished, my more complete discussion of the advances under consideration. The reviewer appears to have taken these references, without looking them up, as claims of discovery by me, whereas they actually contain merely the history of the advances, altogether objectively presented. *Actually no such claims as the reviewer asserts are either made or implied.* Again, therefore, I beg the reader to read the article in question before he draws any conclusion about it.

Returning to the main question here under discussion, there can be no doubt whatever about the fact that every country tends to get its own contributions out of their true perspective. Having been brought up, scientifically, largely on German books, I well recall my surprise, when I had opportunity to spend a few months of study in Paris and Cambridge, to find how badly I had underrated French and English contributions to the development of physics, an error which a few months of study in these centres was well calculated in its turn to correct. It is in this correcting of perspective that the great value of foreign study lies.

We Americans have in the past made so few contributions ourselves, and have been brought up so completely on foreign books, and in foreign schools, that we have been in a particularly favoured position for appraising the contributions of other countries, without being too much impressed with our own scientific importance, since everybody has recognised the fact that we had none. That we, too, are beginning to be charged with a nationalistic bias in science is perhaps merely an indication that some contributions are actually beginning to come from this side of the water.

As international contacts in science increase, and they are now doing so more rapidly than ever before, it is not too much to expect that science will very soon become more completely objective that it has been heretofore. There will be two signs of the approach of that hoped-for day: first, a decreasing amount of international claiming of priorities; secondly, and even more important, a decreasing amount of suspicion of nationalistic motives and of making of unwarranted charges of prejudice in the presentation of work.

[1] R. A. Millikan, *Proc. Nat. Acad. Sci.*, **12**, 48-55; 1926.
[2] R. A. Millikan and I. S. Bowen, *Phys. Rev.*, **27**, 353-361; 1926.
[3] R. A. Millikan and R. M. Otis, *Phys. Rev.*, **27**, 645-658; 1926.
[4] R. A. Millikan and G. H. Cameron, *Phys. Rev.*, **28**, 851-868; 1926.
[5] R. A. Millikan, *Proc. Amer. Phil. Soc.*, **65**, 68-78; 1926.
[6] R. A. Millikan and G. H. Cameron, *Phys. Rev.*, **31**, 163-173; 1928.
[7] NATURE, **121**, 19-26; 1928.
[8] *Phys. Rev.*, **31**, 921-930; 1928.
[9] *Proc. Nat. Acad. Sci.*, **14**, 637-641; 1928.
[10] R. A. Millikan, *Proc. International Congress of Arts and Sciences*, **4**; 1906.
[11] A. Einstein, *Ann. der Physik*, **18**, 639; 1905.
[12] W. D. MacMillan, *Astrophysical Journal*, **48**, 35; 1918.
[13] W. D. MacMillan, *Science*, **62**, July 24 and 31, Aug 7, 1925.
[14] Millikan and Cameron, *Phys. Rev.*, **32**, 533-557; 1928.
[15] Hoffman, *Phys. Zeit.*, **26**, 40, 669; 1925.
[16] Gockel, *Physik. Zeitschr.*, **12**, 597; 1911.
[17] Hess, *Phys. Zeit*, **12**, 1001; 1911.
[18] Hess, *Phys Zeit.*, **12**, 998; 1911; and **13**, 1084; 1912.
[19] Kolhörster, *Phys. Zeit.*, **14**, 1153; 1913; and *V. d. D. P. Ges.*, July 1914.
[20] Millikan, Carnegie Institution of Washington Year Book, No. 21, 1922, pp. 385-386; also Millikan and Bowen, *Phys. Rev.*, **22**, 198; 1923; and **27**, 353; 1926.
[21] "Elster-Geitel Festschrift", p. 413.
[22] Millikan and Cameron, *Phys. Rev.*, **31**, 172; 1926.

The Welland Ship Canal.

THE opening on July 1 of the reconstructed Welland Ship Canal between Lake Erie and Lake Ontario marks an important stage in the developments of the North American waterways which will ultimately enable large vessels to pass between the Great Lakes and the Atlantic Ocean. Lakes Superior, Michigan, Huron, Erie, and Ontario constitute the greatest lake system in the world, and owing to their geographical position and the rapid exploitation of the vast natural resources of the North American continent, the traffic on them, already of enormous proportions, is steadily increasing. Ore, coal, and grain form the greater part of the cargoes carried, and the vessels employed are especially constructed for the quick stowage and discharge of cargo. Many of them, too, are of very large dimensions, there being more than 300 vessels of 600 feet or more in length. In 1926 one vessel carried a single cargo of 15,900 tons, while 12,000 tons of ore have been loaded in about a quarter of an hour. Owing to climatic conditions traffic is only possible for seven or eight months in the year, but in this time a greater tonnage passes between Lake Superior and Lake Huron than passes through the Suez Canal, the Panama Canal, and the Manchester Ship Canal combined.

Between Lake Superior and the Atlantic, however, there are three natural barriers to shipping, the first between Lake Superior and Lake Huron which has led to the building of great locks on both the Canadian and United States sides; the second between Lake Erie and Lake Ontario, formed by the Niagara escarpment across which the Welland Canal runs, while the third lies in the unnavigable stretches of the St. Lawrence below Lake Ontario, to avoid which the St. Lawrence Canal was constructed. This canal at present only admits of the passage of vessels about 260 ft. in length, but its enlargement is already being discussed. One interesting feature of the traffic through the canals is that ships, whether Canadian or American, pass through free of tolls.

The Welland Canal is situated a few miles to the west of the River Niagara and runs practically north and south from Port Weller on Lake Ontario to Port Colborne on Lake Erie, the distance being about 25 miles. Between the lakes there is a difference of level of 325 ft. The first Welland Canal was built a hundred years ago with forty small wooden locks admitting the passage of vessels of 7½ ft. draught. In the 'forties of last century the canal was reconstructed with twenty-seven locks 120 ft. long, 26 ft. wide, and 8½ ft. of water. It was again reconstructed in the 'seventies with locks 270 ft. in length, 45 ft. beam, and 14 ft. of water, and the traffic by 1904 had grown to 620,000 tons and by 1914 to 4,000,000 tons per annum. By then the decision to convert it into a ship canal of the first order had already been made, and the canal to-day has but eight locks, but these are each 820 ft. in length, 80 ft. wide, and with 30 ft. of water over the sills.

Needless to say, the present reconstruction of the canal has involved engineering works of the first magnitude. Embankments, breakwaters, harbours, storage basins, spillways, weirs, bridges have all had to be built, while the most important

feature of the canal is the flight of three twin locks, Nos. 4, 5, 6, which have been built at Thorold and constitute a structure 4100 ft. in length and more than 300 ft. wide. The three locks together have a total lift of 139½ ft., being 54½ ft. greater than the lift of the three locks at Gatun on the Panama Canal. The locks are not so large as those in the Panama Canal, which are 1000 ft. long and 110 ft. wide, but the lift for such a work is unprecedented. The walls for the greater part are formed of reinforced concrete monoliths 60 ft. in length.

During the past year a fully illustrated account of the canal and its construction has been published in *Engineering*, and the articles have included descriptions of the great excavating machines, the travelling forms and the concreting plants with the aid of which the massive walls have been built. In the Panama Canal ships are towed through by electric locomotives, but in the Welland Canal they will proceed under their own power. Every precaution, however, has been taken against accident; the twin locks have double gates, and wire rope hawsers guard the entrances to the locks. The gates themselves are 82 ft. high, 48 ft. wide, and 5 ft. thick, each weighing 480 tons. For the control of the gates and the working of the numerous large sluices and valves throughout the system, electrical machinery has been installed and current for this will next year be available from a power station placed at the foot of the three twin locks. This will contain three 5000 h.p. hydraulic turbines working under a head of 186 feet. The whole of this great work has been carried out by various contractors working under the direction of the Department of Railways and Canals of the Dominion with Mr. Alex. J. Grant as Engineer-in-Charge.

News and Views.

THE discourse by Sir Harold Carpenter which we publish to-day as a special supplement provides a very complete survey of the important results which have been obtained by the study of single crystals of metals. Whilst ordinary metals consist of a large number of crystals with their axes directed more or less at random, means have been devised for producing specimens, large enough for the tests usually applied by the engineer to metallic specimens, but consisting of a single individual. An extensive field has thus been opened up for the study of the properties of solids. The use of single crystals eliminates one very obscure factor, the existence of boundaries of unknown properties between the crystals, and also, by limiting the directions in which slip can occur under the influence of stress, greatly simplifies the geometrical conditions of a mechanical test. The study of the electrical, and especially of the magnetic, properties is correspondingly simplified. It becomes possible to compare the properties of metals with those of ionic crystals, such as rock salt, which have so far proved most amenable to theoretical treatment. The work on metallic single crystals is thus certain to throw much light on a problem of the greatest interest to the engineer as well as to the physicist—that of the cohesion of solids.

THE methods adopted by the crystallographer for growing perfect crystals of salts fail completely when applied to metals, and it has been necessary to devise new methods. For readily fusible metals, the slow solidification of the molten metal in a tube cooled from one end has proved most successful, but other means of attaining the same end have proved their value. The production of very large crystals in homogeneous metals by suitable annealing after critical strain, due originally to Sir Harold Carpenter and extensively applied, especially by him and Miss Elam, has furnished the material for the detailed study of the deformation of single crystals, in which the X-ray method of examination has rendered such valuable services. Lastly, the ingenious method of the Dutch investigators, depending on the decomposition of the vapours of metallic iodides by heat, has made available crystals of some of the most refractory of the metals. There still remain many unsolved problems, and there is still no general agreement as to the nature of the process of hardening by cold-working, but Sir Harold Carpenter clearly indicates the immense advances in the study of metals made possible by the new technique.

THE Institute of Physics a short time ago appointed a committee to inquire into the possibility of drawing up a catalogue of apparatus which had been used in the course of investigations leading to important discoveries. At the request of the committee the Institute is now making a general appeal to all who have charge of historic apparatus. The appeal, which is signed by Dr. W. H. Eccles, Sir F. W. Dyson, Sir W. H. Bragg, Sir C. A. Parsons, Sir J. J. Thomson, Sir R. T. Glazebrook, and Sir H. G. Lyons, is made with the object of obtaining information as to the existence of apparatus and the researches it was used in, so that students of the history of science may be able to visit, identify, and study it. It is also suggested that the committee could possibly assist the owners, if they so desire, to place the apparatus where it could be permanently secured to the nation. In such institutions as the Science Museum, the Conservatoire des Arts et Métiers, the Deutsches Museum, and the Smithsonian Institution, England, France, Germany, and America already possess extensive collections of great value, and there are probably few observatories, laboratories, or scientific societies which do not own some historic apparatus, while other instruments are in private hands. Practically every private collection, however, is ultimately dispersed, and the compilation of such a catalogue as that now being formed might lead to the more historic apparatus becoming the nation's property. As with pictures and other works of art, the selective principle should be applied, and a

joint committee of the Institute of Physics and kindred societies would be a suitable body to act in an advisory capacity.

IN the past, wars, riots, and fires have been the cause of the destruction of much valuable apparatus. Gilbert's collection, which he bequeathed to the Royal College of Physicians, was lost in the Great Fire of London: Hevelius lost both observatory and instruments by a fire at Danzig in 1679; the great fire at Copenhagen in 1728 led to the destruction of Römer's telescopes, and the first observatory at St. Petersburg was burnt down in 1747. One of the most deplorable of all losses was occasioned by the fire at the Volta Centenary Exhibition at Como in 1900, when Volta's original piles and cells, etc., were lost. Wars have been no less destructive than fires. The manuscripts of Thomas Harriott, astronomer and mathematician, disappeared during the Civil War: Gregory Saint-Vincent, the seventeenth century geometer, lost all in the siege of Prague: Chladni lost some of his acoustical apparatus during the Napoleonic Wars, while Regnault, after the occupation of Paris by the Germans, returned to his laboratory at Sèvres to find his standard apparatus and the results of his great researches on the expansion of gases ruined. The destruction of Priestley's library and apparatus occurred during the Birmingham Riots of 1791. How important instruments may disappear unrecorded is shown by the case of Sturgeon's electrical apparatus. In 1825 the Royal Society of Arts recorded the award of a medal and thirty guineas to Sturgeon for the gift of his electromagnetic apparatus, but this, including the first electromagnet ever made, has unfortunately long since disappeared. Such, it may be hoped, will not happen to any important collection in the future, and we feel that the Institute of Physics is doing a public service in obtaining records which should go far to prevent such losses from happening.

ON June 14 a large meeting of university professors, academicians, and scientific men met in the great hall of the Palace of the Apostolic Chancery in Rome in commemoration of the third centenary of the death of Prince Federico Cesi, the founder of the Accademia dei Lincei. After introductory remarks by the president, Prof. Giuseppe Gianfranceschi, Prof. Antonino Anila recounted how the idea came to Cesi of bringing together all scholars of that time the first serious attempt to organise human knowledge recorded in history. This academic activity was to have its centre in Rome, but was to embrace the whole world then known. From this suggestion was born the Accademia dei Lincei, so named from the power attributed to the lynx (*la lince*) of seeing into the depths of things. The most illustrious scientific men of the day supported the project, and Galileo was desirous of becoming a member of the Academy. Prof. Anila emphasised the fact that, so far as his astronomical discoveries went, Galileo received nothing but help from the Church, the opposition to him being based on his persistence in his own special interpretation of the scriptures. Cesi himself made a large number of discoveries bearing on the structure, functions, and classification of plants, being the first to utilise the microscope in such investigations; and in addition he made noteworthy contributions to mineralogical and zoological knowledge. Prof. Anila was followed by the Rev. Prof. Agostino Gemelli, who traced the developments taking place after the death of Cesi, and indicated the relationships between the original academy and the Accademia Pontificia dei Nuovi Lincei and the Reale Accademia dei Lincei of the present day. Prof. Gemelli also contested the view, expressed by certain historians, that the activities of the academy were often restricted as the result of clerical antagonism, especially that of the Jesuits, or of lack of papal support.

THE appointment of a Committee to consider and report on the training of candidates and probationers for appointment as forest officers in the government service was announced in NATURE of June 21. In directing attention to this Committee, the Secretary of State for the Colonies points out that the proper conservation and development of the forests of the British Empire is a problem which has been attracting increasing interest of recent years and is one of great national importance. The Colonial Office is responsible for the management of about one-third of the total forest area of the Empire. It is recognised that the Colonial Forestry Services have been very weak in numbers, whilst, owing to changes or possible changes in the demands for different kinds of timber, it is becoming a matter of urgent importance to explore the possibilities of making fuller uses of the tropical hardwood forests of the Empire. It is considered that a careful inquiry may show that there are some directions in which greater facilities may be made available for the training of future forest officers. To undertake such an inquiry is the *raison d'être* for the appointment of the Committee.

JOHANN KEPLER is recognised as one of the founders of modern astronomy, and his discoveries are known to every student of physical science. He was to Germany what Galileo was to Italy and Newton to England, and it is therefore with interest we learn that arrangements are being made to commemorate the tercentenary of his death, which falls on Nov. 15 of this year. Kepler died in 1630, in the midst of the Thirty Years' War, and was buried in the churchyard at Ratisbon, but the churchyard was practically destroyed in the desperate struggles of the time and the site of his grave is no longer known. In 1803, however, the venerable Prince Primate Dalberg, known for his love of the fine arts, erected a cenotaph at Ratisbon to Kepler's memory, and the commemoration proceedings will commence on Sept. 24 before this memorial with an address by Dr. von Dyck, of the Munich Technical High School. The same evening a meeting of the Society of History and the Society of Natural History will be held, and on the following day Prof. Bauschinger of Leipzig will deliver an address in the old Reichssaal at Ratisbon. The proceedings will be brought to a close with an act of homage before the bust of Kepler in the Walhalla near the city.

MANY places in Germany beside Ratisbon are connected with the memory of Kepler. Born in the little town of Weilderstadt in Würtemberg, Kepler

attended school at Maulbronn, was a student at the University of Tübingen, and in 1594 became a professor of astronomy at Gratz. At Prague he lived for a short time with Tycho Brahe, and he afterwards held professorships at Linz, Rostock, and at Sagan in Silesia. There was nothing in his upbringing or surroundings to stimulate Kepler's interest in science and from his earliest days he had a struggle against misfortune. A sickly child of well-born but indigent parents, he suffered more than once from severe illness, he had the unhappy experience of seeing his parents separate, while after his own marriage, domestic affliction and pecuniary difficulties dogged his footsteps. Even after receiving the appointment of imperial mathematician to the Emperor Rudolph, his salary was often sadly in arrears, and it was while attempting to obtain some money that he died at Ratisbon. Yet amid all his difficulties he was able to publish no fewer than thirty separate works, and he left behind twenty-two volumes of manuscripts. It was apparently from the lectures of Moestlin that he learnt of the revolutionary views of Copernicus, while it was from the long series of observations of Tycho Brahe that he obtained the material which enabled him to search out and enunciate the laws of planetary motion. Beside the memorial at Ratisbon, there is a monument to Kepler at Weilderstadt, a description of which was given in NATURE of July 21, 1870, at the time it was unveiled.

AN industry the breeding of game birds which is well established in Great Britain, though on a small scale, is attracting greater attention in the United States of America. Already some of the largest and most productive game farms in the world have been developed there, and the supply is met by an ever-increasing demand. This has largely to do with the development of the sport of shooting in the States, for most of the game-birds and their eggs are used for restocking State game departments and the 'shootings' of sportsmen's clubs. But in addition the demand for stock for propagating, and the needs of bird fanciers and zoological gardens, are so great that it is seldom necessary to dispose of the birds for food. For the guidance of game-bird breeders the U.S. Department of Agriculture has issued two *Farmers' Bulletins* (Nos. 1612 and 1613) on the propagation of aquatic game birds and of upland game birds, from which may be obtained concise and useful hints on the most up-to-date methods employed in the industry.

THAT alligators should have an economic importance so great as to merit the establishment of alligator reserves and farms will surprise many readers, but it is perhaps more astonishing to learn that the use of alligator hides for one purpose or another has been in vogue in the United States since about 1800. Nowadays the industry concerns itself with the manufacture of trunks, travelling bags, purses, pocket-books, shoes, and miscellaneous novelties, and the result has been a decline in the numbers of alligators which, in some places, threatens extinction. In the beginning of this century the output of the United States tanneries was about 280,000 skins annually, valued at 420,000 dollars, but during the past few years the number cannot have exceeded 50,000 a year, prices ranging from 35 cents for a 3-foot skin to 3 or 4 dollars for a 7-foot skin. Accordingly, the alligator, once denounced, has come to be protected by local laws which enforce a close season, a licence for trappers, and have even created a State Alligator Reservation in Florida. This and much information about the habits, the hunting, and the food of *Alligator mississipiensis* is contained in *Technical Bulletin*, No. 147, of the U.S. Department of Agriculture.

THE fundamental scientific research work which is being carried out under the Clothworkers' Research Scheme in the University of Leeds is year by year becoming more important and receiving more extensive recognition. Perhaps no better indication of the value which is being placed upon this work in scientific circles could be given than that accorded by the Royal Society, which has recently made a grant of £200 for apparatus to facilitate the X-ray work on textile fibres upon which Mr. W. T. Astbury is engaged. This work, along with the physico-chemical work under Mr. J. B. Speakman, is gradually clearing up the complex problem of the structure of the wool fibre, and in the near future it is probable that, knowing what wool really is, better control of the manufacturing processes may be ensured. Thus, the wisdom of running, side by side, fundamental scientific research and textile technology is becoming more and more justified.

THE Department of Zoology of the British Museum (Natural History) has received from Col. F. Wall a collection of more than a thousand skulls and skeletal preparations of Indian snakes, which is by far the most complete collection of its kind ever assembled. The Department of Geology has acquired by purchase a skeleton of the short-legged rhinoceros *Teleoceras fossiger* from the Pliocene of Kansas, U.S.A. An important addition to the collection of meteorites is a fine mass of meteoric iron weighing 299 lb. and forming a complete individual mass, from South-West Africa. This was one of some thirty masses weighing about ten tons displayed in the Public Garden at Windhoek. These had been collected from the desert in the neighbourhood of Gibeon in Great Namaqualand, where in prehistoric times there must have been a terrific shower of enormous masses of iron. Another valuable donation to the Department of Mineralogy is a magnificent group of large crystals of melanterite (iron vitriol) found in ancient workings in the Skouriotissa mine, Cyprus. Mr. R. Crawshay has presented to the Department of Botany 167 crayon drawings of *Russula*. *Russula* is a genus of Agaricaceae (toadstools) which is characterised by the bright colours of its cap and the clearly cut, paper-like gills. Mr. Crawshay has just published a book, "Spore Ornamentation of the Russulas", in which a classification of the species on the basis of the spore characters has been fully worked out. In this work it was impossible to publish drawings of the fungi which were examined, and consequently the original drawings have an additional value.

As a memorial to the late Sir George Beilby, the distinguished chemical engineer, who died in 1924, a

fund was collected in 1926 from the interest on which, at the discretion of the administrators, awards are to be made from time to time to British investigators in science, to mark appreciation of distinguished original work carried out over a number of years, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy. The administrators of the fund have announced the award of £250 each to Dr. Guy D. Bengough, of the Chemical Research Laboratory, Teddington, and Mr. Ulick R. Evans, of Cambridge. The administrators of the fund are the presidents, treasurers, and secretaries of the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals.

THE thirty-ninth annual report of the Council of The Institution of Mining and Metallurgy records the following awards which were presented at the annual general meeting on June 26. The gold medal of the Institution to Sir Thomas H. Holland, in recognition of his distinguished services to geological science and to the mineral industries during his tenure of high public appointments—notably those of director of the Geological Survey of India and of rector of the Imperial College of Science and Technology —and of his researches and publications upon the mineral resources of the British Empire and their relationship and national and international problems. 'The Consolidated Gold Fields of South Africa, Ltd.' premium of forty guineas to J. B. Richardson, for his paper on "The Importance of Recovered or 'Secondary' Tin". The 'William Frecheville' Student's Prize of ten guineas to A. Bray, for his "Notes on the Banket Reefs of the Gold Coast Colony". The 'Arthur S. Dwight' post-graduate travelling grant of two hundred guineas to W. D. Jones. In accordance with the conditions of the grant, Mr. Jones proceeded to the United States in October, where he spent about three months in the study of metallurgical plants and in making personal contacts with operating men. Since his return to England he has submitted to the Council an exhaustive report of his visit. A special grant of £50 from the 'Post-Graduate Grants Fund' of the Institution to S. R. B. Cooke, to enable him to proceed to British Columbia to gain practical experience. The grant was made on the nomination of Prof. James Park, dean of the faculty of mining and economic geology of the University of Otago, New Zealand.

THE University of Freiburg has conferred the honorary degree of doctor of natural philosophy upon Dr. F. W. Aston in recognition of his work on isotopes and other subjects.

AN interesting innovation has been introduced into the advance proofs of papers recently circulated by the Physical Society. Wherever a mathematical symbol occurs for the first time, or is defined, the symbol is noted in the margin. Thus any reader who wishes to find quickly what the symbol denotes has only to run his eye up the margin, a far more rapid process than is sometimes necessary in scientific papers.

A PROVISIONAL programme of the fourth World's Poultry Congress, to be held at the Crystal Palace on July 22–30, has just been issued. The congress is being organised by the Ministry of Agriculture and Fisheries, in conjunction with the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland, and fifty-six countries, ranging alphabetically from Argentina to Yugo-Slavia, are taking part in it. The programme contains a short account of the objects of the congress, a list, with many photographs, of the personnel of the national committees, and a diary of the daily sessions. The papers to be read at the morning meetings are extraordinarily numerous and comprehensive, but the provision of many afternoon and evening entertainments and a post-congress tour suggest that there is no danger of making Jack and Jill dull children. The fee for full membership of the congress is £2 : 2s. for each member from the United Kingdom, and half that amount for wives and relatives of members.

A CORRESPONDENT directs our attention to an experiment described in a recently published school book on chemistry, in which metallic mercury is to be heated in a crucible. This would have the effect of volatilising the mercury, and if the experiment were performed by a number of pupils in a school laboratory the effects might be very serious. Teachers are reminded that the poisonous effects of mercury vapour were recently emphasised by Prof. Stock, and they are warned that such experiments as that just described should never be carried out in school laboratories.

MESSRS. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1, have just issued a handy list of current works on engineering—electrical, civil, and mechanical —which many readers should find serviceable.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A director of education for the County Borough of Middlesbrough—The Town Clerk, Municipal Buildings, Middlesbrough (July 8). An assistant lecturer in agricultural engineering in the University of Leeds —The Registrar, The University, Leeds (July 12). An assistant instructor in dairying at the British Dairy Institute—The Secretary, British Dairy Institute, The University, Reading (July 12). An agricultural education officer under the Isle of Wight County Council Education Committee—The Director of Education, County Hall, Newport, I.W. (July [illegible]). A bacteriologist at the Government Lymph Establishment, Hendon—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (July 14). An assistant lecturer in geography in the University of Leeds—The Registrar, The University, Leeds (July [illegible]). An assistant lecturer in organic chemistry at the University College of North Wales, Bangor—The Registrar, University College of North Wales, Ban[illegible]

(July 14). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (July 19). An assistant works manager of the Metal and Steel Factory, Ishapore, India—The Secretary, Military Department, India Office, S.W.1 (July 19). Three research fellows in the Department of Glass Technology of the University of Sheffield—The Registrar, The University, Sheffield (July 19). An assistant plant pathologist under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 21). An inspector of agriculture under the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 21). An assistant lecturer in the Department of Zoology of King's College, London—The Secretary, King's College, Strand, W.C.2 (July 21). A research physicist in the Department of Glass Technology of the University of Sheffield—The Registrar, The University, Sheffield (July 21). A lecturer in botany and assistant lecturers in pharmacy and chemistry at Robert Gordon's Colleges, Aberdeen—The Secretary and Registrar, Robert Gordon's Colleges, Aberdeen (July 23). A research demonstrator in the division of biochemistry of the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (July 24). A student probationer (zoologist, botanist, or physiologist) at the Marine Biological Laboratory, Plymouth—The Director, Marine Biological Laboratory, Plymouth (July 30). A professor of education in the Rhodes University College, University of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (July 31). An assistant professor of anatomy in the University of Manitoba—The Dean of the Faculty of Medicine, Medical College, Winnipeg, Canada (Aug. 8). A woman demonstrator and assistant lecturer in chemistry at Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (Aug. 30). A Smartt memorial scholar in the University of Cape Town, for research in subjects bearing upon agriculture—The High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Sept. 30). A principal of the Aston Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham (Sept. 30). Assistant lecturers and advisers in, respectively, agriculture, dairy husbandry, and horticulture, under the Bucks Agricultural Committee—The Agricultural Organiser, County Offices, Aylesbury. A lecturer in agricultural bacteriology in the University of Reading—The Registrar, The University, Reading.

ERRATUM.—June 28, vol. 125, page 967, col. 2, line 5 from end, for W. E. Beaton read W. E. Benton.

Our Astronomical Column.

Comets. Prof. H. E. Wood has computed the following parabolic orbit for Forbes's comet, 1930*e*:

T	1930 May 10·588 U.T.	
	321° 8′	1930·0
☊	278 13	1930·0
i	97 15	1930·0
log q	0·06183	

The following orbit of comet 1930*d* is by Dr. A. C. D. Crommelin from observations on May 2, 12, 22 (*B.A.A. Circ.* 95); it represents an observation of June 3 within a few seconds of arc:

T	1930 June 14·1826 U.T.	
ω	192° 18′ 18·92″	1930·0
☊	76 47 11·54	1930·0
i	17 24 34·76	1930·0
ϕ	42 21 25·37	
log a	0·4913883	
log q	0·0049406	
Period	5·458614 years.	

Mr. Blathwayte, of Johannesburg, who had not heard of the discovery of the comet, picked it up as a new comet on June 3; it is the second time that he has taken a known comet for a new one; he has also [dis]covered two comets that were really new. Comet [...] now too far south for European observers, but [will] be followed in the southern hemisphere for some [time]: it approached the earth within 4 million miles [early] in June; this seems to be the third closest approach on record. No news is yet to hand of [met]eors associated with the comet having been [...]

The Planet Pluto. Diligent search of old plates at Mount Wilson observatory has revealed four images that undoubtedly belong to Pluto on plates taken in December 1919 (*U.A.I. Circ.* No. 289). As they are situated within some 6 minutes of arc of positions calculated with the aid of the Uccle observation of January 1927, and as the mean daily motion (−5·14$^{sec.}$ in R.A. 6·8″ in decl.) is also in close accord with that calculated, the identity of the Uccle image with Pluto is also confirmed. The mean of the four positions was telegraphed as follows:

U.T. 1919.	R.A.	N.Decl. 1930·0.	Mag.
Dec. 29·0667	$6^h\ 29^m\ 3{\cdot}8^s$	19° 21′ 56″	19

There is probably some error in the telegraphed magnitude: it would be expected to be about 16.

U.A.I. Circ. 289 gives the following orbit of Pluto calculated by Nicholson and Mayall from observations in 1919 and 1930 (the 1927 position was not used).

T	1988 June 5·5 U.T.	
ω	111° 46′	1930·0.
☊	109 22	1930·0.
i	17 9	1930·0.
log a	1·60071.	
Period	251·86 years.	
e	0·2575.	

The perihelion distance is 29·61, which is slightly inside the orbit of Neptune. Owing to the high inclination, the two orbits do not approach each other within some four units. It will now be possible to make a trustworthy ephemeris of Pluto back to the beginning of the century, so that any other images that may be present on old plates should be identified with tolerable ease.

Research Items.

The Mound Builders of the Central Southern United States.—Mr. Warren K. Moorehead communicated to the Congress on Mid-Western Archæology held at St. Louis in 1929 a brief study of the mound-culture of the Mississippi Valley which has now been published in *Bull. 74 of the National Research Council of Washington.* Within the area of some twenty States several mound-building cultures are to be distinguished. The general custom of mound-building extends between the great plains and the Hudson. In a territory of 600 to 800 miles in extent mound art is highly developed, especially in certain places. An attempt to arrange the various mound cultures according to their status in cultural development suggests the following order: the Hopewell culture of the lower Scioto Valley, the Etowah culture of Northern Georgia and the Tennessee-Cumberland valleys, "Fort Ancient", the average village population of the Kanawha, Illinois, Arkansas, Wabash, Savannah, and other valleys, the Central Illinois Valley culture, and the Florida-South Georgia culture. As regards the origins of the Hopewell culture, it is suggested that a band of very early Algonkin reached or originated in eastern Iowa, one branch may have passed up into Wisconsin, the other proceeded eastward through Illinois and Indiana to Central Ohio, building mounds as they went. On reaching the Scioto Valley they became sedentary and attained the culmination of the Hopewell development. As regards the ultimate origin it is to be noted that Mrs. Nuttal has found seven detailed comparisons between early Toltec art and the Etowah culture.

Pleistocene Man in Ireland. Important work of excavation carried out by members of the Spelæological Society of the University of Bristol in caves in the South of Ireland is recorded in the *Proceedings* of the Society for the year 1929. The excavations, which were carried out in the summer of 1928, resulted in a discovery of no little importance for the history of early man in Ireland. They were undertaken with the view of obtaining material for comparison with results obtained by the Society in the Mendip caves—Aveline's Hole and others. Several caves in the neighbourhood of Dungarvan, Co. Waterford, were examined; but in one only, that of Kilgrany, was it found that any results were likely to be obtained. The area in which the caves are situated lies beyond that covered by the southern Irish moraine and was therefore uncovered in late Pleistocene times, when Ireland was probably joined to Britain. Excavation was carried to a depth of twelve feet from the original surface of the cave. In a stratification of several horizons, hearths were discovered in the second and fourth strata, and beneath the latter was stalagmite which showed an unbroken surface. Beneath a tufaceous portion of the stalagmite was a third hearth associated with a late Pleistocene fauna. In removing the tufaceous portion human remains were brought to light, which careful clearing revealed had been placed in a kneeling position with the left side resting against the wall of the cave. The body had then been surrounded and covered with stones which kept it in a kneeling and upright position. Prof. Fawcett, who has made a careful examination of the bones, pronounces them to be those of a male, 4 feet 7 inches in height. The skull is long, low, and with a pentagonal appearance from behind, recalling one of the Cro-Magnon features. On the whole, it is of Mediterranean type. Although no artefacts were found which would indicate a cultural horizon, there can be no question that the remains are the first of Pleiocene man to be discovered in Ireland.

Fungus Spores in Urine in Disease.—Some phenomena discussed in a paper by Toshio Ohue in the *Science Reports of the Tohoku Imperial University,* Sendai, Vol. 5, No. 1, as to the association of a fungus with a case of meningitis, are distinctly puzzling and deserve fuller elucidation. The spores of the fungus were found in the urine and cerebrospinal fluid of the patient; they were grown on in pure culture and the fungus is identified provisionally as *Alternaria tenuis* Nees. The fungus was also isolated from the dried persimmons which had been eaten by the patient a short time before his sudden illness. When cultures of this fungus were fed to animals it proved pathogenic to a marked degree to guinea-pigs, rabbits, and albino-rats, though in these animals the lungs are the organ chiefly affected, whilst in man the brain was attacked, the lungs showing little alteration. Comparison of the toxic action of cultures with spores and of ultra-filtrates of the bouillon cultures of the fungus suggested that the pathogenicity of the fungus is due primarily to the large spores (7-35 μ long by 7-12 μ broad). The mechanism by which the spores found their way to the urine is still in need of elucidation.

Iron Bacteria.—A very thorough study of these specialised micro-organisms appears to have been made by I. Turowska at various Polish stations, and is reported upon in the *Bulletin International de l'Académie Polonaise,* Cl. des Sc. Math. et Nat. No. 8-10, B.1, pp. 255-282, 1929. Organisms of the genera *Leptothrix, Gallionella,* and *Sideromonas* are studied. They require a certain amount of iron in the water, but more in sunlight, because the iron then tends to be precipitated more readily, less when the pH is near neutrality than at pH 6 for the same reason. Also, in saline waters they do not develop even when the iron content of the water is considerable, presumably because of the reaction of other salts present with the iron. The author attributes to the absence of solar radiation the frequent development of the iron bacteria in pipes even when the iron content of the water supply is low.

The Identification of Hair.—In an article entitled "Circumstantial Evidence from Hairs and Fibres" in the issue of *Chemistry and Industry* for May 30, Dr. C. Ainsworth Mitchell discusses the question of the identification of human hair and the hair of various animals, as well as the fibres of fabrics, from the point of view of legal evidence. The article contains many points of general biological interest as well as information of legal interest.

Inheritance in Fowls.—Frizzled fowls were known in Italy so early as the year 1600. They apparently came from the East, and in the eighteenth century were cited as occurring domesticated in southern Asia and the Philippines, Mauritius, and Mozambique. The feathers curl backwards; the barbs are also curled and later wear off, leaving the feather bare. Probably the skin was originally black. Mr. F. B. Hutt has made an investigation (*Jour. Genetics,* vol. 22, No. 1) of the current belief that frizzle fowls do not breed true and that the homozygous condition is lethal. His results show that the case is parallel to that of the blue Andalusians. Homozygous birds are viable, but they show the frizzled condition of the feathers in a more extreme form than the heterozygotes. The latter are preferred in the fancy, and so only such birds are usually found. When crossed with normally feathered fowls they gave a 1 : 1 ratio of normals and heterozygous frizzled. From this and other

evidence it is shown that the frizzled character is conditioned by a single non-sex-linked Mendelian factor, which is dominant, as are so many other factors in domestic breeds of fowls. In the same number Messrs. L. C. Dunn and Walter Landauer have shown from crosses of silky and white Leghorn fowls that the genes for dominant white, cerebral hernia and polyldactyly are located in the same linkage group or chromosome, the two former very near together and polydactyly some distance away, since it shows loose linkage with the other two.

Sardine Fishing in California. Mr. W. L. Scofield, of the Bureau of Commercial Fisheries, gives a detailed account of the methods used in the sardine fishery in "Sardine Fishing Methods at Monterey, California" (Division of Fish and Game of California. *Fish Bulletin* No. 19. Contribution No. 84 from the California State Fisheries Laboratory, March 1929.) The California Sardine *Sardinia cærulea* is very important commercially, occurring in shoals in enormous numbers. Great skill is needed in picking out those of the right size and much depends on the judgment of the captains of the boats. The schools are located by the luminescence produced by their movements. This can be seen readily on a dark night, and therefore the fishing is almost entirely confined to the night hours when the moon is not shining. A description of the Monterey fishery is given which can be used as a basis for judging future changes in the conduct of the industry. This includes fishing gear, fishing methods, notes on markets and canneries, besides general knowledge of the fishing-grounds. The bulletin is illustrated freely with diagrams and photographs, and embraces a large amount of useful information.

Copepods and Mites from the Philippines. Copepods from Central Luzon described by P. A. Chappuis (Harpacticoids), Friedrich Kiefer (Calanoids and Cyclopoids), and Hydracarina by C. Walter, include new species and sub-species (*Philippine Journal of Science*, February 1930). They are of interest because their region is almost unworked for these groups. Among the Harpacticoida new sub-species of *Nitocra platypus* and *Canthocamptus bidens* are recorded and a new species of *Diaptomus*, *D. sensibilis*. In the Cyclopoida a new variety or sub-species of *Mesocyclops leuckarti* was very abundant and also *Mesocyclops hyalinus*; a form belonging to the *Cyclops varicans* group was also present. All these are widely distributed species. Three mites are described, two of which are new species, *Limneria bakeri* and *Neumania flagellata*, whilst the third, represented by one ovigerous female, belongs to the Sumatran species *Neumania ambigua* Piersig.

Insects of Samoa and of South America.—Two publications of the British Museum (Natural History), more especially of interest to entomologists, have recently come to hand. Both are continuations of monographs which have already been alluded to on several occasions in our columns. The "Insects of Samoa" receives further contributions from Mr. J. R. Malloch, of the U.S. Bureau of Biological Survey, which form Part 6, Fasc. 5 of that publication. They deal with the Dipterous families Ortalidæ and Calliphoridæ. The "Diptera of Patagonia and South Chile" has reached Part 5, Fasc. 1, which is devoted to a description of flies of the family Dolichopodidæ from that region. Its author, Mr. M. C. Van Duzee, of Buffalo, U.S.A., describes a number of new genera and species of the family concerning which practically nothing was previously known from this part of South America. The two publications bear the date 1930 and, like all which emanate from the British Museum, are well printed and clearly illustrated.

Physiological Studies of the Swede.—Numerous studies of the sugar content of such 'root' crops as swedes, mangels, and beet have suggested that the sugar content is by no means uniformly distributed throughout the swollen storage organ. Mr. J. Caldwell has now carried the problem a stage farther in that, by numerous measurements and some simple experiments, he has shown that the increase in girth of the storage organ is different in north, south, east, and west directions, and that this different increase is closely correlated with the activity of the leaves above (*Proceedings Roy. Soc. of Edinburgh*, **50**, 130-141; 1929-30). Mr. Caldwell concludes, mainly as the result of observations of plants upon which all leaves on one quadrant of the shoot are removed, that this correlation is explained by the movement of food downwards into the swollen axis from the leaves above. It is desirable, however, to bear in mind the earlier observations of Jost which have shown the dependence of radial growth in the axis upon leaf development above, quite irrespective, apparently, of whether the leaf was sending food supplies downwards into a storage organ.

Anatomy of Grass Roots.—Dr. M. Henrici has some very interesting notes on this subject in *Science Bulletin*, No. 85, of the Department of Agriculture, South Africa, 1929. In the course of investigations near Vryburg, in British Bechuanaland, and in Ermelo in the eastern Transvaal, he had occasion to study the anatomy of a number of the native grass roots. He found these to fall into two types, one thin and fibrous and branched, the other more swollen, with a looser cortex and less branched. The same types of roots have been described by Brenchley and Jackson at Rothamsted and by other workers, but Henrici's observations, in a new area, are very extensive and seem to add some new facts. He points out that the fatter and less sclerenchymatous type of root may turn up upon the same plant that previously formed the fibrous roots and that its formation was associated with the annual rains. He describes the thickening of the cortex by tangential divisions in the layers lying just outside the endodermis, and adds the interesting note that in some roots in successive seasons there may be successive bursts of this growth activity. In the outer cortex, these roots develop large intercellular spaces traversed by radial plates of tissue; Henrici points out that whilst this structure might have value as a type of aerenchyma, under South African conditions such an adaptation often had little significance; on the other hand, he notes that roots of this type of organisation seem to retain water better when, as so frequently happens, the soil is dry over long periods.

Factors Favouring Fruit Production.—Whilst the necessity of intermingling varieties if a good crop is to be obtained in an orchard mainly planted with a self-sterile variety forms the main theme of *Bulletin* 497 (December 1929) of the Cornell University Agricultural Experimental Station, written by L. H. MacDaniels and A. J. Heinicke, the pamphlet is a very interesting example of how scientific and comprehensive the American experiment station worker can venture to make an exposition of a practical problem in horticulture. The main facts as to pollination and fertilisation of flowers are simply explained and then the results are given of various pollination experiments between different varieties of fruit, most of the work being done with apple. These experiments seem to show that under the New York conditions the Delicious apple is one of the best pollinisers, and Baldwin, with pollen of poor germinating quality, one of the least satisfactory. The discussion

of this special problem is then followed by a comparison of fruit-bearing on spurs and upon long shoots, and with an indication of the influence of the water supply at different seasons upon the processes of flower-bud formation and of flower and fruit development. The *Bulletin* is very effectively illustrated and seems a very good example of the way in which an experiment station may make the significance of its labours intelligible to the horticultural public it tries to serve. V. R. Gardner discusses some similar problems in Special *Bulletin* No. 195 (March 1930) of the Agricultural Experiment Station of the Michigan State College upon "maintaining the productivity of cherry trees". This pamphlet will interest some horticulturalists because of its close scrutiny of the value of the practice of pruning, or otherwise treating the trees, so as to obtain most of the fruit upon spurs. Whilst this practice may be justified in Madison because the spur buds are hardier, under Michigan conditions it would seem that it can easily be carried too far and militate against the general growth and total yield of the trees.

Carboniferous Fossils of Tibet.—The late Sir Henry Hayden collected fossils from the west and north-west of Lhasa where no geological observations had previously been made. These have been described by Dr. F. R. C. Reed (*Palæont. Indica*, N.S., **16**, 1930) and comprise Foraminifera, corals, brachiopods, polyzoa, and mollusca. The brachiopods are almost without exception known from the Upper Carboniferous of the Urals or from parts of Asia, and the prevalence of the foraminifer *Schwagerina princeps* suggests that the age is Uralian.

Anatomy of *Mysorella Costigera*.—The example set by the Zoological Survey of India of small monographs on the fresh-water gastropod mollusca of India as a basis for the accurate determination of those species, if any, that act as the intermediate hosts of internal parasites inimical to man, has borne fruit in the production of a paper on the anatomy of *Mysorella costigera* Kuster (*Records Indian Mus.*, vol. 32). The author, R. V. Seshaiya, of the Merchant's High School, Tirupati, gives a very full and careful description of this small hydrobiid mollusc, its habits and anatomy, with abundant illustrations, that cannot fail to be of great use to future workers in the same field, but abstains from drawing any general conclusions to which his researches may have led him.

Superconductivity in Compounds.—The property possessed by some substances of losing all electrical resistance at very low temperature, which, until Prof. W. Meissner discovered it in copper sulphide, was known to occur only with metals, has now been observed by him and H. Franz in some other compounds (*Die Naturwissenschaften*, May 9, p. 418). The new superconductors are titanium nitride, vanadium nitride, the carbides of molybdenum, niobium, and tantalum, and probably also titanium carbide. The nitrides become superconductors at about 1·2° Abs., molybdenum carbide at about 7°, tantalum carbide at 9°, and niobium carbide at 10°. Some oxides were also examined, but none was found to be superconducting. Niobium carbide exhibits the phenomenon at a higher temperature than any other known substance, the nearest to it being Rose's alloy of lead, tin, and bismuth, which was found by Prof. McLennan to have a transition temperature of 8·5° (see NATURE, vol. 125, p. 447; 1930).

Photo-Conductance in Silver Halides.—An attempt to arrive at the mechanism of formation of the latent photographic image is described by F. C. Toy and G. B. Harrison in two papers in the June number of the *Proceedings of the Royal Society*, on photo-conductance phenomena in silver halides. Some silver bromide was set up in an apparatus in which the changes of its electrical conductivity which occur on exposure to light could be studied at short intervals after illumination started. So long as no permanent decomposition was permitted to take place, it was found that the photo-current (an *internal* current through the crystals) started to flow practically at the instant of illumination, and rose to a constant final value, proportional to the intensity of the light, within a few hundredths of a second. This conductivity had the metallic property of increasing with a decrease in temperature below − 150° C., whereas the current flowing in the dark, which is probably due to an electrolytic movement of silver ions, fell off as the temperature was diminished. The photo-current can thus be reasonably ascribed to electrons. The view taken by these investigators is that when silver bromide is exposed to light, some bromine ions are changed to neutral atoms by the photoelectric process, and are then able to react with neighbouring molecules, such as those of gelatin, leaving the silver atoms with which they were originally paired effectively free.

Electrical Transmission of Pictures.—There are many honoured customs in Japan the origins of which are lost in the mists of antiquity. None is considered of greater importance by the people than the series of impressive ceremonies marking the accession to the throne of a new Emperor. In a paper read to the World Engineering Congress at Tokyo on Oct. 31, 1929, and published in *Electrical Communication* for April last, Y. Niwa describes a new system for the electrical transmission of pictures. This system was used to inform the Japanese of the progress of the Coronation ceremonies in November 1928. During the twenty-two days which elapsed between the Emperor's departure for Kyoto and his return to Tokyo, the number of pictures transmitted by the Niwa system between Tokyo and Osaka, a distance of 236 miles, amounted to two hundred and fifty three. The bulk of these pictures were reproduced in the newspapers. As an example of the rapidity of the transmission the following example is given. As the imperial procession and the imperial carriage were moving across the Double Bridge at Tokyo at 7.10 A.M., they were photographed. At 8 o'clock, less than an hour later, the pictures were received in Osaka. At 9.30 A.M. they were published in a four-page supplement of the *Osaka Daily News* (*Mainichi Shimbun*). As in most of the other picture transmission systems at present in use, the picture to be transmitted and the receiving film are wrapped respectively around drums which are made to rotate synchronously and at the same time are pushed forward in an axial direction. At the transmitting end a toothed rotating disc is used to interrupt the light emanating from a source. The pulsating light produced is projected on the picture and reflected to a photo-electric cell, and the electric currents are conveyed by overhead lines and telephone cables to the receiving end. The signals can also be transmitted by radio.

Solubility of Gold in Mercury.—Accounts in the literature on the solubility of gold in mercury are misleading, and it has even been stated that "gold is miscible with mercury in all proportions". In a paper in the May number of the *Journal of the American Chemical Society*, Sunier and White show that the solubility is quite small, about 0·1306 atomic per cent at 20°, or 100 lb. of mercury dissolve about 2 ounces of gold. The amalgamation process for the extraction of gold really depends on surface adhesion.

Agricultural Meteorology.*

THE meeting of the Commission of Agricultural Meteorology of the International Meteorological Organisation at Copenhagen immediately after the Agricultural Section of the Conference of Empire Meteorologists in London testifies to the interest now being taken in that subject.

The problems of agricultural meteorology would seem capable of division into two broad classes, macrocosmic and microcosmic. In the first, we study the influence of weather on crop yields on a large scale, seeking to fill in the general lines of a broad picture by studying recorded crop and weather data over as many years as possible and using statistical methods to determine their interrelations. In the second, the physiological reactions of the plant to the principal weather factors in plant growth—light, heat, and moisture—are considered in detail by a careful study of particular phenomena in plant growth under the completely controlled conditions of the laboratory or in a small-scale field experiment where as many conditions are controlled as possible.

The macrocosmic problem is the especial province of the statistician, and since the pioneer work of Hooker many studies have been published all over the world on the correlation of weather and crops. One might instance the work of Moore, Bradford Smith, and Kincer in America, the very fine work of Wallén, the president of the Copenhagen Conference in Sweden, and Fisher's work in Great Britain, which has effected a very great improvement in the statistical technique employed, by enabling us to relate crop yields to a continuous sequence of weather instead of merely to weather at isolated periods. The importance of this in crop-forecasting is very great.

Important as the distinction is between the two methods of approach, however, they must not be regarded as being entirely unrelated. Valuable as it is to know the degree to which crop yields depend on particular meteorological variates such as rainfall or sunshine, we cannot use our knowledge to the greatest advantage without knowing the reasons for these relations, and these can only be discovered by the microcosmic method.

The position is being rapidly reached to-day in which the statistician who has discovered the existence of interrelations by the large-scale method is also consulted on the planning of detailed experiments by which the reason for these relations may be discovered. For example, under the "Agricultural Meteorological Scheme" of the Ministry of Agriculture, "Precision Record" experiments on wheat are being conducted at several centres on two varieties of wheat. Great care has been taken to use the modern principles of randomisation and replication to ensure valid results, and each time a set of observations is taken, 256 randomly chosen ¼ metre lengths, 128 of each variety, are examined, and measurements of shoot height and counts of leaf number, shoot number, and number of emerged ears are made. In a word, accurate measurements of growth are being obtained, and it is hoped that when the data have been continued over a sufficient number of years, some of the known relations between wheat yields and weather may become explicable in terms of the previous growth of the plant. It is to be hoped that these methods will be greatly extended in the future.

While meteorological data have usually been considered accurate enough for the large-scale correlation of weather and crops, there is an influential body of opinion which considers that the meteorological data at present collected are inadequate for the intensive and detailed study of weather effects on growth phenomena. Thus at the London Conference we find one delegate (Lawrence Balls) saying, "The meteorology recorded in the field crop, that which the plants themselves are experiencing, is not that recorded in the screen. In Egypt at night you can get as much as 5° C. lower temperature, lasting for perhaps only a few minutes, among the plants, than in the neighbouring screen. Then again the question of soil temperature is important. The temperature of the soil in fallow land is very considerably higher than the temperature of soil under the crop." Another delegate (Walter) said: "In the case of wind the effect on plant growth is evidently a function, not only of the age of the plant, but of the duration of high velocities and the change of direction during the period of specified wind velocities. None of these factors is made available for the research worker in the records of the various observatories as usually published."

Again, at Copenhagen we find Angström saying, "Measurements of temperature in the lowest layers of the air, in conjunction with the meteorologico-agricultural problems, ought, it would seem, to be primarily directed towards making clear the connexion between the nature and the quality of the vegetation on the one hand, and the distribution of the temperature in the lower layers of the air on the other". M. Angstrom then goes on to outline the instrumental technique necessary for this purpose. Much the same view is expressed by M. W. Schmidt: "Although plant growth depends so much on weather, there nevertheless exists to-day a huge hiatus between what the agriculturist needs and what the meteorology and climatology provide. . . . Special methods are necessary for this purpose, which relate to the whole life-environment of the plant, that is, the lowest layers of the air and the uppermost layers of the ground—fine measurements which demand a special apparatus." We find other delegates at Copenhagen expressing the same opinion.

Another point of great interest which was discussed both in London and at Copenhagen was Sir Napier Shaw's proposal that the week should be used as a time unit in meteorology. This resulted in a resolution at the London Conference that "In the opinion of the Conference the month is too long a period for the purpose of summarising, for publication, statistics of agricultural meteorology, and the Conference recommends that the week be adopted for the purpose". The Copenhagen Conference was a little more noncommittal: "La Commission attire l'attention des météorologistes sur la proposition de Sir Napier Shaw et recommande d'éprouver dans certaines recherches, la valeur d'emploi de la semaine comme unité climatologique, de manière à reconnaître par l'expérience si l'emploi généralisé de cette unité est convenable".

It is probably true that while the week is a great improvement on the month, there will always be purposes for which individual research workers will require the original observations taken at daily or, it may be, more frequent intervals.

It is not possible in a short article to deal exhaustively with the whole proceedings of the Copenhagen Conference, but one should not conclude without mentioning Holdefleiss's résumé of the work done in Germany on the correlation of crop yields and weather, which seems to follow on the same lines as similar work already done in England and America, and Åkerman's account of what appears to be the very fine work at Svalöf on the study of the relative resistance to frost of different varieties of wheat, a combination of field experiments and of laboratory work in which plants are subjected to cold artificially produced.

J. O. IRWIN.

* Commission de Météorologie Agricole. Procès-Verbaux de la 3ème Réunion, Copenhagen, 1929.

Mutations Induced by X-Rays.

THE effects of X-rays and radium in producing mutations in various economic plants are being studied at the University of Missouri by Dr. L. J. Stadler and others. A general account of this work appears in the *Journal of Heredity* for January last. Dormant and germinating seeds of barley were treated in this way, and the self-fertilised progeny grown separately from the seeds of each head or tiller of a treated plant. Usually only a single culm from each plant has been affected in the primordial stage. Its seeds produce progeny which segregate, thus revealing the recessive character produced by the mutation resulting from X-ray bombardment.

Among 2800 progenies from treated plants, 53 mutations were found, 48 of which were recognisable as seedlings, while 1500 controls produced no mutations. Later, among 20,000 head progenies of treated barley, some 250 mutations were found. These were mainly chlorophyll abnormalities. About 60 per cent of the latter were white, 5 per cent virescent white, and 15 per cent yellow of various shades. They are mostly lethal, and probably represent mutations at many different *loci* in the chromosomes. A few other mutations, such as pale green, non-glaucous or winter barley habit, were found in progenies grown to maturity.

In all these cases, the mutation apparently consists in a change of a dominant (normal) gene to a recessive one in a somatic cell of the embryo or young seedling. In contrast to the frequency of induced mutation in barley, which is diploid ($2n$ 14), they were rare in similar experiments with wheat and oats. This is probably because the latter are hexaploid and the mutations would therefore probably be masked by the normal genes contained in the duplicate pairs of similar chromosomes.

The same method applied to maize produced similar results. Since a single cell of the embryo mutates, a mutation affecting either the tassel or the ear results in the production of heterozygous plants in the second generation, and segregation only in the third. When young growing embryos which are heterozygous are irradiated, the resulting plant may be a chimæra. A plant heterozygous for purple plant colour may have a sector of green tissue. Treatment applied even on the sixth day after pollination may produce chimæras, but from treatment on the first or second day there result plants entirely recessive for a character heterozygous in the seed.

It was found that dormant seeds would withstand a dose fifteen to twenty times heavier than germinating seeds, and that the resulting mutation rate was roughly proportional to the strength of dosage. Storing irradiated seeds for two weeks before planting did not affect the percentage of mutations. Germinating seeds irradiated at temperatures of 10°, 20°, 30°, 40°, and 50° C. also showed no significant difference in mutation rate.

In maize, endosperm chimæras or mosaics were produced, which Emerson has shown are due to chromosome disturbance, that is, to the loss of a chromosome or a portion of one. These losses can be detected when the dominant gene is derived from the male nucleus, for its loss will reveal in the cell the presence of the recessive gene represented in both female nuclei of the triple fusion from which the endosperm is formed.

Maize has ten pairs of chromosomes, and the loss of seven of them can be identified in endosperm mosaics by the genes which they carry. Certain chromosomes or genes appear to be lost much more readily than others. When maize seeds are treated on the day after fertilisation, numerous small mosaic spots appear showing the recessive characters. If the treatment is applied on the fifth day, the spots are so small that the seeds appear stippled and their nature can only be examined with a magnifier. Such treatment also produces chromosome irregularities in the young embryo. The resulting plants may (1) be defective, (2) have 50 per cent defective pollen, (3) show recessive characters for which the treated seeds were heterozygous.

The method is also being applied to the production of bud mutations in the apple. As apple trees are highly heterozygous hybrids in which breeding results are very slow, it appears probable that the application of the method to fruit trees may be of more economic importance than it is in the case of cereals, where natural mutation has already produced great numbers of types for selection and crossing.

R. RUGGLES GATES.

University and Educational Intelligence.

CAMBRIDGE.—Frank Smart prizes have been awarded to E. W. Jones, Jesus College, in botany, and to W. J. Hensman, Trinity Hall, in zoology.

In connexion with the International Botanical Congress, which is to be held in Cambridge in August next, it has been decided to confer honorary degrees on the following: John-Isaac Briquet, director of the Conservatory and Botanic Garden, Geneva; Pierre Augustin Clément Dangeard, professor of botany at the Sorbonne; Friedrich Ludwig Emil Diels, professor at the University of Berlin and director-general of the Botanic Garden and Museum at Berlin-Dahlem; Thore Gustaf Halle, professor and keeper of the Palæo-botanical Department of the Swedish State Museum of Natural History, Stockholm; Lewis Ralph Jones, professor of plant pathology at the University of Wisconsin; Carl Joseph Schroter, emeritus professor of botany at the Technical University of Zurich; Friedrich August Ferdinand Christian Went, professor of botany and director of the Botanic Garden and Laboratory of the University of Utrecht.

EDINBURGH.—The University Court has approved of the institution of a post-graduate diploma in German. It has also agreed to institute a diploma in tropical veterinary medicine. The course for this diploma, which will be held partly at the University and partly at the Royal (Dick) Veterinary College, will occupy six months (October to March) and will commence this year. The curriculum will include classes in parasitology and entomology, bacteriology, meat and milk production, feeding of animals, breeding of animals, epizootology, and a number of special lectures and demonstrations in subjects of special interest to tropical veterinary surgeons.

LONDON.—Dr. J. Scott Lidgett has been elected vice-chancellor for the year 1930-31 in succession to Sir Gregory Foster, Bart., whose term of office expires on Aug. 31. Mr. J. L. S. Hatton, principal of the East London College, has been appointed deputy vice-chancellor for the same period in succession to Dr. Scott Lidgett.

New professors have been appointed to University chairs as follows: *Bacteriology* (University College Hospital Medical School), Mr. C. Cyril Okell; *Chemistry* (University College), Prof. C. K. Ingold, now Professor of organic chemistry in the University of Leeds: *Geography* (Birkbeck College), Miss E. G. R. Taylor: *Physics* (Imperial College—Royal College of Science), Prof. G. P. Thomson, now professor of natural philosophy in the University of Aberdeen.

Mr. H. R. Hamley has been appointed to the University readership in education tenable at the London Day Training College.

OXFORD.—At the Encænia held on June 25 in the Sheldonian Theatre, the honorary degree of D.C.L. was conferred on Sir Hugh Bell, Bart., and that of D.Sc. on Sir Arthur Keith. In presenting Sir Hugh Bell, the Public Orator, Dr. A. B. Poynton, alluded to his eminence in the coal and iron industries, to the widespread influence exercised by his speeches and letters to the Press, to his unceasing advocacy of the principle of free trade, and to the eminent services rendered to the State by the eloquence, insight, and wisdom of his public utterances. Introducing Sir Arthur Keith, the Orator enlarged upon his skill as a great anatomist in disentangling the relationships of the various species and races of primitive man as disclosed by their osseous relics. The fineness of the transition between different races was illustrated by an apt quotation from the "Metamorphoses" of Ovid. His investigation of origins, said Dr. Poynton, had led Sir Arthur Keith to go further, and to speculate on the destiny and goal of all created things. Would that, casting his gaze both forward and backward, he might announce the speedy return of the Saturnian age.

It had been hoped that another distinguished representative of science, namely, Prof. Einstein, would have been present to receive the Doctor's degree; but much to the regret of the University he was prevented by illness from attending.

In the Creweian Oration which followed the bestowal of the honorary degrees, Dr. Poynton alluded to the gift of the Radcliffe Observatory site by Sir William Morris, and pictured Dr. Radcliffe approving of the supersession of his telescope by the stethoscope, and of the charts of the heavens by the temperature charts of the Infirmary.

WALES.—The Council of the University College of North Wales, Bangor, has appointed Dr. J. L. Simonsen (lately professor of organic chemistry at the Indian Institute of Science, Bangalore) to the chair of chemistry, and Dr. F. W. R. Brambell, lecturer in zoology, King's College, London, to the Lloyd Roberts chair of zoology.

APPLICATIONS are invited by the University of Wales for the following scholarships: The Cecil Prosser Research Scholarship of the value of £250 for research in the Department of Tuberculosis; the Mrs. John Nixon Scholarship of the value of £150 for research in the Department of Medicine and Medical Pathology; the Lord Merthyr Research Scholarship of the value of £200 for research in the Department of Surgery; and the Ewen Maclean Research Scholarship of the value of £150 for research in the Department of Obstetrics and Gynaecology. Particulars of the award of the scholarships and forms of application may be obtained from the Registrar, University Registry, Cathays Park, Cardiff.

Historic Natural Events.

July 6, 1928. Hailstorm at Potter, Nebraska.—A remarkable hailstorm occurred during which hailstones "as large as grapefruit" fell, one of which measured 17 inches in circumference and weighed $1\frac{1}{2}$ pounds. This appears to be the largest single hailstone of which there is authentic record. The stones could be heard hissing through the air, and when they fell on ploughed or soft ground they completely buried themselves. Very little damage was done by these stones beyond the unroofing of a few houses, as they fell 10-15 feet apart.

July 7, 1558. Hailstorm near Nottingham.—It is recorded that during a "marvellous tempest of thunder" near Nottingham, hailstones fifteen inches in circumference fell.

July 8, 1707. Great Heat.—This day, called for some time after "Hot Tuesday", was so excessively hot and suffocating in England, because of the absence of wind, that several persons died, or were in great danger of death, at their harvest-work. A former servant of the Rev. W. Derham, F.R.S., a healthy, lusty young man, was killed by the heat, and several horses on the road dropped down and died the same day.

July 8, 1893. Thunder and Hail.—During the afternoon very heavy thunderstorms and tremendous hailstorms, accompanied in some cases by whirlwinds, took place in the north of England. The hailstones which fell at Richmond, Yorks, were up to two inches in diameter. Photographs of two groups of these hailstones, some being split to show the characteristic structure, have been reproduced in many text-books of meteorology.

July 8, 1923. Carrbridge Flood.—After a violent storm, nearly 600 yards of permanent way on high embankments were washed away by a flood at Carrbridge, and a stretch of two miles, between Aviemore and Inverness, was so damaged that traffic could not be resumed for a month.

July 11, 1863. Tornado in Russia.—After very hot and gloomy weather, a whirlwind 700 feet wide levelled houses and trees to the ground, and raised the dust in dense conical columns of black smoke. A post, 31 feet high, 9 feet in the ground, 11 inches in diameter at the base, was lifted whole out of the ground, two large stones were carried up from a ravine on to level ground, children were carried through the air, and iron sheets were carried 24 miles. Hailstones four inches in diameter fell.

July 11-12, 1892. Glacier Flood.—The front of the small glacier of Tête Rousse, south-west of Mont Blanc, gave way, releasing a mass of imprisoned water and ice estimated at 200,000 cubic metres. This flood rushed down the steep valley in a great wave, destroying two hamlets and several houses and causing 200 deaths.

July 12, 1900. Ilkley Flood.—Great damage was done by a sudden flood at Ilkley, Yorkshire, between 2 and 3 P.M. Ilkley is built on the slope of Rombald's Moor, which rises steeply to the southward to a height of 1323 feet, and it seems probable that there was a very heavy downpour on the moor immediately above the town, the water running off the entire breadth of the land as off a roof. A workman said that "the clouds seemed to come down until touching the lamp-posts and then poured out solid water". Every road was turned into a watercourse, and torrents swept through the steep streets of the town for several hours, excavating trenches many feet deep. The lower rooms of houses were filled nearly to the ceilings, the furniture being washed into the streets, lamp-posts were snapped across, and several houses collapsed under the weight of water, with loss of life. After the storm had subsided the kitchens were filled with mud, which was banked high outside the vacant squares where the windows had been. From one house thirty tons of boulders and rubbish were removed, and the débris swept by the flood into the River Wharfe formed a great sand-bank. In one part of Ilkley the rainfall was 5·40 in., the greater part of which fell in a single hour.

Societies and Academies.

EDINBURGH.

Royal Society, June 2.—**O. F. T. Roberts**: On radiative diffusion in the atmosphere: The processes of long-wave low-temperature radiation in the atmosphere have been studied with the view of investigating the extent to which they may be regarded as diffusion-like; the decrease of water-vapour with height is taken to be exponential, that of temperature to be constant up to the tropopause, and then to be zero. Full allowance is made for the radiation being diffuse. The expression for the upward flow of radiation is obtained in the form of a power series in the temperature gradient in the troposphere; the coefficient of the first power of the temperature gradient is defined as the "coefficient of radiative diffusion". There is a certain amount of ambiguity about the coefficient so defined.—**D. Jack**: A simple spectrum comparator. The instrument, which is inexpensive and easily constructed, consists of a microscope with two objectives giving images of two spectrum photographs or other objects in a single eyepiece. The use of a prism silvered for external reflection allows of the photographs being placed side by side on the microscope stage. By this arrangement the length of the objects which the instrument can accommodate is not restricted by the size of the instrument.—**W. O. Kermack, R. H. Slater**, and **W. T. Spragg**: Certain quinoline and benzacridine derivatives yielding coloured adsorption compounds with iodine. In the case of the active aminoquinoline compounds the colour is usually developed in presence of solutions containing iodine at a concentration of the order of $N/10,000$, whilst in the case of the benzacridine compounds the colour is still apparent at concentrations of $N/100,000$ or even less. The effect of variation of concentration of compound iodine and hydrogen ions and other circumstance has been investigated. The chromogenic property appears to depend not on the nitrogen atom in these compounds but on the molecule as a whole. The compounds investigated differ from most of those previously known to give colours with iodine in that they are basic and form colloidal solutions in which the particles are positively charged.—**S. G. Jones**: A study of apothecial development in the leaf-spot disease of red clover. The disease is caused by the fungus *Pseudopeziza Trifolii*. The apothecial fructifications occur singly, but far more frequently in small clusters on both sides of the leaf and at the same spot. Their development is initiated by a small group of vegetative cells accompanied by an "ascogonial coil" and invariably situated within sub-stomatal cavities of the leaf. The ascogonial coil is capable of branching and extending itself into neighbouring stomatal cavities, there to initiate fresh apothecia. The ascogonial coil and its branches, however, prove to be abortive structures, but their proximity to certain cells of the vegetative mycelium is believed to exercise a stimulus, possibly nutritive, causing these cells to become multinucleate. The development of apothecia proceeds in an apogamous manner from these multinucleate cells, termed "primordial cells". They give rise to the ascogenous hyphæ. The terminal cell of a primordial group invariably passes out to the exterior of the leaf at a stomatal pore, pointing to a respiratory function.—**E. L. Ince**: Tables of the elliptic cylinder functions.

CAPE TOWN.

Royal Society of South Africa, Mar. 19.—**A. Pijper**: The blood-groups of the Bantu.—**F. G. Cawston**: Some observations on the embryonic radula of Limnæidæ. In the embryonic stage it is possible to recognise the marginal teeth with their denticles, the tricuspid laterals and the narrower central tooth of each row. Radulæ are best mounted in glycerine jelly. The number of teeth increases rapidly after the egg hatches, until the mature individual mollusc possesses several thousand teeth.—**R. H. Compton**: The flora of the Whitehall district.—**V. H. Brink**: A comparative study of the sacrum of the Griqua.—**C. Gordon** and **L. Hogben**: The separate identity of the pressor and pigmentary effector activity of pituitary extracts. When exposed to the action of cold normal sodium hydroxide for two hours, the pressor activity was found to be reduced more than 90 per cent. The pigmentary effector activity increased. The increase was doubtless due to the lack of interference from concomitant vaso-motor phenomena.—**D. Slome** and **L. Hogben**: Further observations on the relation of the pituitary gland to the chromatic function of *Xenopus Lævis*. The comparison of reactions of totally hypophysectomised and normal toads (*a*) to photic stimuli and (*b*) to the injection of posterior lobe extracts yield data which reinforce the conclusion that the *W*-mechanism of a previous communication can be identified with the anterior lobe of the pituitary gland.—**Enid Hogben**: Some metabolic changes associated with pigmentary effector activity in *Xenopus Lævis*. Eyeless animals have a significantly higher respiratory rate than eyed animals. The effect of removing one or both lobes of the pituitary gland lowers the dermal respiratory rate by about 24 per cent, and the calcium and magnesium content of the serum by about 30 per cent. Significant differences occur between males and females in all cases; males had a higher respiratory rate than females, and the calcium and magnesium content of the serum was lower in males than in females.—**L. Hogben**: Some remarks on the relation of the pituitary gland to ovulation and skin secretion in *Xenopus Lævis*. Autopsy of large females kept for two years after total operative removal of the pituitary revealed the fact that the ovary had undergone almost complete involution in all cases. Implantation of glands from other individuals or injection of anterior lobe extracts induced ovulation.—After removal of the whole pituitary gland or the anterior lobe alone, the copious secretion of slime so characteristic a response of *Xenopus Lævis* ceases entirely. Injections of anterior lobe extract produce within a few hours complete shedding of the skin. The autacoid is heat stable and ether soluble.—**A. Zoond**: (1) The localisation of respiratory exchange in the scorpion. Occlusion of the book lungs of *Opisthophthalmus capensis* with a thin film of rubber solution. Determinations of oxygen caused total inhibition of respiration. (2) The localisation of respiratory exchange in the polychæte *Bispira Voluticornis*. Cutaneous respiration is 32 per cent of the total, and the branchial filaments are the principal region of respiratory exchange.—**L. P. Bosman** and **H. Zwarenstein**: The blood-sugar in normal and eyeless *Xenopus Lævis*. Higher in eyeless animals than in normal specimens.—**Sir Thomas Muir**: (1) Note on sums of N-line minors pertaining to an N-by-$N+2$ array. (2) Note on the derivatives of the eliminant of two binary cubics.

ROME.

Royal National Academy of the Lincei, Mar. 2.—**A. Angeli**: Pyrrole blacks.—**L. Cambi** and **T. Ricci**: Arylnitrosoferropentacyanides: formation from arylhydroxylamines and nitroprusside. In aqueous alcoholic solution, the reaction between sodium nitroprusside and phenylhydroxylamine yields first the hyponitrosoferrocyanic complex, $[(CN)_5\ FeNO]^{''''}$,

which then passes into the aquoferrocyanide $[(CN)_5FeH_2O]^{III}$, which then passes into the aquoferrocyanide $[(CN)_5FeH_2O]^{III}$, and this, under the action of the nitrosobenzene formed in the first phase, is converted into the arylnitrosoferropentacyanide complex $[(CN)_5Fe(NO)C_6H_5]^{III}$.—**B. Segre**: Construction of bisextuples of straight lines.—**Maria d'Ascia**: Test of the method of least squares for the numerical integration of linear differential equations.—**M. Brelot**: Point sources of heat in a radiating plane in thermal equilibrium.—**A. Wintner**: The anharmonic analysis of secular inequalities furnished by Lagrange's approximation.—**A. Belluigi**: The tectonics of certain deep structures discovered gravimetrically in the Paduan plane.—**Stefano Lodovico Straneo**: Moll's vibration galvanometer. Various points connected with the action of the Moll galvanometer are discussed. **B. Rossi**: A method for the study of the magnetic deviation of penetrating rays. **E. Bossa**: The Hall effect for the metals, nickel, iron, and copper, in weak magnetic fields. For nickel and iron, the course of the Hall coefficient in weak magnetic fields is substantially different from that in strong fields, the gradual increase observed on diminution of the field becoming rapid at about 30 gauss for nickel and at about 6·2 gauss for iron; this rapid increase is maintained at least so far as 2 gauss and 0·2 gauss for nickel and iron respectively. With both metals, dissymmetry of the galvanometer deviations is noted on inversion of the magnetic field. With copper, on the other hand, no trace of such dissymmetry exists, and the Hall coefficient exhibits only a slight increase as the strength of the magnetic field is lowered to about 1 gauss. **G. Bargellini** and **A. Grippa**: 2:5-Dibromophenetidine. Bromination of phenacetin with a quantity of bromine corresponding with four atoms per molecule results in the formation of 2:5-dibromophenacetin, which may readily be hydrolysed to 2:5-dibromophenetidine The results obtained confirm the conclusion previously drawn, that the first halogen atom introduced into the phenacetin molecule enters in the ortho-position to the ethoxy group and the second in the ortho-position to the acetylamino group. **P. Principi**: Observations on the age of the travertines of Ellera in the neighbourhood of Perugia. **G. Brunelli**: Eutrophy from stagnation in artificial lakes. **P. S. Israel**: Investigations on chronaxia. (3) Action of lithium on the chronaxia of the neuromuscular preparation of the frog. Lithium chloride has a distinctly unfavourable action on this phenomenon and cannot replace sodium chloride, this action being exerted particularly on the nerve and to a less extent on the muscle. **B. Monterosso**: Cirrepedological studies (6). Behaviour of *Chthamalus stellatus* in different experimental conditions. **M. Curzi**: First observations on the mutation of a hyphomycetes.—**G. Cannicci**: Contribution to the study of glutathione in Teleostei. Observations on the method of determination (1). Of the two methods which have been suggested for the determination of glutathione, the nitroprusside method, especially as modified by Randoin and Fabre, although not absolutely accurate, gives results sufficiently exact for physiological experiments.—**U. Cassinis** and **L. Bracaloni**: Hydremic curves caused by rest and by physical exercise (2). **S. Visco**: Protein ration and energy ration. When given a diet deficient in protein, rat slowly lose in weight and ultimately die, no matter what the quantity of energy ration consumed. Thus, physiological and economic utilisation of the ternary substances absorbed is possible only to organisms satisfied as regards their protein requirements.—**V. Rivera**: Cosmic waves and cellular multiplication (germinating seeds) (1).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 3, Feb. 15).—**Francis Bitter**: On the diamagnetism of electrons in metals. A formula for diamagnetic susceptibility of free electrons is calculated, taking into account the wave structure of the electron: it has the same form as the classical formula but the mean free path is replaced by $a/4$ where a is the grating constant of the cubic lattice considered.—**Alexander Goetz**: On the experimental evidence of the mosaic structure of Bi single-crystals. Bismuth single crystals of a definite orientation were grown by a special method and examined microscopically with and without etching. Evidence is obtained that the single crystal contains 'blocks' of a definite size independent of the perfection of the crystal provided the crystal is not plastically deformed. Illustrations of the structure observed are given. **George H. Shull**: The first two cases of crossing-over between old-gold and bullata factors in the third linkage group of *Œnothera*. **J. T. Patterson**: Somatic segregation produced by X-rays in *Drosophila melanogaster*. Cultures of eggs and young larvæ of a cross between yellow-white females and eosin-singed males were treated with X-rays and the F_1 females examined. The criterion for somatic segregation was the occurrence of a gray-singed area adjacent to a yellow non-singed area, and this was found in a few cases. **P. ten Bruggencate**: The radial velocities of globular clusters. There is a linear correlation between the displacements of spectral lines for globular clusters, corrected for solar motion, and galactic latitude, similar to that between line displacement and distance of the spirals. **Wilder D. Bancroft** and **C. E. Barnett**: (1) Solid protein hydrochlorides. The pressure-concentration isotherm for hydrogen chloride gas and charcoal is a smooth curve typical of adsorption; zein gives a similar curve. Hexamethylene tetramine gives a curve with four 'flats'; arachin, casein, edestin, fibrin, and gliadin each gives one or more 'flats'. A 'flat' indicates formation of a compound.—(2) Adsorption of ammonia by proteins. Using the method indicated above, it is shown that ammonia gas combines with tartaric acid (as already known) and with p-aminobenzoic acid, but not with aminoacetic acid or the proteins used above.—**Linus Pauling**: The structure of the micas and related minerals. The general formula given for the micas is $KX_nY_4O_{10}(OH, F)_2$, with $2 \leq n \leq 3$, where X and Y are cations of co-ordination number 6 and 4 respectively. The brittle micas have a similar formula in which calcium replaces potassium. **Hans-Joachim Schumacher** and **Gerhard Sprenger**: The decomposition of nitrogen pentoxide at low pressures. Pressures of 0·2–0·004 mm. mercury were used. There is no marked falling off of the unimolecular constant down to about 0·06 mm. pressure but a decrease below this. Experimental procedure is fully described. **Elizabeth T. Stafford** and **H. S. Vandiver**: Determination of some properly irregular cyclotomic fields.—**Ernest W. Brown**: On an extension of the Fourier theorem giving rapid methods for calculating the constant part and the coefficient of any periodic term in the disturbing function.—**M. S. Knebelman**: Content-preserving transformations.—**E. T. Bell**: Simplicity with respect to certain quadratic forms.—**Aristotle D. Michal**: (1) The differential geometry of a continuous infinitude of contravariant functional vectors.—(2) Projective functional tensors and other allied functionals.—**G. A. Miller**: Non-Abelian groups admitting more than half inverse correspondencies.—**M. H. Stone**: Linear transformations in Hilbert space. (3) Operational methods and group theory.

Official Publications Received.

BRITISH.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 16, No. 3, May. Pp. 677-1023. (Plymouth.) 12s. 6d. net.

Ministry of Health: Advisory Committee on Water. Report of Technical Sub-Committee on the Assessment of Compensation Water. Pp. 44. (London: H.M. Stationery Office.) 9d. net.

Indian Journal of Physics, Vol. 4, Part 6, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 6. Conducted by Sir C. V. Raman. Pp. 419-540. (Calcutta.) 1.8 rupees; 2s.

Third Imperial Entomological Conference, 1930. Programme. Pp. 8. A List of the Entomologists employed in the British Empire. Prepared for the Third Imperial Entomological Conference. Pp. 16. 2s. 6d. A Summary of Data relating to Economic Entomology in the British Empire. Prepared for the Third Imperial Entomological Conference by Dr. S. A. Neave. Pp. 23. 2s. 6d. net. (London: Imperial Bureau of Entomology.)

India. Meteorological Department: Scientific Notes. Vol. 1, No. 7: Normal Monthly Upper Winds over eight Stations in India. Pp. 69-107. 1.12 rupees; 3s. Vol. 1, No. 9: Comparison of Temperatures in Stevenson Screens at Heights of 6 ft., 4 ft., and 2 ft. Note prepared by Dr. K. R. Ramanathan. Pp. 113-121. 7 annas; 9d. Vol. 1, No. 10: Distribution of Temperature in the Lower Stratosphere. By P. R. Krishna Rao. Pp. 123-136. 1 rupee; 1s. 9d. Vol. 2, No. 11: Comparative Observations of Temperature inside White painted, Unpainted and Black painted Stevenson Screens. Note prepared by Barkat Ali. Pp. 11. 6 annas; 8d. (Calcutta: Government of India Central Publication Branch.)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Shropshire. Bulletin No. 3: A Progress Report of Instructional and Experimental Work in Poultry and Rabbit Husbandry. Pp. 80. (Newport.)

The Linen Industry Research Association. Report of the Council, 1929. Pp. 23. (Lambeg, Co. Antrim.)

Empire Cotton Growing Corporation. Report of the Ninth Annual General Meeting. Pp. 16. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 402, June. Pp. 657-800+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The National Institute of Industrial Psychology. Report 4: The Measurement of Manual Dexterities. By F. M. Earle, assisted by Dr. F. Gaw and other Members of the Institute's Staff. Pp. 88. (London.) 5s.

The Eton College Natural History Society. First Annual Report, 1929-30. Pp. 42+3 plates. (Windsor.)

University of Bristol: Department of Agriculture and Horticulture. Bulletin No. 4: Mole Destruction Experiments. By A. W. Ling, C. A. MacEachern and E. C. Read. Pp. 15. (Bristol.)

Navy—Hydrographer's Report. Report on Admiralty Surveys for the Year 1929 by the Hydrographer of the Navy. Pp. v-x. (London: Admiralty.)

FOREIGN.

Spisy vydavané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculte des Sciences de l'Université Masaryk). Čis. 115: i. Příspěvek ke studiu adičních sloučenin organických zásad se solemi zinečnatými (Contribution à l'étude des composés l'addition formée par des bases organiques avec des sels de zinc), napsali J. V. Dubský a A. Rabas; ii. Příspěvek ke studiu tvorby solí glykokolu (Contribution à l'étude de la faculté de la glycocolle de former des sels), napsali J. V. Dubský a A. Rabas; iii. Příspěvek ke studiu zásaditých solí, se zvláštním zřetelem k ol-solím měďnatým (Contribution à la connaissance des sels basiques, particulièrement par rapport aux sels "ol" du cuivre), napsali J. V. Dubský a E. Tesařík. Pp. 29. Čis. 116: Musci insulare Rossicae prope Vladivostok. Ad Bryophytorum Orientis Extremi cognitionem additamentum. Scripsit Josef Podpěra. Pp. 40. Čis. 117: Réflexion des ondes acoustiques sur un plan. Par B. Hostinský et J. Kaucký. Pp. 13. Čis. 118: Měření doby kyvu gravitačních vah (Mesure de la période du gravimètre). Napsal Josef Zahradníček. Pp. 15. Čis. 119: Hydrolysa solí beryllnatých a hlinitých odvozených od silných kyselin (Hydrolysis of beryllium and aluminium salts derived from strong acids). Napsal Václav Čupr. Pp. 24. Čis. 120: Buzení krátkých elektromagnetických vln dvoumřížkovými lampami (The emission of short electromagnetic waves by two grid valves). Napsal Josef Sahánek. Pp. 17. Čis. 121: Propriétés projectives du contact, II. Par Edouard Čech. Pp. 21. Čis. 122: A Study of Ideational Behavior of a Garden-Warbler, *Sylvia borin borin* (Bodd.). By Vladimír Teyrovský. Pp. 36. (Brno: A. Píša.)

Sborník Vysoké Školy Zemědělské v Brně, ČSR (Bulletin de l'École supérieure d'Agronomie, Brno, RCS). Sign. C16: Škůdce cukrovky *Bothynoderes punctiventris* Germ. a jeho přirození nepřátelé (The Sugar-Beet Pest, *Bothynoderes punctiventris* Germ. and its Natural enemies). Napsal Dr. Jan Rozsypal. Pp. 92. Sign. C17: Příspěvek k poznání příčin neplodnosti kozlů (A Contribution to the Knowledge of Causes of the Sterility in the Bucks). Napsal Dr. Jan Podhradský. Pp. 32. Sign. D14: Hydrobiologická studia rybníků Lednických. I. Výzkum heloplanktonu a jeho poměrů quantitativních. Podávají Prof. Em. Bayer a Al. Bajkov. Pp. 165. Sign. D15: Význam polykání peří u *Podiceps cristatis* (L.) a obsah jeho žaludku (La déglutition des plumes et le contenu de l'estomac chez le *Podiceps cristatus* (L.)). Napsal Dr. Josef Jirsík. Pp. 23. (Brno: A. Píša.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 241: On the Combination Series of Helium. By Yoshio Ishida and Tadashi Tamura. Pp. 115-134+plates 14-18. 45 sen. No. 242: Über die Bestimmung der Teilchengrösse pulverförmiger Substanzen. Von Kōichi Kasai. Pp. 135-183. 75 sen. Nos. 243-244: Volumenanalizo de Magneziaj Saloj, II., de Tutomu Maeda kaj Ryûzô Syozi; La Solvebleco de Kalcio Sulfata en Akvosolvaĵoj de Alkoholoj, de Takemaro Yamamoto. Pp. 185-206. 40 sen. (Tokyō: Iwanami Shoten.)

California Academy of Sciences. Constitution and By-Laws, Trustees, Officers, Museum Staff and Members, May 29, 1930. Eighth edition. Pp. 87. (San Francisco.)

CATALOGUES.

High Tension Cable Testing and Fault Locating: a Description of the High-Tension Direct Pressure Test for Cables and Overhead Lines. Pp. 28. (London: Watson and Sons (Electro-Medical), Ltd.)

Newspapers, Magazines, Periodicals and Journals of Learned Societies. (Catalogue 526.) Pp. 40. (London: Francis Edwards, Ltd.)

The Photexray X-ray Tube. Pp. 24. (London: Cuthbert Andrews.)

"Liverpool" Paper Insulated Low Tension Cables. Pp. 16. (Liverpool: The Liverpool Electric Cable Co., Ltd.)

Diary of Societies.

FRIDAY, JULY 4.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. C. T. Trechmann: The Relation of the Permian and Trias in North-East England.—J. J. Hartley: The Volcanic and other Igneous Rocks of Great and Little Langdale, Westmorland.—*Paper to be taken as read*:—F. Jessop: The Agates and Cherts of Derbyshire with a Brief Account of the History of the Lower Carboniferous Limestone of the Peak District.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at National Institute for Research in Dairying, Shinfield, near Reading).

MONDAY, JULY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

TUESDAY, JULY 8.

INSTITUTE OF TRANSPORT (at Glasgow).—E. J. H. Lemon: Railway Amalgamation and its Effect on the Workshops.—Sir G. C. Buchanan: The Economics of Port Development and Administration.—W. J. Thomson: Long-Distance Omnibus Services—their Place in the National Scheme of Transport. (Continued on July 9 to 12.)

WEDNESDAY, JULY 9.

INSTITUTION OF MINING ENGINEERS (at Birmingham). (Continued on July 10 and 11.)

CONFERENCE.

JULY 8 AND 9.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology Birmingham University).

Tuesday, July 8, 2.15 to 3.45.—V. B. Wigglesworth and E. K. Sikes: The Hatching of Insects and the Appearance of Air in the Tracheal System.

Prof. H. Munro Fox: Spectroscopic Analyses of Tissues.

P. D. F. Murray: The Differentiation of the Somites and Limb-Buds of the Chick.

5 to 6.—D. L. Gunn: Water Metabolism of the Cockroach.

R. Snow: Some New Aspects of Correlative Inhibition.

Wednesday, July 9, 10 A.M. to 1. Prof. W. Stiles: The Toxic Action of Alcohols and other Substances on Plant Tissues.

W. N. Howarth: Polymeric Forms among Carbohydrates.

E. L. Hirst: High Polymerides in the Carbohydrate Group.

Prof. J. H. Priestley: The Plant Cell Wall.

W. T. Astbury: The Structure of Wool-fibres by X-ray Analysis.

2.15 to 3.45.—L. C. Beadle: Effects of Low Salinities on Water Content and Respiration of Marine Animals.

C. F. A. Pantin: Adaptation of *Gunda ulvae* to Changes in Salinity.

F. T. K. Pentelow: The Fauna of the River Lark.

4.30 to 5.30.—J. Gray and S. B. Setna: The Growth of Fish Scales.

M. A. Tazelaar: Further Work on the Effects of a Temperature Gradient on the Early Development of the Frog.

CONGRESS.

JULY 10 TO 12.

OXFORD OPHTHALMOLOGICAL CONGRESS (at Oxford).

Dr. H. M. Traquair, Sir Farquhar Buzzard, Bart., Prof. J. A. Gunn: Symposium on Toxic Amblyopia.

Sir Oliver Lodge: Modern Theories on the Nature of Light.

Dr. H. Friedenwald: Pathological Changes in the Retinal Blood Vessels and their Significance (Doyne Memorial Lecture).

Prof. A. Schuller: Recent Developments in Radiology Associated with Ophthalmology.

Prof. J. Gonin: Detachment of the Retina and its Treatment.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

SATURDAY, JULY 12, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

No. 3167, Vol. 126]

Education, Environment, and the Criminal.

EVERY year a considerable sum of public money is expended on the issue of official publications —blue books, which it is to be feared the general public too rarely reads. Yet this is a pity; for blue books are sometimes entertaining and usually instructive. Elsewhere we give some figures taken from the returns of criminal statistics for England and Wales for the year 1928 issued by the Home Office. From the data there given it will be apparent that this official publication is of interest to a wide audience—wider, indeed, than the specialists in the study of crime and the criminal, or indeed in any one branch of social reform which impinges on the criminal world. For criminal statistics are not merely a gauge of the criminal tendencies of our population, any more than they are solely an index of the efficiency of our police organisation in detecting crime. Infinitely more suggestive to regard them as a tabulation of the less gratifying products of our social system—an indication of some defective bearing in the machinery by which the daily life of the community is regulated and carried on.

In a perfect society there would be no crime—not necessarily as a result of the perfection of the individual, but because of the complete adjustment of that society to the satisfaction of the needs of the individual. The primal nature of man remains unaltered through the ages. It is based upon certain fundamental necessities which are perennial and common to all living things. These are the urge to the preservation of the individual and the urge to the perpetuation of the race. When once this postulate is grasped the whole problem resolves itself into a matter of adaptation.

The attempt to secure the full satisfaction of the needs of the individual by moulding the environment to his requirements is the genesis of culture and of society. It lies at the roof of Utopias framed by philosophers from Plato to H. G. Wells; it is the motive power of social reform and the justification of the world-old urge towards democracy. For, unfortunately, even in the earliest stages of man's history as a social being, the environment was imperfectly adapted to the needs of all individuals. Differences of age, physique, sex, and individual character made for imperfect adjustment. There must always have been an under-dog. Even in the simpler societies, whether patriarchal or matriarchal, the exercise of family control entails a cramping of individuality by regulations which sooner or later are regarded by someone as harsh, uncon-

scionable, or unnecessary. Their transgression inevitably follows and the eyes of authority behold a crime. As society becomes more complex, maladjustments as between individuals and the environment become more numerous and crime increases. For whatever means the individual may adopt to correct that maladjustment, whether it be murder or merely exceeding the speed limit, if it contravene a regulation laid down by the authority of society it constitutes a crime.

Thus 'crime' is purely a relative term and in the history of mankind its connotation has varied with the variations in type and the advance of the social organism.

It must be remembered, however, that to regard society as a means of securing the full satisfaction of individual needs may tell less than half the story. It is obvious that the environment with which a man may find himself at odds is a complex of individuals like unto himself, and in the satisfaction of his own needs he is precluded from impeding the satisfaction of the legitimate needs of others. Just as the patriarch in a primitive community imposes his will upon the members of his group, so in a more highly organised society the will of that society, whether it be embodied in a despot, a constitutional monarch, or in the representative assembly of the people, exercises itself to guard against encroachment by the individual. Hence the paradox that the social organism which was created originally to provide an environment which would admit of the complete self-expression of the individual almost immediately becomes a medium to which he must adapt himself. Self-expression is given a free rein so far, and so far only, as it does not come into conflict with the limitations imposed by society.

It is a matter of importance to stress the fact that crime has no fixed connotation but that it varies at different grades of culture. Even murder, the most serious injury to the person, at certain stages of social development is a private matter for the victim's immediate group and not a concern of the community as a whole. This way of looking at the matter survives even in Europe, where in some of the less advanced communities the family or tribal vendetta survives under a comparatively highly organised system of government. Plural marriage, which is perfectly legitimate in a polygamous society, becomes the crime of bigamy in a society organised on a monogamous basis. Incest, a criminal offence, though only since 1908 in England, has varied in definition in different ages and in different societies according to the forbidden degrees, and a form of union which we would now class as incestuous constituted the primary form of royal marriage in ancient Egypt.

Any contravention of a regulation laid down with communal authority may constitute a crime. In the army a man's 'crime sheet' records behaviour contrary to regulation and may contain no entries in any sense of 'criminal' in common usage. For the purpose of the "Criminal Statistics", crimes in the sense of indictable offences may range from murder and manslaughter to stealing a dog or "inciting an infant to bet". Each year the list of such offences becomes longer. Additions were made to no less than twenty classes of offence by legislation which came into force in England and Wales in 1928. They affected such widely varying matters *inter alia* as fraud, forgery, money-lending, road-transport lighting, and the protection of the lapwing.

Thus legislation, and especially legislation of the grandmotherly or meticulous type, more particularly if it does not have an overwhelming weight of public opinion behind it, leads to an increase of crime. It adds to the number of offences and thereby swells the roll of those who offend. The prohibition laws of America afford a peculiarly instructive example—at least so far as it is possible to judge from the outside. There the union of various interests with ulterior motives—of these perhaps the most potent the desire to eliminate the influence of the saloon-keeper from the sphere of politics—joined with the temperance movement to attain their object through the prohibition laws. These public opinion—the ultimate tribunal—has not merely not been strong enough to enforce, but it would seem as if as a whole it has not even desired to enforce them in their entirety. Hence 'bootlegging' and a whole series of customs offences, with the acts of lawlessness which accompany them, as well as the illicit manufacture and sale of alcohol, now help to swell the list of crimes.

It requires very little consideration of the variety of and variation in criminal statistics to show that those anthropologists who a generation and more ago sought to fix a criminal physical type were attacking a social problem on too narrow a front. In so far as certain stigmata denote physical and mental degeneration they may be taken as indication of potentialities in certain directions, which, given certain conditions, are likely to become actively criminal. The force of heredity is no more negligible in human relations than in animal breeding. But in a modern society the effects of heredity and of environment are almost inextricably interwoven. The study of the evolution of man and his congeners, the great anthropoid apes, points to the

fact that while the latter have survived by an early specialisation adapting them to their environment but limiting their advance, man has survived through an infinite adaptability to varying conditions. Hence it is no longer possible to look upon the criminal, that is, the criminal in the more serious sense of the social outlaw, as a type— a throwback or a survival in any real sense. He is a failure in adaptation. Normally man must be regarded as infinitely educable. The criminal, however, even the criminal of habitual type, is an individual of imperfect inhibition. His conduct may be conformable to an earlier stage of culture: but as things are it is a maladjustment with his social environment. The man who steals to procure food which will save him from starvation takes that which in a more primitive society would be procurable by his own effort or would be given him for the asking. For here the necessities of life are common to the members of the group, or are the product of group activity: but in a society in which his act has come to be looked upon as a crime, he shows that either he has not responded to training or he has been imperfectly educated to survive in the conditions imposed upon him by society.

Criminal statistics, then, serve as an index of the degree to which there is a lack of adjustment as between the individual and the requirements imposed by life in any given community. In the imperfect world in which we live, it cannot be hoped to eliminate crime, but with these data as a starting-point it is possible to probe for the causes which retard progress towards a state of social equilibrium. On one hand, it may be asked whether the incidence of crime is such as to point to an undue proportion in the community of a class congenitally unfitted by physique and mental constitution to acquire a habit of conduct in accordance with the standard of the community— a problem for the expert in the study of delinquents and the eugenist. On the other hand, the number and character of the crimes may suggest an inquiry whether the training by which society seeks to secure that the individual is brought into harmony with, and fitted to survive in his environment is suitable and effective— the province of the educationist. Moreover, it must not be overlooked that the environment itself may be at fault. Social conditions may be such as to render nugatory all efforts towards individual training, or by force of unduly harsh or unnecessary legal and social restrictions make demands which an appreciably significant proportion of members of the community is unable to meet, constituting a call for social or legal reform which should not be ignored.

The Great Chemists.

Das Buch der grossen Chemiker. Herausgegeben von Dr. Günther Bugge. Band 1: *Von Zosimos bis Schönbein.* Pp. xii + 496 + 42 Tafeln. (Berlin: Verlag Chemie G.m.b.H., 1929.) 24 gold marks.

THE appearance of any work on the history of chemistry which is more than a sketch of the subject is so infrequent that a general expression of satisfaction and a recommendation seem inevitable in all cases, and are usually given to the exclusion of any detailed criticism. There are, however, certain general errors which seem fated to recur in all such works, and it may be useful, in addition to the statement that the present work is one which every chemist should add to his library, to notice some of these here.

The present volume is a composite production and suffers inevitably from the faults of such. The treatment is uneven and the value of the contributions varies rather considerably with the authors. The subject matter as a whole is, however, of high standard, and in the cases where the original sources have been used it contains many points of interest and importance. In many cases, however, the sources have clearly been secondary, or even further removed from the originals. Common and well-known errors, therefore, appear again, in many cases with reference to the secondary or tertiary literature from which they have been taken. It is impossible to refer to all such cases, but a few examples will be given. The statements on pp. 369 and 373 that Dalton was indebted to Richter are not in accordance with the facts as set out in the careful examination of the question published by Meldrum many years ago, and that on p. 391 that Mayer took account of Gay-Lussac's experiments on the expansion of gases into a vacuum is given with a reference to a secondary source. If the author had read Gay-Lussac's work and had seen a criticism of this statement published a few years ago, he would scarcely have repeated this old error. The discussion of the early work on hydrofluoric acid follows the usual incorrect course (p. 284): the facts were published by the reviewer some years ago.

Although an American writer is taken to task (p. 224) for giving Geoffroy's name incorrectly, there are numerous examples of the mangling of names in the present volume, particularly those of Englishmen or English places. On the same page as the mis-statement about Mayer and Joule we find "Sir Dugald Clirs"; on p. 45 we find "Sommerset" (and are, incidentally, told that

Bacon studied in the " Hochschule zu Oxford ") ; a little further on (p. 46) we find " Brever " for Brewer and the date of Jebb's edition of the " Opus Majus " is incorrectly given ; " Wresham " appears for Wrexham, and " Clerc Maxwell " does duty for the name of the great physicist. It would be well to publish a list of errata in the forthcoming second volume.

The treatment, on the whole, is moderately international, but the book is clearly intended mainly for German readers, and its reception in other countries must, in consequence, pay the price of this. As an example we may refer to the statement, after being told that Agricola had 'lifted' [abgeschrieben] large portions of Biringuccio's " Pirótechnia " in the composition of his " De Re Metallica ", that, after all, the Italian's name shows that he is of " germanische Abstammung The usual sneer at " die englische Pruderie " occurs (p. 410), in this case, however, in connexion with what appears to be a wholly imaginary example, so that perhaps our love of fair play and regard to veracity have been mistaken for prudery. In very few cases do notable English books appear to be known to the writers, and the literature references are seriously incomplete in this respect. Thus, Darmstaedter, in his article on Agricola, refers only to his own edition of the " De Re Metallica ", without mentioning Hoover's masterly work, and many other examples could be quoted.

As an example of the lack of knowledge of English and American scholarship on the part of many authors, the article on Roger Bacon may be quoted. The relations of Bacon with the Church are in the old-fashioned mid-Victorian Huxley-Spencerian vein, namely, that of an enlightened experimenter struggling with ignorant bigotry. In reality we know that Bacon's " Opus Majus " was not written until after pressing invitations from the Pope, and that Bacon 'got himself into hot water' not by his scientific views but by his wholly unnecessary personal abuse of highly placed members of his order. It is to be feared that the enlightened modern eminent man of science is often quite sensitive even of scientific criticism : what he would do if he were called a blockhead by his inferiors, and had the same freedom of action as Bacon's superiors, we do not wish to contemplate. All recent studies of Bacon's chemical work, such as those of Little, are completely ignored, and the article is very poor.

The treatment of Zosimos follows the usual lines. After the statement that Berthelot and Ruelle's edition is very defective, which seems to be regarded as a pious duty by all recent German authors who compile from it, the so-called 'mystical' element in Alexandrian chemistry is stressed. It should be realised that Alexandrian authors in general introduced some complication into their writings which we avoid, in that they attempted to take account of the existence in Nature of God and of the soul. The treatment of a scientific subject gains in clearness and objectivity by ignoring these, but it may perhaps be suggested that it becomes rather one-sided. As philosophers, the Alexandrians were not satisfied by chemical cookery. The contributions made to *practical* chemistry by the early chemists of Alexandria are not made sufficiently clear. The reviewer will show in another place that the theory of the four primary colours of Demokritos, whose authority is invoked by all the early writers on chemistry, probably influenced the first theories in a way which does not seem to have been fully recognised, and that under its influence the theory and practice of the science descended in a perfectly natural way.

The article on Geber adds rather considerably to the complexity of the subject, although here much recent work is carefully considered. We knew from Berthelot that some of the Arabic works of Jabir were quite different from the " Summa " of Geber, but it is now suggested that these Arabic works are not authentic. It may be noticed in passing that the author of the " Summa " might have been English.

The treatment of the medieval writers is generally very unsatisfactory. Recent scholarship is practically ignored and in several cases the chemical aspects are referred to only in the very briefest way. Instead of an attempt to deal with the undoubted interest which some of the great schoolmen showed in chemistry, with careful references to the original sources, we are given merely a mass of undigested rhetoric from which we strive in vain to extract a few grains of objective truth. The general character of these articles may be judged from the following quotation from the later one on Paracelsus (who is treated highly sympathetically) : " Über allen Dingen zittert der Abglanz eines fernen Glückes. alles Böse ist transparent und macht das Gute sichtbar, wie alles Nein das Ja, wie das Schwartz das Weiss und wie der Teufel Gott ". There is much in this vein.

When the seventeenth century is reached the articles become more interesting and objective and in some cases contain really valuable material. It would perhaps be unfair to select certain article-

as especially good, since so much depends on the particular taste of the reader, but the reviewer found the following of great interest: Glauber, by Walden—an outstandingly good article; Libavius, by Darmstaedter; Klaproth and Mitscherlich, by the editor; Faraday, by Ostwald (apart from the error on p. 424 as to the source of the nomenclature of electrolysis, which is really due to Whewell, and the usual over-emphasis of the opposition of Davy to the laboratory assistant's F.R.S.). Articles which seemed less interesting, and, in some cases, to be more based on secondary sources, were those on Albertus Magnus, Paracelsus, Van Helmont, Lully, Berthollet (scrappy), and on Fourcroy and Vauquelin (merely dull).

The book, which is well printed and reasonably priced, must, like other recent German works on the history of chemistry, be used with caution and in close proximity with the originals. For the general reader who finds no difficulty with the language and is not much concerned with minute accuracy, it will be found very interesting. A second volume, bringing the study down to Emil Fischer, is promised and will be welcomed, but the editor might well impress on his collaborators the necessity of a rather broader outlook, a closer scrutiny of the original sources and less leaning on other historians, and more attention to recent scholarship in other lands than Germany.

J. R. PARTINGTON.

Cocci and Hæmophilic Bacteria.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 2. By C. H. Browning, W. Bulloch, J. H. Dible, A. Fleming, F. Griffith, R. Tanner Hewlett, J. E. McCartney, T. J. Mackie, D. G. S. McLachlan, J. W. McLeod, W. Mair, E. G. D. Murray, G. H. Percival, W. M. Scott, A. L. Taylor, W. J. Tulloch, H. D. Wright. Pp. 420. (London: H.M. Stationery Office, 1929.) 21s. net.

THE volume of the Medical Research Council's "System of Bacteriology" before us deals with "Cocci and Hæmophilic Bacteria". A comparatively brief chapter is devoted to the staphylococci. There is an extremely interesting short note on the history, and Prof. Bulloch has appropriately emphasised the important and really primary work done on these organisms by Ogston in Aberdeen. The whole chapter, though brief, is well written, and gives a sufficiently detailed and accurate account of this group of bacteria.

Chap. ii., on the streptococci, is necessarily a long one, and occupies more than double the space given to any of the other cocci. This indicates the vast amount of work that has been done, and particularly during recent years, on this group of organisms. The list of references in itself indicates the amount of work that would require to be expended even to read superficially all the papers that have been published on this subject, and the chapter shows evidence that the reading by some of the authors has not been very carefully done. We think this chapter has also suffered from the multiplicity of authors. The early parts by McLeod are well done, and this can also be said of the section by Mackie and McLachlan. It may be desirable in a volume which is to be one of reference that an account should be written of results recorded by various authors as to the finding of streptococci in certain conditions of the skin, but we do feel that more judgment might have been used in the selection of published work in which there was, to say the least, evidence of some value brought forward to establish a claim to causal relationship. We do not think that judgment has been shown in the section by Percival.

To write above seborrhœa corporis, that "Although the characteristics of the streptococci isolated from these lesions have not yet been investigated, *it is very probable*, from a comparison with the hæmolytic streptococci isolated from impetigo, that the organisms in question are capable of elaborating a diffusible toxin. *If this is the case* the eczema reaction which is provoked may be due to the direct action of such a toxin . . .," without giving any evidence that the streptococci are not mere saprophytes in this condition, is in our opinion not worthy of being published.

The chapter on mouth streptococci seems to be somewhat confused, and we are at a loss to know whether this section is confined to this group, as the heading and the table of contents would suggest. Does the author maintain that the streptococci of rheumatic fever and of subacute endocarditis dealt with here are all mouth streptococci? There is a great deal of valuable information in this chapter, but it is not well arranged, and it is, in our opinion, too much dominated by the personal views of the author. Thus, in referring to the work of Leschke and Auerbach, who think that the best time to examine the blood is when the temperature is high, we are told that there is no convincing evidence that this is so, and the only fact given in support of this statement is that "the writer's experiments indicate that the number of organisms in the circulating blood do not undergo

 B 1

great or sudden variations". No other evidence is given, and not even a reference to the author's experiments. On the following page, it is stated that "the original infection of the valves must result from an invasion of the blood stream by streptococci", and again, "they enter the blood stream from foci of infection". Surely it is almost certain that this entry and this spread will give rise to temperature, and if blood culture is made at that time the bacteria are more likely to be found than when the organisms have got settled down in the valves.

On rheumatism, in reference to the work of Beattie and Yates, the author states: "If their figures are considered in detail, it will be found that streptococci were isolated from the synovial membranes in 20 per cent of all cases". In answer to this it is stated that the author (1925) has pointed out that "similar organisms can be isolated from the heart blood of a not dissimilar percentage of cases dead from any cause". These statements are no doubt correct, but they are misleading. The author ignores altogether the experimental results obtained with the organisms in the 20 per cent of the cases, the rheumatic history of these cases, and particularly that in double the number of cases done at the same time the synovial membranes contained no streptococci, and that therefore general blood infection was excluded. The remaining parts of this section, on the enterococcus (though we disagree with the differentiation between this and *S. faecalis*), the parts on the anaerobic streptococci and on chemotherapy, are all important contributions which add considerable value to this whole chapter.

The chapter on pneumococcus is a very exhaustive study of this organism, and the authors have given very careful attention to detail. The views of various authors are given with extreme fairness and with excellent critical judgment. On the gonococcus, Tulloch writes with the authority of one who has himself done a considerable amount of work on the subject, and in consequence is quite familiar with the work of others. Nothing but praise can be given to this section, and we would specially emphasise the valuable part on practical diagnosis. The section on meningococcus (and, by the way, we are glad to see the protest against the American name, *Neisseria intracellaris*) is again evidently the work of an expert on the subject. We do not agree with all Dr. Murray has written—and particularly with the emphasis laid on identification by cultural characteristics—but it is a well-written article and gives an excellent and valuable account of most of the work done in relation to this organism.

Chap. vi. calls for little comment. The confusion which exists in regard to the bacteriology of influenza presents a difficult task to a writer on the subject, and Dr. Scott has done the very best with the material at his disposal. He has given the various views with great fairness, and though apparently he is a convinced believer in *B. influenza* (Pfeiffer) as a cause, he has not overemphasised the evidence in his favour.

The work by Prof. Hewlett in Chap. vii. gives all the necessary information on the various subjects dealt with in that chapter.

Taking the volume as a whole, we welcome it as a very valuable addition to the bacteriological library. It will be a constant source of reference to all workers on this group of organisms, and they will, we think, generally find some valuable information on any work they may be undertaking.

J. M. BEATTIE.

Tropical Agriculture.

A Text-Book of Tropical Agriculture. By Sir Henry Alford Nicholls. Revised by John Henry Holland. (Macmillan's Manuals for Students.) Second edition. Pp. xxxvi + 639. (London: Macmillan and Co., Ltd., 1929.) 15*s*.

WITH the need for the development of our resources in the tropical colonies brought so prominently before us in recent years, it is surprising that we have been so long without an up-to-date text-book on tropical agriculture. The want of such a book has long been felt; the reviewer has frequently been asked in recent years to recommend a suitable work of this character to intending settlers and for use in schools and colleges. The demand for the book is further indicated by the fact that Sir Henry Alford Nicholls's text-book, first published in 1892, was reprinted seven times at intervals of about five years. The subject of the present review is the second edition of the same work, which has been revised and partly rewritten by Mr. J. H. Holland, of the Museums staff of the Royal Botanic Gardens, Kew.

To deal with the several groups of subjects included under the general term 'tropical agriculture' is no easy task. To deal with them exhaustively would require a volume for each. The result would be a series of monographs, of which the complete set would not only be too bulky, and too costly for the planter, but it would also be so exhaustive that the average man would not find

time to wade through it, and it would be beyond the ability of the school or college teacher to sift out of this mass of information the facts essential for class-room lessons. It is true that a man who is about to undertake maize-growing on a large scale will be glad to have an exhaustive treatise on the subject, which he can consult from time to time as questions arise. But with the tendency toward reducing the risk of loss by the use of catch-crops, green-manure crops, and rotation crops, the tropical agriculturist would like to have some handy and not too detailed book of reference which will suggest to him crops which are, at any rate, worth experimental cultivation. The book before us is of this character. It is of handy size, limited to 639 pages, well illustrated, with a convenient index in a single series and having the main points of the text indicated by marginal headings which enable one to find quickly the facts which are dealt with.

The text-book is divided into two parts, the first of which, comprising about 100 pages, deals with the elements of agriculture, grouped into thirteen chapters, namely, soils, plant-life, propagation of plants, climate (a bare couple of pages, which might have been enlarged with advantage), manures, rotation of crops (less than four pages; the result of experiments in the Dominions and Colonies, conducted during recent years, might have been recorded to good purpose), drainage, irrigation (here the information is limited to two pages and more might have been said), tillage operations, pruning, budding, and grafting.

The second part, comprising 510 pages, is divided into twenty chapters, dealing with such diverse subjects as coffee, cocoa, tea, sugar-cane, fruits, spices, tobacco, drugs, dyes and tans, tropical cereals, food-plants (for example, cassava, arrowroot, yams, pulses, etc.), fodder-plants, rubbers, fibres, oil-seeds, and volatile oils.

The paragraph on teff-grass (*Eragrostis abyssinica*), p. 465, might have been enlarged to advantage. More than a quarter of a million acres in the Union of South Africa are devoted to this grass as a hay crop, and its use has extended to Northern Rhodesia, Australia, and elsewhere. The value of the crop to South African farmers is placed at more than a million pounds sterling per annum. The very fine seed of the teff plant requires suitable handling if the crop is to succeed, and instructions as to seeding, etc., would have been helpful.

In view of the great importance of maize for stock food, for feeding native labour, and as a cash crop for export, a little more attention might have been given to it. Some of the information supplied could have been replaced to advantage by the results of more recent work in the Union of South Africa, in Rhodesia, in Kenya, and elsewhere. The writer speaks of 'yellow-dent' as a particular variety of maize, whereas it is a class-name which covers many varieties. It is misleading to speak (p. 405) of a rainfall of about "50-80" inches as "required" for maize; in some countries this proves far more than is good for the crop. The precipitation requirement will vary, of course, with the incidence of the rainfall, and the degree of evaporation and transpiration which, again, are affected by temperature. The Argentine maize-belt, which produces a large part of the world's supply, has an average rainfall ranging from 31·5 in. to 39·4 in. (see Burtt Davy, "Maize", pp. 37-42). In Rhodesia, Natal, and the Transvaal, a mean rainfall between 25 in. and 35 in. is the optimum for this crop.

In reading through the pages, one feels that the author of this revision must have been somewhat hampered by the fact that he was preparing a new edition of an old book. The changes which have taken place in agricultural practice, in the more than thirty-five years since the first edition appeared, due in part to increase in knowledge of the fundamental sciences and in part to experience, are so great, and such vast developments have taken place in the Dominions and Colonies in the period referred to, that it would have been better had the book been completely rewritten from cover to cover.

A very minor error, but one too frequently made, is the use of capital letters for the adjectival form of specific names of plants: for example, *Ledgeriana* and *Deeringiana* instead of *ledgeriana* and *deeringiana*. The use of capitals for *Litchi* and *Cavendishii* is correct, these being proper nouns in the nominative and genitive cases respectively. Owing to the difficulty which agriculturists, foresters, and horticulturists must necessarily have in ascertaining whether a word used as a specific name is entitled to a capital letter (on account of the fact that it has been used at one time as a generic name), it might possibly be better to decapitalise specific names throughout, in all technical publications intended for their use.

It is the duty of a reviewer to criticise. In doing so it is far from our desire to belittle a book for which we have long felt the need, and which can be confidently recommended to the would-be settler, the planter, and last, but by no means least, the teachers in schools and colleges who are endeavouring to arouse an interest among their students in the development of the British Empire overseas.

Our Bookshelf.

Elements of Optical Mineralogy: an Introduction to Microscopic Petrography. By N. H. Winchell and A. N. Winchell. Entirely rewritten and much enlarged by Prof. Alexander N. Winchell. Second edition. Part 3: *Determinative Tables.* Pp. xii + 204. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 22*s.* 6*d.* net.

THIS edition of Part 3 of Winchell's "Elements of Optical Mineralogy", now published separately, entirely supersedes the earlier edition, which was incorporated with Parts 1 and 2 in one volume. Following a short introduction, five tables for the determination of minerals under the microscope are given. In the first a few of the commoner opaque and semi-opaque minerals are arranged with reference to their colour in reflected or transmitted light. No pretence is made, however, of dealing completely with this group. Minerals transparent in thin section are dealt with exhaustively in Tables 2 to 5. They are first listed with reference primarily to their birefringence. In Table 3 colour is the main determinative characteristic. Next come complete lists of isotropic and anisotropic minerals placed in the order of their refractive indices. In Table 5 the author has arranged the minerals in the order of their power of dispersion, so far as has been possible with the scanty data at present available. This is a useful addition to the methods of classification more usually adopted in determinative tables. Full explanatory notes precede each table.

There are also three plates, conveniently held in a pocket at the end of the book. Plate I. is a large coloured diagram showing the relationship between the interference colours of crystals, the thickness of the sections, and the birefringence of the crystals. Plate II. is a graphic representation of the most important minerals, based on their refringence, birefringence, and optic sign. It shows the variation in these properties resulting from variation of composition. The third plate is a copy of Wulff's stereographic plot for use in the study of minerals by the methods of the Federoff universal stage.

The volume is well produced, comprehensive, and up-to-date. It should prove useful to all engaged in the study of microscopic petrography.

The Acoustics of Orchestral Instruments and of the Organ. By Dr. E. G. Richardson. Pp. 158 (20 plates). (London: Edward Arnold and Co., 1929.) 10*s.* 6*d.* net.

DR. RICHARDSON has followed his recent "Text-Book of Sound" with an attractive book founded on the 1929 Martin White lectures given at the Northern Polytechnic, London. The subject of the lectures was the tone production of the organ and other wind instruments, and forms the basis of the first four chapters. Whilst the treatment is essentially popular, it includes much of the important work done since the time of Helmholtz. A special feature of the book is the profusion and excellence of the illustrations, which include not only all the various instruments discussed, but also Carrière's striking photographs of eddy formation in the production of edge tone, details of the remarkable Pleyel Hall in Paris, and vibration curves of Milner and Barton and Browning. It is unfortunate that all these curves are of necessity qualitative, since they were obtained with recording apparatus depending upon resonance in which the response was unequal and imperfectly known at the various frequencies.

No special chapter is devoted to the organ, which is "in itself an orchestra", but the scope of the book is extended in the later chapters to deal with percussion, the strings, and *ensemble.* It is a little difficult to understand why church bells are included and the pianoforte excluded. The modern composer uses the pianoforte, and in one work even the gramophone (to reproduce the song of the nightingale), as purely orchestral instruments. There is more detail of architectural acoustics than of the phenomena of hearing, which are equally important in considering the effects of an orchestra in action. Apart from an appendix on the theory of fingering and cross-fingering on the wood-wind, the book is free from mathematics and is therefore of wider appeal. The author has further elaborated some of the topics of his Cantor Lectures (*Jour. Roy. Soc. Arts,* **78**, January 1930). W. H. G.

The Scientific Fundamentals of Gravity Concentration. By Prof. Josef Finkey. Translated into German from the Hungarian by Prof. Johann Pocsubay. Translated from the German by C. O. Anderson and M. H. Griffiths. (Bulletin of the School of Mines and Metallurgy, University of Missouri, Technical Series, Vol. 11, No. 1.) Pp. 295. (Rolla, Mo.: School of Mines and Metallurgy, 1930.) 1 dollar.

PRIMARILY this work appears to have been written with the view of helping the mining engineer to understand more thoroughly the principles mentioned. Undoubtedly it will clear up many abstruse points for the practical engineer, but the strongly mathematical treatment makes it a work for the specialist, who will no doubt read it as it should be read, that is, in conjunction with the latest published accounts of experimental research on mineral dressing.

Descriptions of machines are not attempted, and the author makes it plain in his preface that it was his wish to treat those parts of the subject which are not adequately treated in the standard works. As it now appears in three languages, this may be taken as some measure of the merit of the work. After the introduction there are four chapters, of which the first deals with the mechanical principles of gravity concentration, and the subsequent chapters deal with the preparation of mineral or ore for concentration, jigging, and concentration on tables respectively.

It will be clear from the above that the scope of the work is limited to the treatment of ores and minerals in water. As is well known, there is a great number of processes in use for the dressing of minerals to-day in which water plays no part

at all, and others in which water is modified to give further benefits. That the latter class is not treated directly, is simply further proof of the special nature of the work. To the student the importance of the work will lie in its supplementary character, while the engineer in charge of a mineral dressing plant will find much new light thrown on the separation of mineral and gangue by water. C. H.

Winchester College Natural History Society. The British Palmate Orchids. By H. Cary Gilson. Pp. 36+35 plates. (Winchester: P. and G. Wells, Ltd., 1930.) 3*s*.

ALTHOUGH much valuable work on the British palmate orchids has appeared in recent years, notably by Dr. G. C. Druce and by the Rev. T. and Mr. T. A. Stephenson, this has been scattered among a number of papers in different journals. It is consequently difficult to find out the general conclusions which have been, or can be, drawn from such work, or even to tell what species are actually recognised as distinct.

Mr. Gilson has attempted in the little book under notice to bring together all this information and to sum up what seem to be the chief conclusions which can be derived. The descriptions of the species are very complete and clear, while full references are given to the sources of information. Each species is illustrated by photographs of the plant *in situ* and of individual flowers. These are good on the whole, but would be more useful if the scale of magnification were given in each case.

In the second part of the book the author describes his own studies on the group as represented in the neighbourhood of Winchester, describing a number of localities and the orchid populations growing there. The most interesting portion of this part of the work is Mr. Gilson's theory of the status and origin of the various forms of the polymorphic *Orchis latifolia* L. as found in Britain. This is very suggestive and is certainly worth following up. As Mr. Gilson properly points out, only definite experimental work can prove what is correct in this and other examples. It is, however, decidedly encouraging to see that this extremely difficult group of plants is being studied along ecological and genetical lines in conjunction with the more orthodox taxonomic methods; for it is only by such means that further progress can be made either in the orchids or in any other group of British plants. V. S. S.

Physical Measures of Growth and Nutrition. By Dr. Raymond Franzen. (School Health Research Monographs, No. 2.) Pp. xii+138. (New York: American Child Health Association, 1929.) 1 dollar; cloth, 1.25 dollars.

THIS monograph is a statistical study of anthropometrical data obtained from 10-12-year-old children: the work was carried out with the view of devising satisfactory methods of measurement of the state of nutrition of the subjects. No satisfactory agreement between different observers was obtained when only general estimates of nutritional condition were made; greatest agreement was reached between different estimates of the amount and quality of muscle and of subcutaneous tissue.

Certain of the conclusions given in the report may be mentioned to give an idea of the scope of the work; thus it was found that the correlation of height with weight is not nearly so high as that of other skeletal combinations with weight; individual differences in chest dimensions and hips are more important as determinants of variations in weight. Individual variations in weight depend on variations in certain easily determined bodily measurements, and can be almost wholly explained as due to these latter. The methods used and the results obtained are presented in great detail; the work is an important contribution to the determination of the characteristics of the 'normal' boy or girl and to the value of different methods of estimating this normal and the deviations from it.

Ethnography. By Prof. Loomis Havemeyer. Pp. vi+522. (Boston, New York, Chicago and London: Ginn and Co., 1929.) 21*s*. net.

THERE are few subjects in which the preparation of a text-book presents greater difficulties than ethnography, especially if for various reasons it is necessary to keep within a moderate compass. Prof. Havemeyer's "Ethnography" has been written with the special view of the significance of the facts for the development of social evolution. In order to avoid too great diffuseness on one hand, and, on the other, the effort to be encyclopædic, his plan has been to select a few tribes under the main races about which we know all the typical and significant facts on reliable authority, and then to describe them under the main aspects of their self-maintenance, self-perpetuation, self-gratification, religion, and regulative organisation. On this scheme the black, brown, red, yellow, and white races are described in turn; but the main groups of the yellow and white races are not touched upon for reasons of space, the description of the former being confined to Tibetans and Yakuts, and of the latter to Hindus.

Races of Africa. By Prof. C. G. Seligman. (The Home University Library of Modern Knowledge.) Pp. 256. (London: Thornton Butterworth, Ltd., 1930.) 2*s*. 6*d*. net.

PROF. SELIGMAN'S book on Africa is almost a *tour de force* in condensation. As an introduction to the study of African peoples and culture it will be of the greatest assistance to students. Apart from its value as a comprehensive, if brief, summary of the present state of our knowledge, it serves to bring home to the public how great are the gaps in our information to be made up before anything approaching certainty in our conclusions can be attained. As the author points out in his introductory chapter, there are still in Africa unsurveyed areas and uncharted tribes. In physical anthropology a beginning has scarcely been made in the anthropometric survey which is an essential condition of valid argument on the racial history and affinities of the African peoples.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Artificial Disintegration by α-Particles.

IT is commonly assumed that the process of artificial disintegration of an atomic nucleus by collision of an α-particle is due to the penetration of the α-particle into the nuclear system; the α-particle is captured and a proton is emitted.

On general grounds it seems possible that another process may also occur, the ejection of a proton without the capture of the α-particle.

Consider a nucleus with a potential field of the type shown in Fig. 1, where the potential barrier for the α-particle is given by the full line and that for the proton by the dotted line. Let the stable level on which the proton exists in the nucleus be $-E^\circ_p$ and the level on which the α-particle remains after capture be $-E^\circ_\alpha$.

If an α-particle of kinetic energy E_α penetrates into this nucleus and is captured, the energy of the proton emitted in the disintegration will be $E_p = E_\alpha + E^\circ_\alpha - E^\circ_p$, neglecting the small kinetic energy of the recoiling nucleus. If the nucleus disintegrates without capture of the α-particle, the initial kinetic energy of the α-particle will be distributed between the emitted

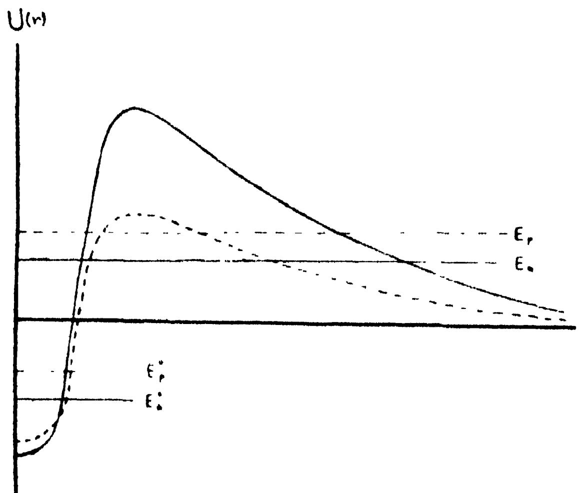


FIG. 1.

proton and the escaping α-particle (again neglecting the recoiling nucleus). The disintegration protons may have in this case any energy between $E_p = 0$ and $E_p = E_\alpha - E^\circ_p$.

Thus, if both these processes occur, the disintegration protons will consist of two groups: a continuous spectrum with a maximum energy less than that of the incident α-particles and a line spectrum with an energy greater or less than that of the original α-particles according as $E^\circ_\alpha > E^\circ_p$ or $E^\circ_\alpha < E^\circ_p$, but in either case considerably greater than the upper limit of the continuous spectrum (see Fig. 2).

In some experiments of one of us in collaboration with J. Constable and E. C. Pollard, the presence of these two groups of protons appears quite definitely in certain cases, for example, boron and aluminium. A full discussion of these and other cases of disintegration will be given elsewhere, but it may be noted that the existence of groups of protons has already been reported by Bothe and by Pose. In general the experimental results suggest that with incident α-particles of energy about 5×10^6 volts (α-particles of polonium) the process of non-capture is several times more frequent than the process of capture.

It is clear that, if our hypothesis is correct, accurate measurement of the upper limit of the continuous spectrum and of the line will allow us to estimate the values of the energy levels of the proton and α-particle

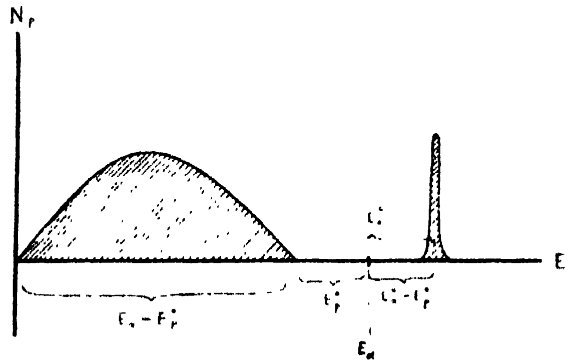


FIG. 2.

in the nucleus. In the case of aluminium bombarded by the α-particles of polonium the protons in the continuous spectrum have a maximum range of 32 cm. and those of the line spectrum a range of 64 cm. These measurements give the following approximate values for the energy levels:

$$E^\circ_p = 0{\cdot}6 \times 10^6 \, \epsilon \text{ volts, and } E^\circ_\alpha = 2 \times 10^6 \, \epsilon \text{ volts.}$$

On the wave mechanics the probability of disintegration of both types is given by the square of the integral

$$W = \iint f(r_{\alpha,p}) \cdot \psi_\alpha \cdot \psi_p \cdot \phi_\alpha \cdot \phi_p \cdot dV \cdot dV' \qquad (1)$$

where $f(r_{\alpha,p})$ is the potential energy of an α-particle and a proton at the distance $r_{\alpha,p}$ apart, and the wave functions ψ_α, ψ_p represent the solutions for the α-particle and proton before and ϕ_α, ϕ_p after the disintegration. In calculating the integral (1) we must develop the incident plane wave of the α-particle into spherical harmonics corresponding to different azimuthal quantum numbers of the α-particle, and deal with each term separately.

In the case of capture of the α-particle the estimation of (1) can be carried out quite simply. It can be shown that the effect of the higher harmonics is very small, and that the disintegration is due almost entirely to the direct collisions. Thus we obtain for the probability of disintegration

$$W_1^2 = \frac{A}{v_\alpha^2} \cdot e^{-\frac{8\pi^2e^2}{h}\cdot\frac{Z}{v_\alpha}} \cdot e^{-\frac{4\pi^2e^2}{h}\cdot\frac{Z}{v_p}}$$

where v_α and v_p are the velocities of the initial α-particle and the ejected proton respectively. Since only the first harmonic is important in disintegration of this type, it is to be expected that the protons will be distributed nearly uniformly in all directions.

When the α-particle is not captured the disintegrations will arise mainly from collisions in which the α-particle does not penetrate into the nucleus. For disintegration produced in this way the higher harmonics become of importance. The probability of disintegration can be roughly represented by the formula

$$W_2^2 = B \cdot e^{-\frac{8\pi^2e^2}{h}\cdot Z\left(\frac{1}{v'_\alpha} - \frac{1}{v_\alpha}\right)} \cdot e^{-\frac{4\pi^2e^2}{h}\cdot\frac{Z}{v_p}}$$

where v'_α is the velocity of the α-particle after the

collision, and B is a function of the angle of ejection of the proton. The protons of the continuous spectrum will not be emitted uniformly in all directions. According to the expression (3) the distribution with energy of the protons in the continuous spectrum will have a maximum value for an energy of ejection of about 0·3 of the upper limit, and will vanish for zero energy and at the upper limit.

More detailed accounts of the experimental results and of the theoretical calculations will be given shortly.

J. CHADWICK.
G. GAMOW.

Cavendish Laboratory,
Cambridge, June 18.

Submarine Cable Interference.

DURING the summer of 1929 measurements were made on interference voltages received on a submarine cable in Trinity Bay, Newfoundland. The interference voltages were impressed on a vacuum tube amplifier capable of a power amplification of the order of 10^{15}. The amplifier and associated apparatus were designed to permit analysis of interference frequencies from 100 to 4000 c.p.s.

The usual types of natural as well as industrial interference were observed. The major part was of atmospheric origin, low frequency, low amplitude kicks being usually present, but at times masked by sharper and stronger static crashes and other types of interference.

During the three months over which tests were conducted, occasional comparisons were made between cable interference and audio frequency atmospherics applied to the amplifier by a large untuned loop. The two inputs were essentially the same regarding types of natural interference, but the higher frequency components of the former were considerably attenuated due to shielding effect of the sea water.

The level of natural interference was as a general rule low during daylight hours. During the evening a gradual increase of static kicks occurred, night level being reached some two hours after sunset. This level was usually held until the beginning of daybreak, when it dropped rapidly, usually reaching the day amplitude in less than thirty minutes. The highest levels of natural interference occurred during the last week of August and the first week of September.

In a few instances the interference in the intermediate frequency range (500 to 1500 cycles) increased considerably. By aural observation this interference appeared as a jumble of hollow rustling or roaring sounds. Another type of interference which often followed and sometimes accompanied periods of high intermediate frequency interference was characterised by swishing sounds, such as made by thin whips when lashed through the air. These 'swishes' were always found to vary in frequency, passing downward during some periods and at other times upward. At times the upward and downward progressions were observed simultaneously. The frequency range covered lay usually between 700 and 2000 cycles, but the individual tones usually did not cover a range of more than an octave. The duration of a 'swish' varied from possibly ½ second to more than a second. These two types of interference appeared to be independent of time of day or weather conditions. There is some evidence of correlation between them and periods of high magnetic disturbance. It is probable that the tones observed by Barkhausen[1] were the same as swishes of descending frequency. The musical atmospheric disturbances of descending tone described by Eckersley[2] may be of the same nature, although there are several notable points of distinction.

A type of interference frequently observed consisted of a damped oscillation of substantially constant frequency usually starting with a static kick. The audible duration was of the order of ⅛ second. The frequency range over which these oscillations could be expected extended from 1600 cycles to 2200 cycles. These oscillations, called 'tweeks' because of their characteristic sound, were observed on nearly all nights. They were never observed during daylight hours. They frequently appeared at dusk, at first very highly damped and spaced by intervals of several minutes. After nightfall the damping gradually decreased and the rate increased, the night conditions usually being reached in approximately one hour. The rate of occurrence during a night was usually between 3 and 30 per minute. Just previous to dawn the rate often increased for a few minutes, then decreased rapidly, reaching zero at the approach of full daylight.

Two independent series of tweeks were often observed, one of high amplitude and of frequency in the general region of 1700 cycles. The other was in the neighbourhood of 2000 cycles, of low amplitude very highly damped. The former often occurred in rapid trains. The latter were always observed singly. These two series of tweeks appeared to be entirely independent, often occurring at random during the same period. Frequent changes were observed in the frequencies of successive tweeks of both series, but the two were never observed to merge.

It is probable that electromagnetic disturbances resulting from static kicks could produce tweeks by multiple reflection between the earth's surface and a Heaviside layer. Considering the high amplitude tweeks, a reflecting layer height of 88 km. would correspond to a frequency of 1700 cycles. This is in fair agreement with Schelleng[3] and others as to the location of the low frequency reflecting layer.

The non-appearance of tweeks during daylight hours might be expected because of an ionised absorbing layer at low altitudes produced by the sun as described by Heising.[4]

The higher frequency tweeks, because of their higher damping, might be expected to originate under less favourable reflecting conditions. They may be produced in a higher latitude where the reflecting layer is lower, as suggested by Heising. They might even result from reflection between two Heaviside layers, the lower one being sufficiently poor in reflecting powers to permit passage of waves to the earth's surface.

EVERETT T. BURTON.

Bell Telephone Laboratories,
New York, New York,
May 23.

[1] Barkhausen: *Phys. Zeits.*, **20**, pp. 401-3; 1919.
[2] Eckersley: *Phil Mag.*, **49**, pp. 1250-60; 1925.
[3] Schelleng: *Proc I.R E.*, **16**, pp. 1471-6; Nov. 1928.
[4] Heising. *Proc. I.R.E.*, **16**, pp. 75-99, Jan. 1928.

Electron Diffraction by 'Forbidden' Planes.

SEVERAL experimenters have obtained results which they interpret as showing that electrons can be selectively reflected by crystal planes which would not give a corresponding Bragg reflection with X-rays, for example (100) in the first order for a face-centred cube. In some cases even 'half orders' of reflection are found. Thus in a recent paper[1] Rupp finds reflections from odd orders and half orders of the (100) cleavage plane of rocksalt, and similar face-centred cubic crystals. His experiments, like the others, were

made with electrons of the order of 100 volts energy, detected electrically.

I suggest that some of these extra reflections may be due to the Kikuchi lines, which are caused by diffuse scattering in the crystal followed by selective reflection. Using a single collector and varying angle or voltage, there is nothing to tell an experimenter whether a peak in his curve is caused by a Kikuchi line, or a Laue spot, falling on his collector. Some recent experiments which I have made to look for the half order effect show that the Kikuchi lines may be very prominent. If a piece of rocksalt is mounted so that the electrons, of about 30,000 volts, are incident on a cleavage face, a pattern of lines and spots is formed by the diffracted rays on a willemite screen (Fig. 1). If the crystal is

FIG. 1.—Diffraction by rocksalt The large spot shows the position of the beam with the crystal removed.

rotated about axes in, and perpendicular to, the cleavage face, the lines move rapidly over the screen and the spots flash in and out, forming a brilliant effect. I have measured the spots on the screen and photographed the whole pattern. Even quite complicated and unsymmetrical patterns, such as that reproduced, can be analysed and indices assigned to the planes which cause the various lines and spots, using the distances between the black and white Kikuchi lines to give the spacings. The angles between the lines are approximately those between the planes to which they are due, and this gives a useful check. In no case have I found it necessary to assume reflections from forbidden planes or orders. In an experiment, such as Rupp's, in which the crystal and collector are kept fixed and the voltage varied, the Kikuchi lines would move parallel to themselves. If one of them crossed the position of the collector a peak would be recorded. This event might or might not coincide with the appearance of a spot on the line at this point. If it does not, there will be a peak not explained on the simpler theory.

The measurements of the actual spots fit the simple theory approximately, but there is a slight compression perpendicular to the crystal surface such as might be caused by a refractive index. The corresponding inner potential would be about +10 volts, rather more than Rupp found. There is, however, always some charging up, and I am doubtful if one should regard the 10 volts as a true property of the rocksalt, or merely as an expression of the strength of the charge. Heating removes the charge, but also destroys the spots or greatly weakens them. Blue rocksalt is better than white, probably because of better conductivity.

G. P. THOMSON.

University of Aberdeen,
June 30.

[1] Rupp: *Annalen der Phys.*, vol. 4, p. 1097; 1930.

A Physical Interpretation of Perturbations in Band Spectra.

THE interesting phenomena of predissociations and perturbations in band spectra are now attributed to interactions of various kinds between certain electronic states in the molecule. As has been shown, especially through a theoretical paper of Kronig (*Zeitsch. f. Physik*, **50**, 347; 1928), these phenomena may be considered from a common viewpoint, the characteristics of which are given below.

(1) Two interacting states, having equal energy, must also occupy equal values of J, the quantum number of the resultant angular momentum in the molecule.

(2) They must further belong to electronic states, of which the resultant orbital angular momenta (Λ) around the molecular axis agree within zero or one unit in $h/2\pi$.

(3) They must finally satisfy every kind of symmetry, to be questioned in cases of diatomic molecules.

Franck and Sponer interpret the predissociation phenomena in a very tangible way (*Göttinger Nachr.*, p. 241; 1928). A molecule, vibrating along the potential gradient a in Fig. 1, passes through the intersection P into a new state b. If the potential energy at P is greater than the dissociation energy of b ($W_P > W_b$), the molecule will predissociate through b, although being perhaps far below the dissociation limit of a. The conditions to be fulfilled are all included under section 2 and 3 in Kronig's theory above. Franck and Sponer emphasise the probability of the transition $a \rightarrow b$, when the intersection P is situated on the horizontal branch of b ($W_P = W_b$). Fig. 1 corresponds to a more general condition of predissociation, very recently proposed by Herzberg (*Zeitsch. f. Physik*, **61**, 604; 1930). From a wave mechanical viewpoint, predissociation

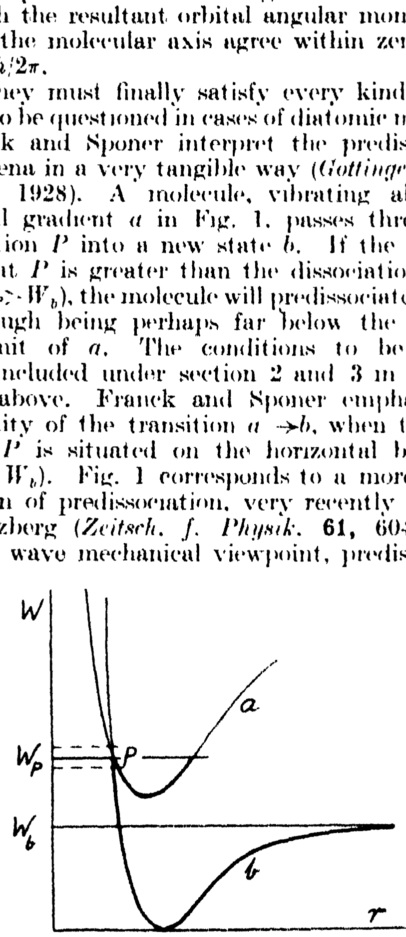


FIG. 1.

will take place even when the molecular energy not exactly agrees with W_P, as indicated by the dotted lines in Fig. 1.

Now, what happens when the intersection P falls below the limits of dissociation in a and b, as indicated in Fig. 2? Apparently the molecule will synchronise in a and b, and as both states now are quantised in discrete levels, all conditions in Kronig's theory have to be fulfilled. These conditions give an expression for the conservation of energy and the resultant angular momentum in the molecule. In addition, our viewpoint brings arguments on the conservation of the nuclear distance and the vibrational impulse during the act of transition in P.

A band series, emitted by raising the rotational energy of the molecule performing an electronic transitions $a \rightarrow c$, will exhibit perturbations in frequency as well as in intensity for lines corresponding to the region of intersection at P. An exact determination of P affords, of course, the construction of

a potential gradient $V_J(r)$, resulting from the rotation and nuclear vibration in the molecule (O. Oldenberg, *Zeitsch. f. Physik*, **56**, 563; 1929). As shown by Kronig, the frequency perturbations in the band-lines will be of the characteristic 'resonans type', in agreement with empirical results, especially with those of Rosenthal and Jenkins on the spectra of CN and CO (*Proc. Nat. Acad. Sci.*, **15**, 381; 1929; **15**, 896; 1929). The probability for the molecules penetrating the barrier between the potential gradients is essentially determined by the factor

$$\exp. - \frac{4\pi}{h}\int \sqrt{2\mu(V_J(r) - W)}dr$$

(Gurney and Condon, *Phys. Rev.*, **33**, 127; 1929). There will thus be a decrease of intensity in the perturbed region of the band series, due to the 'leaking through'

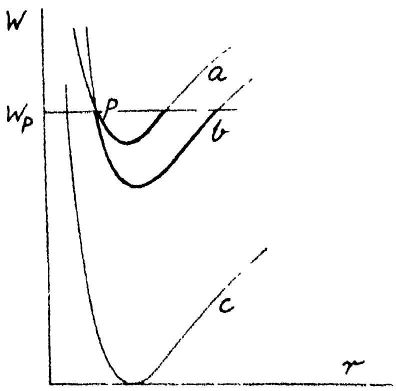


FIG. 2.

of molecules from a to b. This is a feature of many perturbations observed, and it seems not unlikely that a careful examination of their intensity distributions would admit a determination of the angular intersections at P. On the other hand, transitions $b \rightarrow c$ are allowed in cases obeying the emission rules (Δv 0, 1), and consequently, if our interpretation is correct, sporadic lines belonging to this system will appear in the perturbed region of the system $a \rightarrow c$ although the intensity maximum of $b \rightarrow c$ may be situated far away in spectrum. In fact, there are numerous perturbations in band spectra which exhibit a large, unsymmetric splitting of lines into two components, which may be interpreted in this way. In certain cases these conditions should also give rise to unequal perturbations in the P and R branches.

The main purpose of this note is to point out that Kronig's arguments can be graphically illustrated, and that this immediately requires further arguments for the appearance of perturbations in band spectra. As a matter of fact, there are cases known where no perturbations appear, although they might be expected to occur by Kronig's theory.

E. HULTHÉN.

Laboratory of Physics,
University of Stockholm,
May 30.

Variations with Sidereal Time in the Intensity of the Cosmic Ultra-Radiation.

PRELIMINARY results of measurements on the cosmic ultra-radiation, or the so-called highly penetrating radiation, as carried out by me using a Kolhörster ionisation chamber in Abisko in Northern Sweden (N. lat. 68° 21′, 388 metres above sea-level), have been reported in *Lund Meddelanden*, No. 121. The chamber is placed in an iron shield of 11 cm. floor-thickness and 6 cm. wall-thickness, and the opening upwards free. During the period Nov. 13, 1929 – Jan. 13, 1930, the chamber was observed every second hour except during the nights between 24^h and 6^h M.E.T. approximately. Later on, a photographic recording cylinder was placed in front of the microscope of the chamber, and the observations have been performed day and night in connexion with—as before—meteorological, magnetic, and auroral routine work.

The derived values of the intensity of the ultra-radiation as reduced to 760 mm. air pressure have been grouped according to sidereal time, and the mean values for every sidereal hour in fortnightly intervals are shown in Fig. 1, night-part dotted. The curves show considerable changes in their shape, as also in the case with the curves of G. Hoffmann and F. Lindholm as reproduced in *Gerlands Beiträge zur Geophysik*, **20**, 12, 1928, and **22**, 141, 1929. The means for the total period, however, and especially the means for the period Nov. 13–Dec. 16, 1929, agree essentially with the curves showing variation with sidereal time, deduced from the measurements of W. Kolhörster, G. v. Salis, K. Büttner, and E. Steinke (compare, for example, Corlin, *Zeitschrift für Physik*, **50**, 808; 1928; and Steinke, *Physikalische Zeitschrift*, **30**, 767; 1929). Only the maximum at 0^h sidereal time in the measurements of these authors is missing,

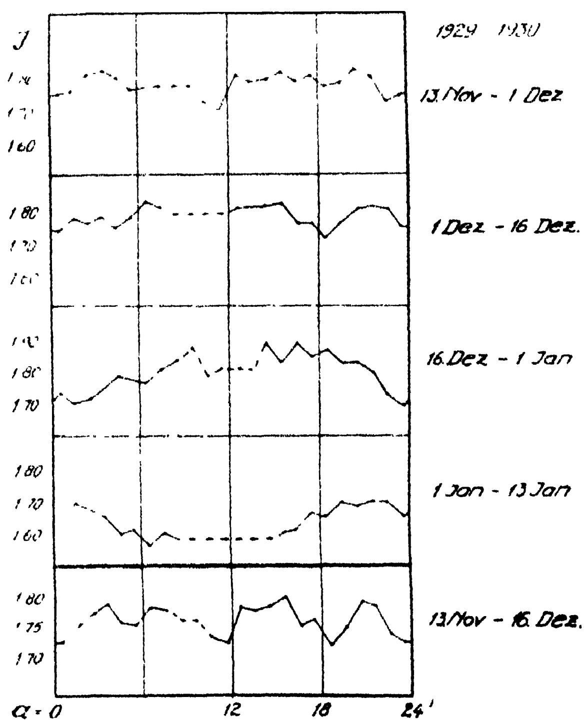


FIG. 1.

which may be caused by the difference in latitude of the places of observation. It is concluded that the daily sidereal curve of the cosmic ultra-radiation can present a very different shape for short intervals of time, but that there is a certain characteristic curve which always appears in the means for longer periods. This curve exhibits principal maxima for 0^h (except possibly for high northern latitudes), 6^h, 12^h–16^h, 20^h–21^h, and principal minima between 8^h and 12^h and for 18^h–19^h sidereal time.

The measurements of F. Lindholm also show the existence of this underlying characteristic curve, in spite of the very different shape of the curves for different months found by him (*Gerl. Beitr.*, **22**, 141; 1929). Thus, by taking the means of the three curves, termed "offen" in Fig. 3 of that paper, the upper

curve of our Fig. 2 is obtained. For comparison, the sidereal curve from the measurements of E. Steinke obtained in November 1926 with the same type of apparatus is shown in Fig. 2 (cf. also *Zeitschrift für Physik*, **50**, 808, and *Phys. Zeit.*, **30**, 767). It may be emphasised that at present no single set of hourly measurements carried out with allowance for the earth radiation and the air pressure, and with no shield covering the apparatus, has been published without showing this characteristic sidereal curve in the average values for a sufficiently long period. The

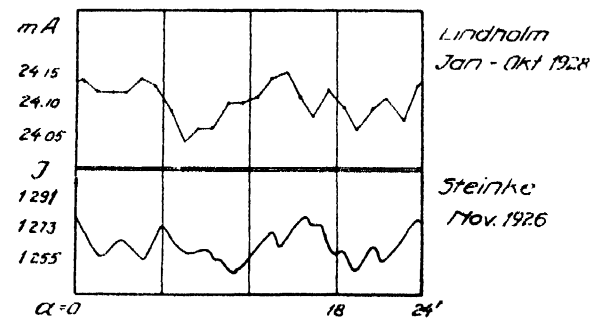


FIG. 2.

existence of a characteristic sidereal curve for the cosmic ultra-radiation seems thus to be definitely proved also. If so, it follows as an important consequence that there exist definite radiation centres among the heavenly bodies.

If there exist a correlation between the intensity of the cosmic ultra-radiation at a particular place and magnetic disturbances, which is now under investigation in Abisko, we look for the radiation centres in other directions than those which directly correspond to the sidereal times in question, and this may be carried out with the help of Carl Störmer's equations.

AXEL CORLIN.

Geophysical Observatory,
Abisko, May 2.

Raman Effect of Nitric Acid in Solution.

IN a recent publication (*Proc. Roy. Soc.*, **127**, 279; 1930; see also NATURE, **124**, p. 762; 1929) Ramakrishna Rao has shown how the Raman effect can be applied, in the case of nitric acid in solution, to demonstrate the increase of ionisation with dilution. In repeating his experiments I have obtained plates which, while confirming Rao's main conclusion, contradict some of his results.

In agreement with Rao, I find that the lines with $\Delta\nu \sim 1050$ cm.$^{-1}$ show the following peculiar behaviour upon dilution. Starting with 65 per cent acid and using the same exposure in each case, the intensity increases at first as the acid concentration is reduced, passes through a maximum, and afterwards falls off again. As was pointed out by Rao, this is doubtless due to the increase in the degree of ionisation with dilution, the lines in question belonging to the nitrate ion. Now Rao supposes that the wave-number shifts $\Delta\nu \sim 623$ and 673 cm.$^{-1}$ (given by him as 638 and 685 cm.$^{-1}$ respectively) also belong to the ion. If this be true, the corresponding lines ought to show upon dilution the same type of intensity variation as do those with $\Delta\nu = 1050$ cm.$^{-1}$. From my plates and photometer curves, however, it can be seen that this is not the case. The pair of lines with $\Delta\nu = 623$ and 673 cm.$^{-1}$ shows in fact a continuous decrease in intensity with dilution, and indeed disappears at a concentration where the lines with $\Delta\nu = 1050$ cm.$^{-1}$ are at their strongest. This behaviour is exactly parallel to that of the lines belonging to the non-ionised HNO_3 molecule, to which therefore $\Delta\nu = 623$ and 673 cm.$^{-1}$ must be ascribed.

The reason for Rao's error in ascribing these shifts to the ion is probably as follows. At concentrations where the lines with $\Delta\nu = 1050$ cm.$^{-1}$ are near their maximum intensity, a new weak single line seems to make its appearance. It is excited by the 4358 A. mercury line with $\Delta\nu = 707$ cm.$^{-1}$ approximately. It lies at 4497 A. ($\pm$ 2 A.), that is, not very far from the pair of lines with $\Delta\nu = 623$ and 673 cm.$^{-1}$ (λ = 4480 and 4490 A. respectively); and it is possible that a confusion between them led Rao to mistake the behaviour of the pair. The continuous spectrum, which masks Rao's plates at these concentrations, seems in my case to be not nearly so strong.

In support of his ascribing of $\Delta\nu = 623$ and 673 cm.$^{-1}$ to the nitrate ion, Rao states further that these shifts also occur for a solution of sodium nitrate. I am unable, however, to observe them in this case. Instead I find (along with a continuous spectrum) a weak single line with $\Delta\nu = 717$ cm.$^{-1}$, in agreement with the observation of Dickenson and Dillon. This line is clearly the analogue of the line with $\Delta\nu = 707$ cm.$^{-1}$ found in nitric acid; they both have about the same intensity (relative to the corresponding $\Delta\nu = 1050$ cm.$^{-1}$). The frequency concerned must belong to the nitrate ion, for the same single line is also found for calcium nitrate solution. There is, on the other hand, no evidence in favour of ascribing $\Delta\nu = 623$ and 673 cm.$^{-1}$ to the nitrate ion.

LEONARD A. WOODWARD.

Physikalisches Institut,
Leipzig, Germany,
June 10.

Vegetable Oils as Fungicides.

SINCE 1914 the chemical and mycological departments of Wye College have collaborated in testing the fungicidal properties of spray fluids, especially those containing sulphur. In this work, accounts of which have been published from time to time, a special technique has been developed, by which it is possible to determine within narrow limits the action of the spray fluid upon the powdery mildew of the hop (*Sphaerotheca Humuli*). The method has recently been applied to the investigation of certain oil emulsions, in particular vegetable oils, which have been found to possess marked toxic properties towards this fungus. Whilst some of these oils, for example, rape oil, have been recommended for insecticidal purposes and are of practical use as solvents for such substances as pyrethrum extract, their value as fungicides does not hitherto seem to have been noticed.

In experiments in which 0·5 per cent soft soap was used as the emulsifier, the following oils (of commercial standard) proved completely fungicidal against the hop powdery mildew: olive oil, 0·5 per cent; sesame oil, 0·5 per cent; cottonseed oil, 0·5 per cent. Rape oil required a concentration of 2·0-3·0 per cent and castor oil at 2 per cent was non-fungicidal. In experiments with other emulsifiers indication was obtained that the type of emulsifier used had a pronounced effect upon the toxic properties of the spray.

The experiments in question have been carried out on plants in the greenhouse, and no injurious effects have been observed on the foliage with many of these vegetable oils when used at a comparatively high concentration.

It is intended to ascertain whether these vegetable oils have a protective as well as a direct fungicidal action.

H. MARTIN.
E. S. SALMON.

South-Eastern Agricultural College,
Wye, Kent, June 20.

Weekly Variation in the Intensity of Ultra-Violet Waves of Sunlight in an Industrial Town.

DAILY records of the intensity of the ultra-violet radiation were made in Huddersfield between 1925 and 1928 by the acetone methylene-blue method.[1] While as a quantitative method this only gives approximate values, comparisons may be made in a qualitative way. The figures obtained here have now been analysed for weekly variations. Since this is one of the very few so-called smoky towns in which such records have been taken, the results may be of wider interest.

The subjoined table shows the mean daily intensity

Season.		Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
June–Aug.	3·6	3·0	3·1	3·2	3·2	3·1	3·4
Sept.–Nov.	1·2	0·8	0·9	1·0	0·9	1·1	1·1
Dec.–Feb.	0·5		0·4	0·6	0·4	0·4	0·3
Mar.–May	1·8	1·7	1·7	1·7	1·6	1·5	1·6
Annual mean	1·78	1·45	1·53	1·61	1·55	1·57	1·63

on each day in the week for the four seasons and also an annual mean. One 'degree' is approximately sufficient to produce a moderate erythema of a white skin. There is a fairly pronounced maximum intensity on Sunday in all seasons except winter, giving indication of the effect of smoke-screening. The loss on week-days in summer amounts to nearly 15 per cent. Actually it seems that industrial smoke may here be responsible for a greater loss than this: there is an increase in the output of smoke from domestic sources on Sundays which will effect a lowering of the Sunday excess of radiation by an amount not easily ascertainable. The fair constancy of the mid-week figures probably shows that the effect of purely meteorological changes has been mainly eliminated in the analysis.

A similar summary for a country station would form an interesting comparison.

S. MORRIS BOWER.

Climatological Station,
Oakes, Huddersfield,
June 20.

[1] *Vide* Hill: *Proc. Roy. Soc.*, A, vol. 116, p. 268; 1927.

Blood-Groups among Australian Merino Sheep.

IN this laboratory, from time to time, we come across an anti-sheep cell hæmolytic serum from rabbits which causes rapid agglutination and sedimentation of sheep red blood cells. This is undesirable from the serologist's point of view. A sample of such serum was recently tested against fifteen random samples of sheep cells, and the latter, on the basis of agglutinability, could be sharply divided into two groups. We do not, of course, regard this observation as original, but merely wish to stress its importance for serologists and especially also for commercial firms dealing in bacteriological laboratory material. It might be well to define the group to which belonged the red cell antigen used in preparing a given hæmolysin, two or more groups having been determined on the basis of response to immune agglutinin. Incidentally, we pursued the line suggested by the above observation, and found that there are at least two 'blood groups' amongst pure-bred Australian merino sheep.

J. V. DUHIG
(Director).

Brisbane and District Laboratory,
Hospital for Sick Children,
Brisbane, Queensland,
April 23.

Infra-Red Absorption Spectrum of Sulphur Dioxide.

DICKINSON and West (*Phys. Rev.*, **35**, 1126; 1930) have determined the Raman spectrum of sulphur dioxide; they obtained displacements of 524 (weak), 1146 (strong), and 1340 (medium) cm.$^{-1}$. We had already examined the infra-red absorption spectrum of sulphur dioxide between 2 μ and 20 μ with a Hilger *D*. 42 spectrometer, using quartz, fluorite, rocksalt, and sylvine prisms, and found bands at 2498, 2321, 1871 (very weak), 1355, 1152, and 606 cm.$^{-1}$; of these the band at 1355 cm.$^{-1}$ is most intense and seems to possess a complicated structure. The fundamental frequencies are probably $\nu_1 = 1355$, $\nu_2 = 1152$, and $\nu_3 = 606$ cm.$^{-1}$. The two larger frequencies are in good agreement with those deduced from the Raman spectrum, although the scattered line at 524 cm.$^{-1}$ agrees more closely with the difference between ν_2 and ν_3 ($1152 - 606 = 546$ cm.$^{-1}$) than with ν_3 itself. The other bands can be accounted for as combination- and over-tones.

Careful examination failed to reveal bands reported by Coblentz ("Investigations of Infra-Red Spectra", p. 52; 1905) at 3·18 and 10·4 μ.

A detailed account of the investigation will be published shortly.

C. R. BAILEY.
A. B. D. CASSIE.
W. R. ANGUS.

Sir William Ramsay Laboratories of Inorganic and Physical Chemistry,
University College, London, June 3.

Effect of Magnetic Fields on Dielectrics.

IN a paper by S. Whitehead on dipoles in relation to the anomalous properties of dielectrics (*Phil. Mag.*, May 1930) there is a slight reference to the effect of magnetic field on dielectrics, but no details of any experiments or results. Experiments which we have carried out show clearly that when a constant magnetic field is superimposed on a dielectric which is being subjected to an alternating electric stress, so that magnetic and electric fields are normal to one another, then the presence of the magnetic field causes a change in the power factor of the dielectric and hence in the losses occurring therein. The nature of the results indicates that the effect of the magnetic field is to decrease the power factor.

PHILIP L. BURNS.

Faculty of Applied Science and Technology,
Queen's University,
Belfast, May 22.

The Acquired Characters of *Alytes*.

IN reply to the letter of Dr. Walker on Alytes which appears in NATURE of June 14, he is right in saying that I assume that potentialities of growth are altered by the environment and that the result is handed on to succeeding generations. Proof that it is so exists and could be given in detail were not space in NATURE so precious. Przibram gave five or six such cases when he was in London two years ago.

Dr. Walker's alternative explanation is hard to follow, namely, that 'variations' (produced by chance ?) survive. The superstition that selection can call into existence something that was not previously there is hard to kill.

E. W. MACBRIDE.

Imperial College of Science,
South Kensington,
London, S.W.7,
June 17.

Applied Science in Conference and Display.

THERE has been an opportunity during June to take part in two scientific occasions in Germany, both of first rank significance. The Achema Exhibition, opened in Frankfort on June 10, which continued for a fortnight, was primarily a display of laboratory apparatus and all that pertains to the efficiency and well-being of the chemist in his laboratory. A side issue of a most comprehensive character was an exhibition of chemical plant. Concurrently with the exhibition, a meeting of the Verein Deutscher Chemiker was held in Frankfort, and afterwards other more specialised bodies of chemists were in congress there: the habit of centring such annual meetings round an exhibition seems to be spreading. The meeting of the V.D.C. was of course of purely German interest, but a considerable number of British chemists visited the exhibition.

There can never have been a more comprehensive show of aids to chemical manipulation: to one who remembers the then startling innovations provided in Emil Fischer's new laboratory in the Hessischestrasse, Berlin, in 1899 on its opening, the progress is as remarkable as that made in any other branch of chemistry, and one does not recollect before to have had an opportunity of seeing it all summarised as it were under one roof. Comment in detail is impossible and so we pass to the chemical plant section, where undoubtably one of the outstanding exhibits was that of Krupp, designed to show the progress made in the invention of special non-rusting steels or more properly iron. On the principle said to apply to good wine, this exhibit was largely left to speak for itself: it consisted not only of the steels themselves with explanatory literature of real value, but also of all kinds of utensils for the household and for industry, including chemical industry. The exhibit was made by Krupps in conjunction with well-known users of the special VA and VM steels, so that a complete picture was obtainable of the many applications which rustless iron now has. The initial difficulties in working it have been largely overcome, and it appears to be chiefly a question of price which prevents it from being almost universally employed. It should be mentioned that Krupps show household utensils of rustless iron in their own shops in the larger cities of Germany.

Of equal interest was the comprehensive exhibit of the famous Metallgesellschaft of Frankfort, who have not hitherto indicated so clearly in how many different fields they are active. As necessitated by the novelty and interest of the exhibits, a very large force of technical experts was in evidence and no visitor was able to complain of lack of attention. Perhaps the greatest interest was evidenced in the display of the Carbo-Union showing the manifold way in which the remarkable absorbent properties of active carbon are being utilised, as, for example, in the stripping of benzol from gas, the recovery of volatile solvents from air, even when very dilute, the purification of water, the dephenolising of effluent from coke ovens, etc. There only remains space to mention the extending use of alloys of silicon with aluminium, which appear to have an ever-widening scope of application as their metallurgy is being better understood. The exhibition was adequately and comfortably housed in permanent buildings such as most Continental towns possess and was regarded by exhibitors and visitors alike as a serious and important occasion.

A night's journey in a sleeper, and we were in Berlin for the Second World Power Congress, attended by nearly 4000 delegates from forty-eight or more countries. The Congress, or at least the official delegates, were welcomed in the Reichstag on the evening of Sunday, June 15, by the highest in the land, when the Earl of Derby, the retiring president, handed over the gong of his office to Dr. Oscar von Miller. The little ceremony was both dignified and imposing, and the human touch supplied by the good wishes for the success of Lord Derby duly bore fruit at Ascot.

The official opening took place the next morning in the Kroll Opera House, when, following a short musical introduction, an address of welcome was delivered by Dr. von Miller and responded to by the delegates of the various nationalities, Sir Charles Parsons speaking first on behalf of Great Britain. The speeches were necessarily written and spoken to the microphone, so that the meeting was entirely devoid of personality, oratory, or enthusiasm. At the end we were favoured with more music conducted by a man whose joy, delight, and enthusiasm in what he and his orchestra were giving us was a veritable treat to behold. We must take heed lest in allowing everyone in a large audience to hear what is said we so mechanise what they hear as to make it of no interest. At the subsequent technical meetings, held in two large halls, every seat was provided with earphones and a dial, enabling the hearer to listen either to the original paper or to its translation in either of the three languages—English, French, or German. This arrangement also was only a partial success, in that the effort to speak for the microphone largely destroyed the personality and hence the effect of the orator. At the instance, we believe, of the Americans, the speeches at the World Festival in the evening of June 18 were transmitted by wireless from San Francisco. However attractive the idea, the transmission proved not only inaudible, but also an absolute nuisance, and after a quarter of an hour's patience, the audience ignored it. We have emphasised the terrors of the microphone because we have experienced its devastating effects at banquets at home, where real oratory such as provided by Dr. Nicholas Murray Butler at a recent Pilgrims' gathering is too great a treat to be lightly abandoned to the radio mechanic.

At the technical meetings a very large number of papers were read, discussed, and available in type; but the real value of the meeting, as always, was the contacts made between workers in different lands with kindred interests. Outstanding, as always in Germany, was the official hospitality

Apart from the reception at the Reichstag, the Congress was entertained by Germany, by the State of Prussia, and by the town of Berlin, in addition to a gala night at the Opera and the usual public and private hospitality. Fortunately, the English delegation was not only the largest, but also most thoroughly representative in character, and it played an important part in the deliberations. It was all the more to be regretted that Mr. Dunlop, the prime mover in the Conference, was himself prevented by ill-health from being present.

Naturally, the opportunity was not lost to show the visitors at the great evening festival some of the modern tendencies of Germany. Chief amongst these is the outdoor movement with a minimum of clothing and the cultivation of physical fitness. Most charming displays were given by girls and by young men. Of extraordinary interest was the final display of representatives of the German States in their national costumes and dances: the subordination of Prussia and the accentuation of the Rhine, of the Franks, of the Bavarians, scarcely seemed accidental. The enthusiasm when the president joined his native Bavarians was a fitting climax to a most remarkable evening, which to the knowledgable gave much room for thought, both retrospective and prospective.

Members of the Congress were provided with a quite unusual amount of literature, much of it of a permanent nature, giving information as to the power projects of Germany and of Europe. We have become used to the amazing development of cheap electric power either from coal or from water in the United States or in Canada: what the Congress should bring home is that similar developments are taking place on the Continent. Cheap electricity can do so much for the needs and comfort of mankind that no country of the first rank can afford to let its citizens be without it—it should be available in every village, in very farmhouse, throughout the land, as will soon be the case in France; it should be possible to carry out every power operation on the farm and in the living house, as well as in the factory, by its aid. The presence of so many of our leading electricians at the Congress shows that they are alive to the problems, but we fear the country as a whole fails to realise how far behind Britain is in the use of electricity per capita. We have very little water power, but our engineers are at least capable of emulating the remarkable results achieved at Chicago, where something less than a pound and a half of coal per kilowatt hour is required.

It is often forgotten that the production of electric power is as much a water as a coal problem, about 400 tons of cooling water being required for every ton of coal burnt, so that suitable sites for very large stations are not always easy to find.

The scope of the Congress stretches of course far beyond electric power; the carbonisation of coal either at high or low temperatures; the problems of oil, its refining and cracking, all come within its scope. In the end the goal is the same, to turn the heat latent in coal or oil, lignite or peat, with the highest degree of efficiency into energy, into power. The transformation in early days was not an easy one and as represented in percentages highly inefficient. Amazing progress has been made in improving the efficiency; the World Power Congress can but accelerate this. E. F. ARMSTRONG.

Irregularities in the Annual Variation of Temperature in London.*

THE average temperature of London is lowest about the middle of January and highest towards the end of July, but in any one year the temperature rises and falls irregularly, and the coldest day may occur in February or March instead of January, the warmest in August or September instead of July. Even when thirty or forty years are combined, some of these irregularities remain, and it is an interesting question whether, as the record is extended, the curve of temperature will tend more and more to a smooth annual variation, or whether certain irregularities are inherent in the climate and will always remain. This question was first examined in detail for Britain by Alexander Buchan, who recorded his conclusions in 1869 as follows:

"Deductions from all observations hitherto made show that . . . there are certain periods more or less well defined, when the temperature, instead of rising, remains stationary or retrogrades; instead of falling, stops its downward course, or even rises; and at other times falls or rises respectively for a few days at a more accelerated speed than usual."

* Synopsis of a paper read at the Royal Meteorological Society on June 18, by Dr. C. E. P. Brooks and S. T. A. Mirrlees, with some references to the subsequent discussion.

Buchan picked out six cold and three warm periods, as follows:

Cold Periods.	*Warm Periods.*
1. February 7–14	1. July 12–15
2. April 11–14	2. August 12–15
3. May 9–14	3. December 3–14
4. June 29–July 4	
5. August 6–11	
6. November 6–13	

Buchan's work was based in the first place on data for Scotland about 1860, but his results have been tacitly assumed to apply over the whole of the British Isles, and the 'Buchan cold and warm spells' have attained some celebrity. A repetition of the investigation seemed to be called for, using a long series of records for London.

Daily means of temperature at Kew Observatory based on hourly readings were formed for the two nearly equal intervals 1871 to 1900 and 1901 to 1929. These showed many small irregularities, and as warm and cold 'spells' were being sought rather than individual days, it seemed advisable to smooth the data. This was done by forming overlapping five-day means, for example, January 1–5, 2–6, etc., each five-day mean being entered against the middle day. The two curves obtained

in this way were compared with a standard curve representing the generalised annual variation, which was obtained by harmonic analysis of the twelve monthly means; the first two terms, representing the annual and semi-annual waves, were found to be sufficient for this purpose. The results are shown in the main curves of Fig. 1.

This figure shows that the five-day means of temperature during both periods oscillate irregularly about the smooth curve, but in general keep rather close to it. In most months the irregularities in 1871–1900 are quite different from those in 1901–1929, showing that they represent temporary or 'accidental' abnormalities and not permanent features of the climate. In particular, the curves seem to show quite definitely that the 'Buchan cold spells' do not recur regularly in London. The first, February 7–14, is represented, it is true, by a marked dip in 1901–1929, but the curve for 1871–1900 during those days rises rapidly to a maximum. In April 11–14 and May 9–14 neither curve shows any abnormal feature. In June 29–July 4 the curve for 1901–1929 is low but rising steadily, while that for 1871–1900 is definitely high, indicating a warm rather than a cold spell. In August 6–11 both curves are rising steadily, and again in November 6–13 neither shows any special anomaly. The figure is rather more favourable to Buchan's warm spells, for though the third, December 3–14, is not supported, the first two fall on dates when both curves are definitely high. An examination of the average temperatures at Kew Observatory for 59 years therefore accords no support for any of Buchan's cold spells, but suggests that the first two warm spells may have been well founded.

Apart from this, the curves show several points of interest. In December and January the average temperature since 1901 has been about 2° F. above the average for 1871–1900, a difference associated with the prevalence of warm winters during the present century. The magnitude of this change is clearly brought out by the lower inset diagram, which shows the results of harmonic analysis of the two periods separately. Not only have recent winters been warmer, but also the generalised minimum has been displaced from early in January to the end of the month, while at the same time the generalised maximum has been retarded from the middle to the end of July and the annual range has decreased, all indications that the climate has become more oceanic. Again, in 1901–29 temperature rose very rapidly during the latter half of May, and on May 30 the curve reaches a level which is not found again until June 17, a truly remarkable feature to occur in the 29-year averages for a season during which temperature should be rising

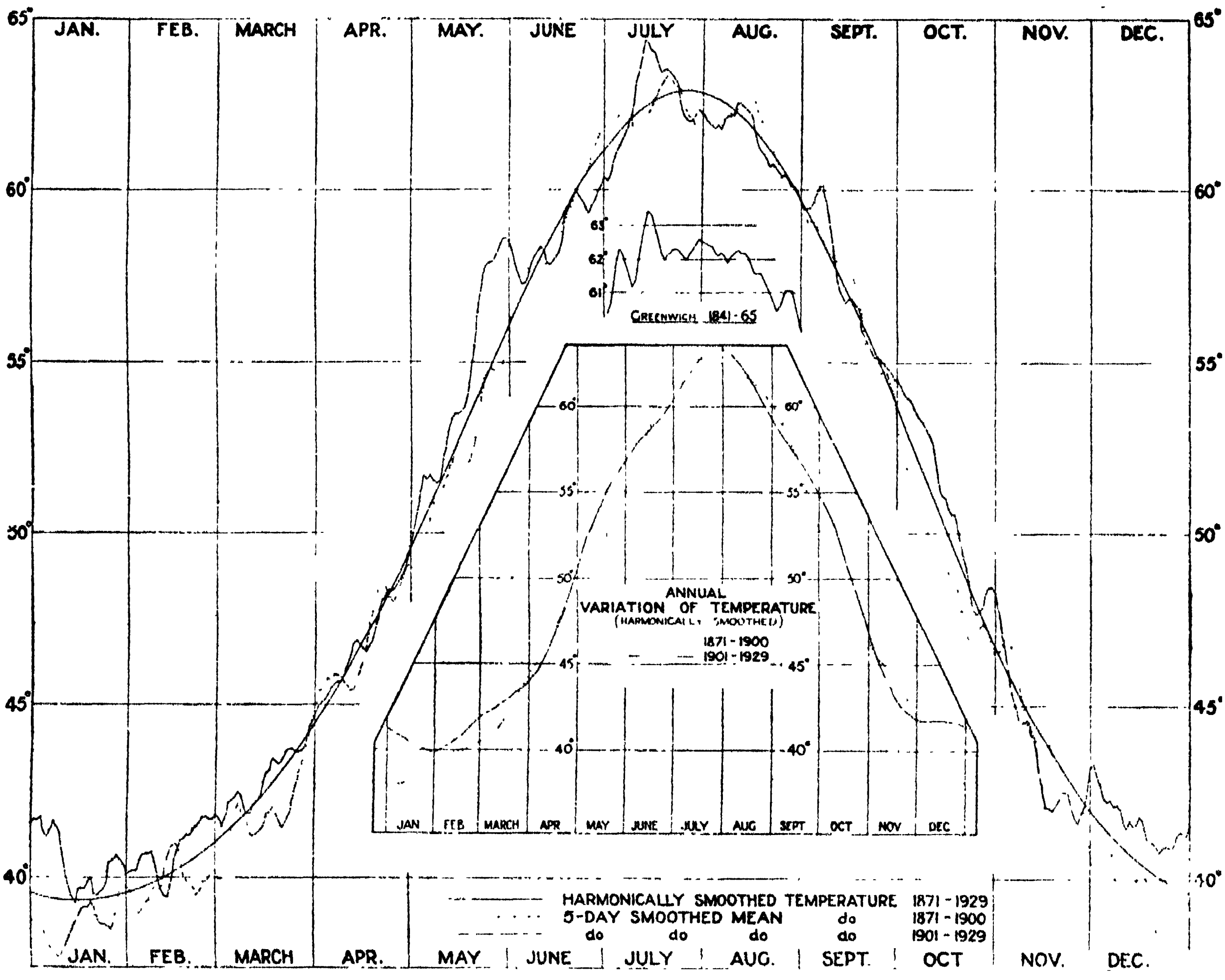


Fig. 1.—Temperature curves derived from Kew observations. (Reproduced by courtesy of the Royal Meteorological Society.)

steadily. A somewhat similar distortion, though less pronounced, occurs in early October, when the curve for 1901–29 shows a definite slackening of the autumn fall of temperature.

The third point of interest concerns the temperatures of high summer. Both curves show a marked swing, with a range of 2° F., from a maximum in mid-July to a minimum early in August and back to a second maximum in mid-August. This feature was of such interest that the five-day means of temperature at Greenwich during July and August were extracted for the period 1841–1865, and are shown in the upper inset of Fig. 1. Here the July maximum is again shown, but the minimum early in August does not appear and the August maximum is reduced to very small proportions. The impression left by a comparison of these three curves is that there is a definite tendency for a warm spell to occur in mid-July, after which there is a period during which temperature oscillates irregularly until the autumn fall sets in after the middle of August.

Although the comparison of curves showing averages over a number of years is the simplest method of approaching a problem of this nature, the results are sometimes misleading. The more interesting abnormalities revealed by Fig. 1 were accordingly studied year by year, in order to determine whether they are regular characteristics of the climate or whether they merely reflect a few outstanding events. In the first place the 'Buchan cold spells' in February, April, and May were examined to determine if there was any definite tendency for temperature in individual years to fall to minima on those dates. The results were entirely negative; the chance that one of these periods will be unseasonably cold is exactly equal to the chance that it will be unseasonably warm. If we allow a 'grace' of two days on either side, the individual curves show that temperature actually rose to a maximum more often than it fell to a minimum.

The warm period in mid-July affords an example of the fallacy sometimes introduced by reasoning from averages. During the whole 59 years the average temperature was highest on July 15–19, but when the individual years were examined, this predominance was found to rest entirely on four years, 1876, 1881, 1900, and 1921, while temperature was below the smooth curve on 30 occasions out of the remaining 55. The second crest on the curve occurs on August 14–18, and this period was abnormally warm on 32 occasions, cool on 27, a negligible difference.

The general conclusions drawn from the investigation were summed up as follows: "On the whole it seems improbable that there exists in our climate an abiding tendency for any part of the year to be either abnormally warm or abnormally cold for the season. It does seem, however, that such tendencies may spring up suddenly, persist for ten or twenty or thirty years, and as suddenly and mysteriously vanish. Any positive conclusions as to these spells are valid only for the time and place of their occurrence, and cannot be applied to other times or places. Thus, while Buchan's cold and warm spells were probably true for Scotland in the 1860's, they are certainly not true for London in the twentieth century."

In the discussion which followed the paper, Mr. D. Brunt objected that 'cold spells' were on some occasions limited to one or two days, and these would be masked by the use of five-day means. He also thought that the investigation should have dealt with individual years rather than with averages over long periods. It was suggested that a possible explanation of the persistent belief in Buchan's cold and warm spells was that when they did occur, they had a tendency to fall on or near Buchan's dates, though in many years they were absent. On the other hand, Mr. Mirrlees thought that the belief had persisted because meteorologists had devoted a great deal of effort to explaining the occurrence of such spells, and little or none to finding out whether there was anything to explain. Apart from this, a few of the explanations advanced were sufficiently plausible, for example, pressure changes set up by differential warming of the earth's surface, and outbreaks of polar ice, but as usually happens when theorising loses touch with facts, some of the theories were merely absurd. They included cosmic dust from meteor showers in the earth's atmosphere, cometary matter between the earth and the sun, the latent heat of freezing and thawing of Russian rivers, the varying absorption of radiation owing to changes of humidity, and *mirabile dictu*, the meteorological effects of newly expanded foliage in spring.

C. E. P. BROOKS.

Crime Statistics of England and Wales.

CRIMINAL statistics, apart from their primary purpose, usually afford some interesting sidelights on social habits and in particular on any changes which are taking place in the daily life of the community with which they deal. For example, in the criminal statistics of England and Wales for the year 1928 (Cmd. 3581, H.M. Stationery Office, price 4*s*. net) an attempt has been made to gauge the effect of the coming of the 'motor age' on crime. Taking the year 1928 and comparing the figures for the crime of 'breaking in' with those of 1911 it appears that, while the figures for the metropolitan area are practically stationary, in the home counties they show an increase of 437·8 per cent, and over the whole of England and Wales outside the metropolitan area the increase in boroughs and cities is 87 per cent, but in the counties it is 137 per cent. This is attributed to the increased use of the motor-car, which is thought to have acted in two ways. Greater numbers of the population have been enabled to live outside urban areas and premises are more often left unoccupied, while an increase in the 'all in' policy of insurance has tended to reduce precaution. On the other

hand, the burglar is also able to avail himself of the car and thus to travel with greater speed and further afield.

A preliminary analysis of the crime statistics in the return contains some interesting remarks relating to variations in the character and volume of crime. The quinquennium 1910 to 1914 is taken as a basis of comparison, as representing a normal average of criminality. Since this period the rise in population has been 9·26 per cent. and the normal rise in crime is therefore taken to be round about 9 per cent. Only figures over this percentage are taken as indicative of any real increase in crime. It may be noted in passing that both in the years after the Boer War and after the Great War there was a marked increase in criminality.

Taking the principal classes of crime, that is, indictable offences, as a whole the figures of 1928 show an increase of 33 per cent over those of 1910–1914. The highest increase in any individual class is under the head of offences against property with violence 80 per cent—while crime against the person increases by 22 per cent. Malicious injury to property falls by 57 per cent. But to bring out the significance of these figures a further analysis is necessary. Taking the class of offences against the person, these fall into two categories—sexual offences and offences generally of violence against the person. In the latter, after making allowance for the rise of 9 per cent, the only offence that shows an appreciable rise is that of procuring abortion. Such crimes as murder and attempts to murder, manslaughter, cruelty to children and child-stealing are among those that show a decrease. The net decrease over all is 4 per cent. In sexual crimes the greatest increase is in indecent assault and defilement of girls between 13 and 16. In the case of rape, defilement of very young girls, and in procuration and abduction there are decreases. Bigamy showed a very high figure—an increase of 120 per cent; but there is a decrease as compared with the period 1920–24. Offences between males increased.

In the class which shows the next greatest increase over 1910–14—crime against property with violence—a heavy increase in offences of 'breaking in', attempts at entering and being in possession of housebreaking tools far outweighs decreases in burglary and robbery. Reference has already been made to the motor-car as a factor in this section of crimes. It is to be noted in this connexion and also in connexion with certain other classes of crime, that the increase is in part due to the fact that a number of cases previously unreported are now brought to the notice of the police. For this the increase of insurance is to some extent responsible as such cases are now reported in order to obtain compensation.

Some interesting points are raised in an attempt to ascertain how far crime is affected by certain social factors, such as education, improved social conditions, and the old age pension, the after effects of war service, and the increased activity of women.

For the purpose of investigating the bearing of education on crime, the figures of 1928 are compared with those of 1882, when the results of the Education Acts of the 'seventies were beginning to bear fruit. It is sometimes said that the criminal now works with brains not brawn; but the figures in those classes of crime in which education is the primary requisite scarcely seem to bear this out. Since 1882 the population has increased by 50 per cent, but the increase in indictable offences is 30 per cent only. The incidence in offences against the person was about the same, but malicious injury to property and forgery and currency offences, the most likely to be affected by education, showed a decrease of 46 per cent and 3 per cent respectively. On the other hand, larceny of post letters increased; but this was owing in part to the immense increase in the volume of correspondence and the greater number of people handling the mails. Frauds also show a heavy increase, but this is a matter of recent years, and up to 1900 the figures show little variation.

Significant facts emerge in an examination of male age groups which bears upon the question of the effects of war experience and social conditions. The opinion is frequently expressed that war experience has led to a disregard to the rights of property and a disposition among war service men to take whatever is wanted and whenever it is wanted. But as a matter of fact the age groups in 1928 of those men who passed through the War compare very favourably with their seniors and juniors except in respect of obtaining by false pretences, frauds, etc. The group 21-30, however, which during the war would have ranged in age from 7 to 16, shows a relatively high rise in incidence of convictions and has obviously suffered from absence of parental control and other social conditions during the War. Again, the effect of improved social conditions and of the old age pension is seen in the older groups of 50 and over, where there is a fall in the incidence of convictions of 52 per cent.

As regards crime among women, the figures as a whole show that the increasing activities of women have not resulted in any serious rise in crime and have been accompanied by a great fall in the less serious and petty offences. Non-indictable offences have fallen 34·5 per cent, while the number of women has increased by 11 per cent. Cases of simple drunkenness have fallen from 12,219 to 5249, and aggravated drunkenness from 26,045 to 5489. Cases of cruelty to or neglect of children fell from 1424 to 362.

The figures for non-indictable offences present certain points of considerable social interest and significance. While there is an increase in less serious offences under Customs, Excise, and Inland Revenue laws, and a huge increase in motoring offences, proceedings for all offences denoting criminality or debased conditions of life have fallen considerably.

Studied comparatively, the statistics as a whole tend to show a more orderly and law-abiding population, living in improved social conditions. The most serious problem they reveal, as indicated by the incidence of crime in the age-groups, is that of the care and training of the adolescent.

Obituary.

MR. E. A. SPERRY.

THE death on June 16 of Mr. Elmer Ambrose Sperry, announced from New York, removes one of the best known of American inventors and electrical engineers and one who will always be remembered for his development of the gyroscopic compass and its application to all classes of vessels, including submarines, battleships, and passenger liners. But he did important work in many branches of engineering, and in 1925, when he was made an honorary doctor of science of the North-western University, Illinois, he was referred to as "an electrical engineer and a physicist who has shown remarkable skill in applying scientific methods and knowledge to the solution of practical problems; inventor of the Sperry gyro-compass; of many valuable aeronautic instruments; of the highest power searchlight; of fire control apparatus for the United States Navy; a pioneer electrical manufacturer in America; and a founder member of the Society of the American Institute of Electrical Engineers."

Mr. Sperry was sixty-nine years of age, having been born at Cortland, New York, on Oct. 12, 1860. Educated at the State Normal and Training School at Cortland and at Cornell University, at the age of twenty he founded the Sperry Electric Co. of Chicago. Electric arc lamps, electric mining machinery, and electric traction engaged his attention in turn, and he founded the Sperry Electric Railway Company of Cleveland, which in 1894 was bought by the General Electric Company of New York.

For the development of his invention, the gyro-compass, in 1910 he founded the Sperry Gyroscope Co., Brooklyn, and the following year fitted one of the compasses in the U.S. battleship *Delaware*. Subsequent inventions have added to the accuracy and the utility of his compass, and to-day ships are kept on their course day by day by the compass acting as helmsman.

Sperry's work was acknowledged by many societies, and in 1926 the engineering societies of the United States awarded him the medal which commemorates the work of the great iron-master John Fritz (1822–1913), among previous recipients of which have been Westinghouse, Noble, Edison, Kelvin, and Bell.

WE regret to announce the following deaths:

Mr. Victor Branford, editor of the *Sociological Review* and author of "Science and Sanctity" and other works on sociology, on June 22.

Mr. W. J. Greenstreet, editor of the *Mathematical Gazette* and honorary member of the Mathematical Association, on June 28, aged sixty-nine years.

Mr. C. E. Siebenthal, who was responsible for the annual reports on lead and zinc issued by the U.S. Geological Survey from 1907 until 1924, on Mar. 1, aged sixty years.

Prof. Frederick Slate, emeritus professor of physics in the University of California, known for his work on analytical mechanics, on Feb. 26, aged seventy-eight years.

Dr. W. E. Story, emeritus professor of mathematics at Clark University, fellow of the U.S. National Academy of Sciences and a vice-president in 1896 of the American Association for the Advancement of Science, on April 11, aged seventy-nine years.

News and Views.

IN his recent presidential address to the Institute of Mining and Metallurgy on "Periodical Variations in the Prices of Minerals and Metals", Mr. James G. Lawn pointed out that variations in the price of minerals and metals over short periods of years affect the mining engineer very closely and bring numerous difficulties in their train. Many efforts have been made, therefore, to secure the stabilisation of such prices, and this of necessity generally means control over supply, since the demand side cannot be so easily regulated. Sometimes, however, successful efforts have been made to stimulate demand; the most notable example being that of nickel. After the War the demand for nickel fell off rapidly, but as a result of research and propaganda, the producers were able to obtain the absorption of their whole output for commercial purposes and later on to increase considerably the consumption. Control over supply can sometimes be effected where known deposits capable of profitable working are limited in number and extent. In other cases, metallurgical difficulties in extracting a marketable product afford a basis for control. In the former category would fall diamonds, nickel, cobalt, potash, and nitrate, and in the latter, aluminium and magnesium. In the diamond mining industry, everyone connected with it, whether in South Africa, Congo Territory, Angola, or West Africa, recognises the necessity of control, and, despite many ups and downs in the trade, prices have been maintained for forty years. In the production of cobalt, an agreement between the producers in Ontario and Katanga to supply a half share each has maintained the price at 10s. per lb. Aluminium ores are plentiful, but since metallurgical treatment of the ores is costly the business is in comparatively few hands and control has been secured by agreement for some eighteen years.

IN his presidential address to the Devonshire Association on June 24, Mr. R. Hansworth Worth gave a detailed and stimulating account of the physical geography of Dartmoor. The address will appear in due course, with an admirable series of illustrations, in the *Trans. Devon Assoc.* for 1930. A good account is given of the vegetation of the moor and of its conversion into peat. It is shown that since the Early Bronze Age some two feet of peat have accumulated in the Erme valley. Decay is also going on, especially in the hill-top bogs, as for example in the ground around Cranmere Pool. From the coincidence of the planes of pseudo-bedding in the granite with the slopes of the hillsides and from other evidence, it is argued that the present topography of

Dartmoor is close to the original surface of the granite The china clay of the moor is referred to the action of vapours derived from the cooling granite-magma co-operating with meteoric water which obtained access to the granite surface through the then overlying cover of sedimentary rocks. Unusually wide partings in some of the tors are thought to be due to wedges of ice forcing the blocks apart when the climate was much colder than at present. The rock-fields known as 'clitters' are compared with similar erosional features in Spitzbergen, where they are probably due to hill-creep actuated by deep frost action. Rainfall and climate, rivers and border hills are given detailed treatment, and the address concludes with a brief survey of the geology of the area.

MR. WORTH protests against the methods of recent geologists who have "blazed a trail of unnecessary disfigurement across the whole face of the Moor". The perpetrators of this alleged damage may, perhaps, not unreasonably claim that their exertions have been amply justified by the harvest of results attained. Mr. Worth, however, does not refer to these beyond stating that he cannot accept the idea of differentiated types of varied age. He thinks that the intrusion of the granite took place in one operation. He also suggests that the attempt to make tectonic capital out of the direction of the joints is mistaken, since the joints are local in their origin and orientated in all directions He believes that the granite came into place as a wedge-like intrusion operating along the whole length of the axis from Dartmoor to the Scilly Isles, and that "there exists an elongated mass of granite, irregular in shape, isolated and self-sufficient, not fed by any lower reservoir through either necks or dykes, and that the upper protuberances of this mass now reach the surface and form the granite bosses of Devon and Cornwall".

ON July 1 a large party of archæologists began a four days' pilgrimage along the Roman Wall, assembling at Hexham, and proceeding along the whole 73 miles' length of the Wall from Wallsend-on-Tyne to Bowness-on-Solway in Cumberland. The expedition was organised by the Society of Antiquaries of Newcastle-on-Tyne and the Cumberland and Westmorland Antiquarian Society. A similar pilgrimage, but on a small scale, was made in 1920, and it is twenty-four years since a visitation of the extent and thoroughness of that of this year has been attempted. The first day's expedition covered the Wall from its eastern extremity to the Roman bridge at Chollerford, 21 miles west of Newcastle, when Mr. F. Gerald Simpson, Mr. Parker Brewis, and Mr. R. C. Bosanquet acted as guides. On the second day, Chesters (Cilurnum), the sixth fort on the Wall, and the museum with its remarkable collection of antiquities from the Wall were visited. Sir George Macdonald and Mr. R. G. Collingwood acted as guides. The second day's pilgrimage also extended to the great fort at Housesteads, to Peel, and to Chesterholme with its milestone. On Thursday Carlisle was reached after a journey of which the most notable feature was a visit to Birdoswald, where Mr. Richmond's excavations were examined in detail and the many problems raised by his work were thoroughly discussed. On Friday the pilgrimage came to an end at the seaboard. On Thursday, the party had received a large accession in numbers, in part, no doubt, owing to the attractions of the Birdoswald fort, but also without question owing to the fact that the itinerary for that day included the stretch of the Wall which is now threatened by quarrying operations.

ALTHOUGH the pilgrimage was independent of any movement in connexion with the attempt to save the Wall, we may expect with confidence that a visitation such as this will not fail to make its influence felt, both in the present issue and in formulating safeguards against similar vandalism in future. Apart from this possibility, the most striking feature of the pilgrimage was the way in which was brought out the great significance for Roman studies in Britain of the work of excavation and research in the neighbourhood of the Wall—notably at Cilurnum, Chesterholme, and Birdoswald—since the last occasion the Wall was visited.

THE annual exhibition, the eighth, of the antiquities obtained from Ur during the excavations of the past season by the Joint Expedition is now open at the British Museum. The exhibits, which are arranged in chronological order, are representative of every period of the city's history from the earliest to the latest times. The plans and drawings which illustrate the architecture of the temples, etc., at various periods are a revelation of the technical skill attained in Mesopotamia at this early age. Especially to be noted is the system of canals and walls discovered last winter, dating from about the time of Abraham. A photograph of a column of bricks from the temple ruins of the Third Dynasty (about 2300 B.C.) affords authentic evidence of the use of this architectural element at so early a date. The exhibits from the Royal City naturally take first place in interest and importance. A case of clay sealings is of particular significance, as it not only illustrates the early art and beginning of writing among the Sumerians, but it also provides material in the stratigraphical sequence of the sealings for fixing the dating of the Royal cemetery, which has been in dispute. A sectional drawing illustrates the sequence in the great pit in which were unearthed the remains of the city destroyed by the Flood. Cases contain reproductions of the actual graves in which lie the painted pottery side by side with the crushed skeletons. Above these cases is ranged pottery and clay figures from the graves and ruins below the flood level which illustrate the earliest art of Sumeria yet discovered, antedating by some centuries the magnificent wild boar carved in stone which was mentioned in Mr. Woolley's reports and is now exhibited here.

FROM the brief reports so far received, it would seem that the Indian earthquake of July 3 was much inferior to its great predecessor on June 12, 1897. Buildings were, indeed, damaged in many

places, some persons were injured by their fall, but as yet, though the earthquake occurred at 3 A.M., no loss of life is reported. In two sections of the Eastern Bengal Railway, bridges are unsafe and the lines are damaged. The centre of the earthquake is said to be at Gauhati on the Brahmaputra, about 320 miles north-east of Calcutta. As some slight damage was caused in that city, the shock must have been strong over an area of 300,000 square miles, and the disturbed area cannot be much, if at all, less than half a million square miles. That the shock should have been felt over so wide an area without attaining greatly destructive strength within it shows that the focus must be unusually deep. In his admirable memoir on the earthquake of 1897 (*Mem. Geol. Surv. India*, vol. 29, pp. 1-379; 1899), Mr. R. D. Oldham has outlined its epicentral area, and it is of some interest to note that Gauhati lies close to its eastern margin, showing that, after the lapse of nearly forty years, the centre of activity has shifted some fifty miles or more towards the east.

THE British Arctic Air Route Expedition sailed on July 6 in the *Quest* for East Greenland via the Faroes and Iceland under the leadership of Mr. H. G. Watkins. The main object of the expedition, as explained by the leader in an article in the *Times*, is to investigate the possibility of an air route across Greenland as a link in the route from London to Canada. This would be predominately a land line. No stretch of sea more than some three hundred miles would have to be crossed in one lap. The expedition is provided with two De Havilland Moth aeroplanes and fifty dogs and will be absent about a year, the *Quest* returning to Norway during the winter and leaving the fourteen explorers in Greenland. Journeys by dog sledge will be made on to the ice cap to north and south from a base about the Arctic Circle. Trial flights across to the west coast are contemplated. Perhaps the most important scientific aspect of the expedition will be the station which it is planned to found on the highest part of the ice cap for meteorological purposes. This will give the first winter observations from the interior of Greenland. Mr. Watkins thinks it not improbable that the best flying route across Greenland will be by the depression in the ice cap which seems to exist between about lat. 66° N. on the east and lat. 70° N. on the west. If this is so, air bases might be established in the vicinity of the settlements of Angmagsalik on the east and Disko on the west.

THE annual report of the Empire Marketing Board for the year 1929 has just been published (H.M. Stationery Office, price 1*s*.). Although the Board is of a non-political character, a change in government led to alterations in personnel, but it happily remains representative of all three parties. The experience during the past year has been most encouraging, and the outlook seems full of promise. The shipment of a number of Empire-grown foodstuffs into Great Britain in 1929 has in many cases surpassed all previous records, some such commodities being dried fruit from Australia, dairy produce and pork from New Zealand, fruit, sugar, and wines from South Africa, tea from India and Ceylon, and poultry from the Irish Free State. It is realised that no amount of good marketing will sell poor goods, and considerable attention is being devoted to the promotion of fundamental research work. Scientific investigations are being carried out both at home and overseas, the long lists of grants supplied for problems very varied in nature being evidence of the extent of the field under the auspices of the Board. The fullest co-operation has been, and is still being, sought between the Board and wholesale and retail traders. Encouraged by the goodwill already shown, and in order to utilise trade experience to the fullest advantage, a new main committee of the Empire Marketing Board has been appointed, to be known as the Marketing Committee. Its aim will be to secure a regular contact between itself and the complicated distribution system of Empire products among the consumers. The methods by which the Board attains publicity are many and various. Nearly two million leaflets were distributed during the past year, and the value of exhibitions, lectures, the cinema, etc. is becoming increasingly apparent. The publication of weekly intelligence notes giving full marketing information for fresh fruit and dairy produce has been extended, statistics of approximately ninety per cent of the butter held in cold storage now being included. In addition, statistical surveys of the world position as regards production and consumption of various foodstuffs are being issued.

The need for a closer co-operation between the breeder of domestic stock and the geneticist was the burden of Prof. F. A. E. Crew's address on "Genetical Methods of Livestock Improvement" to the Royal Society of Arts (*Jour. Roy. Soc. Arts*, May 16, 1930). He pointed to the difficulties of creating an ideal standard to which any breed should conform, since no single purpose could be imposed on any breed, independently of the fundamental necessities of healthy life and prolific breeding. The case of sheep was instanced as an example of the attempt by one set of interested persons, the manufacturers of wool, to set up a standard of fleece purity without reference to the primary purpose of the fleece as a protection for the sheep itself during the successive stages of its development. The geneticist is already in possession of a vast mass of knowledge of vital importance to the breeder, and although the breeder seems loth to take advantage of these facts, harmonious collaboration between the two is sure in the future to lead to the revisal and definition of standards, the analysis of excellence, the purification of stocks, and the removal of the menace of sterility. Prof. Crew looked forward to a time when added knowledge of the influence and working of the ductless glands would enable rate of growth, fertility, fat deposition, and so forth to be removed from the slow methods of selective breeding and to be controlled by the administration of the appropriate endocrine products prepared by the biochemist.

STREET traffic luminous signals have been widely adopted in many cities abroad and experiments with them are being made in many towns in Great Britain.

Many of the most efficient police officers in almost every country in the world are being used as semaphore machines, and the fatigue of continual arm movement must be considerable. As traffic supervisors they will probably always be required, but in our opinion considerable economies and higher efficiency could be obtained by the use of luminous signals. At many of the street crossings in Berlin there are conspicuous red, yellow, and green lamps visible to the traffic moving in one of the streets and simultaneously green, yellow, and red lamps visible from the other. Only one lamp is alight at the same time. The green and red mean proceed and stop, the yellow when it follows red indicates to the motorist or pedestrian that he is to get ready to proceed and when following green that he is to begin to stop. With one-way traffic in one street, as in the Unter den Linden in Berlin, this arrangement answers admirably. In the *Illuminating Engineer* for June there is an interesting paper on luminous traffic signals by T. Austin. He points out that the improvements made in glass moulding and in the production of coloured glass and the use of gas-filled electric lamps have immensely improved daylight colour signalling. For railway signalling, signal lamps can now be made which have a range of visibility of 4000 feet in bright sunshine. For street signalling economy can be effected by using automatic signals. When these are used, however, it will be necessary that motorists and others should be warned by a suitable sign when entering a district which uses them.

THE annual reports of the council and director of the Norman Lockyer Observatory for the year ended March 30 have just been issued. They show a very satisfactory year's work in spite of unfavourable weather conditions. Only 134 nights during the year were sufficiently clear for work to be done, and 124 of these were utilised. The Council considers, nevertheless, that at no observatory in Great Britain are the weather conditions more favourable for observation than they are on Salcombe Hill. The determination of spectroscopic parallaxes of early-type stars and the investigation of bright hydrogen line stars continue to form the main part of the work of the observatory. The equipment is about to be increased by a generous gift from Mr. Robert Mond, chairman of the observatory corporation, of an equatorial mounting for the Zeiss triplet lenses now in the possession of the observatory and a dome to house it. The work is in the hands of Messrs. Cooke, Troughton, and Simms, and is well under way. The Council remarks that if sufficient income were at its disposal, the observatory would be able, with present equipment, to keep another assistant or research student fully employed on valuable work. This, however, cannot be contemplated until further funds are available, and under existing conditions of depression in industry there seems little promise that the Council will be able to provide for any extension of the staff. During the year there has been a decrease of almost £160 in subscriptions and donations, but this has been offset by savings in salaries and maintenance and increased income from investments. The net result is a credit balance of £75 6*s*. 4*d*. carried to capital account as against £98 7*s*. 11*d*. in the previous year. A survey of the contents of the library has been undertaken, and shows that the observatory possesses a total of 5370 volumes and 7500 pamphlets, etc.

IN honour of the seventy-fifth birthday of Prof. Bohuslav Brauner, of the University of Prague, a special jubilee number (May–June) of the *Collection of Czechoslovak Chemical Communications* has been issued. This number contains more than twenty original contributions by friends and pupils of Prof. Brauner, together with a complete bibliography of his own original works and a lengthy account of his association with D. I. Mendeléeff. This communication is of unusual interest, since it makes available for English readers many fresh details concerning the varied and full life of the Russian savant, who died in 1907. From this intimate account of Mendeléeff's life and many-sided interests it becomes apparent how much he was indebted to Prof. Brauner for bringing his views and the periodic classification of the elements before Western men of science. Indeed, many of Prof. Brauner's earlier researches (for example, the proof that beryllium is a bivalent metal, the separation of didymium into praseodymium, neodymium, and samarium, and the attempted fractionation of iodine and of tellurium) were all directed towards the substantiation of the Periodic Law. Among the other contributions to this issue of *Collection* are three from Prof. J. Heyrovský and his collaborators, who continue the series of polarographic investigations with the dropping mercury cathode. These researches have now been in progress for ten years, and the method has been found of service in attacking problems in inorganic, physical, analytical, and now in organic chemistry. Prof. J. Štěrba-Böhm and Dr. Pisaříček describe certain new cerium compounds, particularly the double oxalates of the alkali metals with trivalent cerium. The existence of these compounds has revealed the cause of the difficulties encountered in attempting to precipitate cerium oxalate with alkali oxalates. Prof. B. N. Menšutkin and M. B. Wolff have also communicated a paper on the transformation of the cyclohexane ring into that of benzene.

IN the *Times* of July 1 reference is made to the recent purchase in London, by Dr. A. S. Rosenbach, the book dealer of Philadelphia, of a manuscript relating to the discovery of America. The manuscript is more than four hundred years old, and is thought to have been written by a friend of Columbus. Andreas Bernaldez, who was born about 1450 at Fuentos le Leon, Spain, and in 1488 was made curate of the village of Los Palacios near Seville and afterwards became chaplain to the Archbishop Diego de Deza, a friend of Columbus. When Columbus was on his way to the court of Ferdinand and Isabella to report on his second voyage he was the guest of Bernaldez, with whom Columbus left some of his writings. Until recently the manuscript, which is entitled "The Story of Christopher Columbus and the

ship in which he crossed the ocean until he discovered the Indies where they found gold" has lain disregarded in a Spanish library.

THE *Himalayan Journal*, the annual publication of the Himalayan Club, has made its second appearance. The current issue is full of well-illustrated articles on various aspects of mountaineering in the Himalayas. Lieut.-Col. H. W. Tobin reviews the history of exploration among the glaciers and peaks of the Sikkim Himalayas, and Lieut. J. B. P. Angwin gives an account of an expedition into the little known Kagan valley of the Kunhar River to the west of Kashmir. Several other articles treat of exploratory expeditions, and there is a useful account of the German attempt on Kangchenjunga in 1929. We note that among many spellings the Survey of India has adopted Kmchinjunga as the official spelling. In relation to the Shyok flood of last year, Major K. Mason discusses the likelihood of the Chong Kumdan glacier dam reforming and impounding another flood.

BARON GERARD JAKOB DE GEER, of Stockholm, and Prof. Tullio Levi-Civita of Rome, were elected foreign members of the Royal Society at a meeting of the Society on June 26.

HIS ROYAL HIGHNESS THE DUKE OF YORK has been elected an honorary member of the Royal Institution.

THE Bruce Prize of the Royal Society of Edinburgh for the period 1928–30 has been awarded to Mr. N. A. Mackintosh for his researches into the biology of whales in th waters of the Falkland Islands Dependencies. This prize is awarded by a Joint Committee consisting of representatives from the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society.

AT a meeting of the Royal Society of Edinburgh, held on July 7, the following were elected honorary fellows: *British Honorary Fellows*—Sir Arthur Stanley Eddington; Sir William Bate Hardy; Sir Arthur Keith; Prof. J. E. Marr; Prof. R. Robinson; Dr. D. H. Scott; *Foreign Honorary Fellows*—Prof. V. F. K. Bjerknes, Bergen; Prof. W. B. Cannon, Cambridge, U.S.A.; Prof. M. Caullery, Paris; Prof. G. Fano, Rome; Prof. E. H. O. Stensiö, Stockholm.

THE following appointments in the Colonial Agricultural Services have recently been made by the Secretary of State for the Colonies: Mr. W. J. Blackie, to be government chemist, Fiji; Mr. M. H. Grieve, to be assistant agricultural officer, Kenya; Mr. F. W. Thomas, to be district agricultural officer, Tanganyika Territory.

ARRANGEMENTS have been made with National Flying Services, Ltd., for the visit of a party to Hanworth Park on Wednesday, July 16, under the auspices of King Edward's Hospital Fund for London. Buses will be in readiness at Victoria Embankment (outside Charing Cross Underground Station) at 2.30 P.M. On arrival the visitors will be received by Capt. F. E. Guest, chairman of National Flying Services. Flying will be in progress during the afternoon, when all the latest types of light aeroplanes will be on view, and passenger flights will be available to visitors at a charge of 5s. Hanworth Park is the centre of private flying in Great Britain, and has been described as the most beautiful aerodrome in the world, as well as the most active civil flying training organisation. The estate was once a hunting-seat of Henry VIII. Tea will be obtainable on the club premises at a small charge. Application for tickets (price 10s.) should be made to the Secretary, King Edward's Hospital Fund for London, 7 Walbrook, E.C.4.

IT was decided at the International Congress of Orientalists held at Oxford in 1928 that the next meeting should take place in Holland. In accordance with that decision, preparations are now being made for the Congress to be held at Leyden on Sept. 7-12, 1931. Leyden was the place of meeting of the sixth Congress, which was held in 1883. An influential committee of organisation has been formed at Leyden, to which the preliminary arrangements have been entrusted. The secretary of the committee is J. H. Kramer, and the secretarial headquarters are at the Musée ethnographique, Rapenburg, 67, Leyden, to which inquiries and communications should be addressed.

WE have received a further notice of the second International Congress of Experimental Cytology, which is to be held at Amsterdam, on Aug. 4–9, in conjunction with the Anatomical Congress. As indicated by the preliminary programme, the questions discussed will relate mainly to problems which can be investigated by tissue culture methods. One symposium is concerned with the relations between blood and connective tissue, another with growth and differentiation in their reciprocal relations. Several of the papers will be illustrated by kinematograph film demonstrations. These include the function of osteoclasts, the phenomena of nerve stimulation, the functioning of heart muscle in tissue culture, and experiments on early chick and duck embryos. Papers will also be given on micro-dissection and other technical methods, and a discussion will be held on mitogenetic and other biological forms of radiation. Dr. Rhoda Erdmann will introduce a proposal to found an International Association of Experimental Cytology. Further information may be obtained from the Bureau of the Congress, 108 Sarphatistraat, Amsterdam.

AT the first ordinary meeting of the Microscopical Society of Wales, held on July 3, the biology of Roath Park, Cardiff, was discussed. Roath Park, through which a brook flows, has an area of more than 160 acres, and comprises a recreation ground, pleasure garden with bowling-greens and lawn-tennis courts, etc., a botanical garden, rock garden, flower and Cactus conservatories, lake, wild garden, and Llandennis gardens. As the largest park or open space in Cardiff it attracts many visitors. During the past two or three years, however, bathers using the lake have been affected by their skin being punctured, after which intense irritation sets in, and Roath Park Lake

has thus become a topic of conversation from a point of view other than that of its amenities. From the botanical point of view the park is notable amongst provincial parks and open spaces: the birds breeding in or frequenting it have been studied for about a quarter of a century, and many mammals have been recorded. As a field for microscopical study and research little has been done, but the meeting of the Society on July 3 directed attention to the many and varied interests which the park offers to microscopists. Although it is less than three months since the first move towards the formation of the Microscopical Society of Wales was made, its membership already exceeds a hundred, and the formation of local branches in other parts of Wales is under consideration.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A research assistant at the Imperial Forestry Institute, University of Oxford—The Secretary, Imperial Forestry Institute, The University, Oxford (July 15). An assistant lecturer in botany in the University of Birmingham—The Secretary, The University, Birmingham (July 23). A lecturer in biology at the Cheshire School of Agriculture—The Principal, Cheshire School of Agriculture, Reaseheath, Nantwich (July 26). Five electrical inspectors of factories for inspection of factories and other places under the Factory Acts—The Industrial Division, Home Office, Whitehall, S.W.1 (July 28). A professor of biochemistry in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 29). A junior assistant under the Directorate of Metallurgical Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A director of the Rubber Research Institute of Malaya; also a head of the botany division of the institute—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2 Idol Lane, Eastcheap, E.C.3. A temporary lecturer in biology or botany at Lincoln Training College—The Principal, Training College, Lincoln. A part-time lecturer in chemistry and experimental physics at Queen's College, London—The Secretary, 43 Harley Street, W.1. A lecturer in malignant disease in Aberdeen University and radium officer at the Aberdeen Royal Infirmary—The Secretary, The University, Aberdeen.

Our Astronomical Column.

The Spectrohelioscope.—Descriptions of the spectrohelioscope and of typical observations made with this instrument for solar research have been given by Dr. Hale in NATURE during the course of his experiments (**118**, Supplement, July 3, 1926, 1-8; **119**, 708-714; **121**, 676-680). A detailed account of the instrument is also given in the *Astrophysical Journal*, December 1929; and more recently, in the March issue, Dr. Hale describes some rapidly moving hydrogen flocculi which he has observed near sunspots—in particular several flocculi representing active prominences connected with a large group of sunspots from Sept. 16 to 26, 1926. The typical phenomenon described in the paper is a curved dark filament descending into the spot (either into the umbra itself or terminating at the edge of the penumbra as a small black head) with velocities of the order of 50 or even 100 km./sec. The bearing of those observations on the structure of the hydrogen vortices of the solar atmosphere is left for discussion in a future communication to the *Astrophysical Journal*. Photographs of rapidly changing flocculi are but seldom secured with the spectroheliograph—not that such flocculi are infrequent, but that their active phase appears to be usually of short duration, and so are usually missed at the time of exposure of the daily spectroheliogram. Moreover, high radial velocities pertaining to a flocculus would, owing to the Doppler effect, cause a displacement of the spectral line from the second slit of the spectroheliograph and so prevent, partially or entirely, the flocculus from being recorded. It is one of the ingenious features of Dr. Hale's design for his spectrohelioscope that flocculi with large radial velocities, especially differential velocities along their length, can be picked up and their velocities quickly measured by means of the 'line-shifter'.

The Planet Pluto.—The *Scientific American* for July contains an article by Prof. H. N. Russell describing Prof. P. Lowell's prediction of the elements of a trans-Neptunian planet and the search that has been carried on at the Lowell Observatory, resulting last January in the detection of Pluto.

Lowell's only notable error in predicting was his exaggeration of the mass and magnitude of the body. He assigned to it a mass 6 times that of the earth and a magnitude of 12-13. This error was responsible for the delay of 15 years before the prediction was verified. Instruments of insufficient light-grasp were used in the search until the president of Harvard (Prof. P. Lowell's brother) gave a specially rapid triple objective of 13 inches aperture. Mr. Tombaugh began a systematic search with this instrument about a year ago, and six months later he discovered Pluto.

Prof. Russell notes that Lowell's memoir (dated 1915) is now procured with difficulty. He therefore reproduces facsimiles of three pages of it. One is given as a specimen of the nature of the analysis; the other two are the final pages, giving a summary of the whole, and the elements of the two predicted orbits. The closeness of the prediction is shown by comparison of Lowell's first orbit with the following elements of Pluto deduced by Dr. A. C. D. Crommelin from the observations of 1919, 1927, 1930. This is practically identical with that given by Nicholson and Mayall using 1919, 1930, thus confirming the identity of the 1927 object with Pluto.

Perihelion Passage .	. 1991·2	1989 Jan. 15·8 U.T.
Longitude of Perihelion	. 205°	221° 44′ 1·0′
Asc. Node . .	. Not predicted	109 21 35·0
Inclination . .	. 10 (conjectural)	17 9 1·8
Eccentricity . .	. 0·202	0·2529548
Period . . .	. 282 y.	250·753 y.
Perihelion distance .	. 34·3	29·706
Computer . .	. Lowell (1915)	Crommelin

The close agreement in the four independent elements of date of perihelion, longitude of perihelion, eccentricity, and period is beyond what can reasonably be ascribed to chance. It is noteworthy that Prof. Russell's article was written before he knew of the 1919 and 1927 images: they have justified him in the estimate that he had already formed of the value of Lowell's work.

Research Items.

Monoliths in Assam.—Mr. J. P. Mills, and Mr. J. H. Hutton in vol. 25, No. 1, of the *Journal and Proceedings of the Asiatic Society of Bengal* describe a series of five groups of remarkable monoliths in the Cachar Hills not previously recorded in print. The monoliths are pear-shaped, artificially dressed, and each contains a cavity in the bulbous end. They are now recumbent, though they appear at one time to have been erected on their narrow ends. They fall into two distinct types which may be regarded as male and female. The former constitute the whole of a large group at Kartong, and a smaller group between Kartong and Kobak. Most of the stones are incised with geometric designs and forms of men and animals, such as the pig and the mithun. While the monoliths may be interpreted as embodying the phallic principle, assisting the fertilising of Nature, the hollows seem to have been meant for some specific purpose not easy to discern. It may be that they were intended to hold water to promote rainfall, or they may have been intended to contain offerings on the analogy of holes recently scooped out in ancient monoliths at Kasomari. It is concluded that the North Cachar hollowed monoliths must be regarded as a specialised development of a phallic ancestral cult typical of Assam. It is clear that they were not erected by the Nagas and old Kukis who are the present inhabitants of the area. Local tradition assigns them to the Mikirs. This may be the case, subsequent invasion having overwhelmed the Mikirs and left them in isolated communities too weak to provide the labour requisite to carry on the custom. It is more probable, however, that it is to be associated with the Khasi Synteng group of tribes and that it has disappeared owing to their migration into an unsuitable environment.

Tasmanian Crania.—Dr. W. L. Crowther describes in the *Papers and Proceedings of the Royal Society of Tasmania* for 1929 two crania (immature) of the extinct Tasmanian race. Immature crania of the Tasmanians are comparatively rare. Of these two, Skull *A*, that of a child of seven years of age, was found in 1908 by the author and Dr. Inglis Clark at Oyster Creek. It was in a cemetery near the Government Station where the last thirty or forty of the race were buried and was at least sixty years old. Skull *B*, that of a child 7-12 years old, was found by Mrs. Legge on the west coast in 1927. No trace of any other human bones was found with it, and the mandible was missing. Skull *A* from its fragility was judged to be female. Rings of short bronze-coloured hair still adhered to the scalp. Posthumous distortion of the left side was probably due to the body having been laid on that side. The glabella is not prominent. The orbits are almost equal in height and breadth, markedly contrasting with those of the adult. The mandible is in position and the face shows marked prognathism. The six-year molar is erupted and the twelve-year molars are *in situ*. Skull *B*, probably male, shows little or no prominence of the glabella and supra-ciliary ridges. The supra-orbital notch is wide and shallow. The nasal bones are not projected forward and upward as is seen in the adult. The orbits again are almost equal in height and breadth. There is no suggestion of the heavy overhanging eyebrows of the adult. The face is not so prognathous as Skull *A*. The vault of the skull is flattened rather than of the typical carinate form. Generally, both the skulls conform to the adult type and could be distinguished by their Tasmanian characteristics; but in both the typical carination is absent. In early life it appears that the marked width of the face at the expense of its height is not pronounced. The orbit and nasal apertures appear to expand laterally as the result of growth and mastication, and with the normal heavy development of the glabella and supra-orbital ridges give rise to the facial characteristics of the adult skull.

Growth Rate of Young Gorilla.—Dr. C. V. Noback is reported to have made a study of the development of a young gorilla received at the New York Zoo some time ago (Science Service, Washington, D.C.). He found that it grew more slowly than a boy of the same age, the rate of growth during the first three years of life being measured in terms of adult weight. But the bones and teeth matured more rapidly than those of a human child, for the full set of milk-teeth was developed at approximately eighteen months, and the permanent teeth began to be acquired at the age of two and a half years. The study will be reported in full in the *American Journal of Physical Anthropology*.

The Swallowing of Feathers by Grebes.—It has often been observed that different species of grebes contain quantities of their own feathers in their stomachs, and the frequency of this curious habit suggests that it has some functional significance. Mewes thinks that the purpose is to protect the lining of the stomach from abrasion, Biedermann that the feathers perform a function similar to that of pebbles in granivorous birds. Neither of these suggestions is altogether acceptable, and Dr. Josef Jirsík has made a new attempt to solve the problem (*Bull. de l'école supér. d'agronomie Brno, ČSR.*, 1929, Sign. D. 15). He found a young great-crested grebe (*Podiceps cristatus*) only a few hours old to contain 13 feathers, and another of the same brood 93, all the feathers having been plucked from the mother—an instinct apparently present at birth. The young birds began to swallow their own feathers as soon as they appeared amongst the down, and the adults took their own or each other's feathers almost indiscriminately throughout the whole year. Further, when the stomachs contained only small insects feathers were few, when fishes had been devoured they were many; so that the quantity of feathers seems to be regulated by the quantity of food swallowed. Hard and indigestible fragments of food were surrounded in the stomach by feathers, and the actual observation, made by means of a powerful binocular telescope, of vomiting movements on the part of the grebes similar to those of herons, strongly suggests that the feathers enable the birds to reject, in the form of a cast, the indigestible portions of a meal. Here apparently is a close analogy to the swallowing of fur by owls and other birds of prey.

Conditioned Responses in Fishes.—Mr. H. O. Bull (*Jour. Mar. Biol. Assoc.*, N.S., vol. 16, No. 2, 1930) has published the results of his further work on the capacity of fishes to form conditioned responses towards definite stimuli. He found that the wrasse is able to form stable conditioned motor responses to the note of a tuning-fork sounding the note lower *C* or to an electric buzzer giving a note approximately *F* in the second octave, when either was used singly. The fish was, however, unable to discriminate between them as sounds when both were used simultaneously but differentiated them by their position. The author was also able to build up conditioned responses involving visual stimuli in the plaice, cod, and coalfish. Two species of *Blennius* were able to form stable conditioned responses towards gustatory stimuli, such as sea water extracts of natural food substances, but

did not respond to an artificial olfactory stimulus such as artificial musk. The author concludes, as a result of his series of experiments, that the essential similarity between the responses built up in fishes and the conditioned reflexes in dogs becomes more emphasised as the data accumulate.

Young Stages of *Conus*.—The apex of *Conus* is not commonly found in a good state of preservation, while complete immature individuals are rare and that of *Conus adversarius* Conrad has hitherto been unknown. Mr. Burnett Smith is now fortunately able to describe and figure three specimens (*Proc. Acad. Nat. Sci. Philad.*, vol. 81). In the youngest of these a slight yet definite constriction serves to distinguish the whorl proper from the anterior canal, and this the author considers to be a significant suggestion of a pleurotomoid ancestry for the genus *Conus*.

South American Fish Poisons.—Messrs. E. P. Killip, of the U.S. National Museum, and A. C. Smith, of the New York Botanical Garden, in a botanical exploration of Peru and Brazil, paid attention to the plants used by the natives as sources of fish poisons, as such plants are possible sources of new insecticides. The most successful fish poison appears to be prepared from the roots of a plant which was frequently cultivated on this account and, curiously enough, was never seen anywhere in flower or fruit. They identify this plant as *Lonchocarpus nicou* (Aubl.) DC. after comparison with the specimen in the British Museum (Natural History). Two other species of this genus are also described as sources of fish poisons: one species from the lower Amazon River with an exceptionally powerful poison they decide is new and describe under the name of *L. urucu*.

Virus Diseases of Plants.—Henderson Smith summarises the literature on two obscure problems connected with virus diseases of plants in *Biological Reviews*, vol. 5, April 1930. The spread of the virus from the point of inoculation can take place from cell to cell, but the rate of spread seems high for such a process though low for transport in the water stream; Henderson Smith concludes that transport is probably mainly effected by the phloem. He also discusses the abnormal inclusions, the *X* bodies, characteristic of many virus-infected plants. He points out that some recent observations (F. M. L. Sheffield and Henderson Smith, NATURE, Feb. 8, p. 200) support the more commonly accepted view that these bodies are not living organisms, but a reaction product of the cell to the virus irritant.

Soil Formations in the Tropics.—Researches in recent years have shown that in mature stages of soil formation the characteristics of the parent material are obliterated and the soils are expressions of climate irrespective of origin. A low temperature with rainfall greater than evaporation and constant bleaching by cool water leads to a podsolised soil or podsol of a light colour and high silica content. Podsol is typical in Canada and northern Europe. In order to investigate its occurrence in high altitudes in the tropics, Mr. M. W. Senstius explored soils in the Dutch East Indies and the Philippine Islands. His results are given in a paper on weathering and soil formation in *Proceedings of the American Philosophical Society* (Vol. 69, No. 2). Many of the conditions favourable to the development of a podsol occur in the heights of those islands. Analyses of the soil samples showed that podsolisation takes place in much the same way as in the lowlands of middle latitudes, though the bleached layer below the dark humus is much thicker. Nevertheless, the author did not find in any of the areas visited a true podsol containing little else but silica. The investigation, on the whole, supports the principles of soil classification on a climatic basis.

Helium and the Origin of Petroleum.—M. N. Rogers discusses a "radioactive hypothesis of petroleum formation" in the *N. Zealand Jour. Sci. and Tech.* for April, 1930. He suggests that methane, arising from the decomposition of the organic substances in sedimentary rocks, is condensed as a result of the ionisation due to the radioactive constituents in the same rocks. Lind and Bardwell have already shown that the effect of α-rays on methane is to produce the higher saturated hydrocarbons and liquid olefines. Rogers assumes that the extent to which such a process has operated in a sandstone may be indicated by the content of helium in the latter. Experiment indicates that for each cubic foot of helium generated nearly two tons of liquid hydrocarbons could be formed. In the Eldorado oilfield of Kansas 70 million cubic feet of helium per annum have been produced. In the Sedan field of Kansas several million cubic feet of gas with about one per cent of helium escape daily. The Petrolia gas-field originally contained more than 1000 million cubic feet of helium. It is further pointed out that radon is about fifty times more soluble in petroleum than in water, and that this might lead to a localisation of radioactivity which would bring about partial elimination of hydrogen and the production of solid hydrocarbons.

Apatite Deposits of Chibina Tundra.—In one of the Scientific Chemico-technical Publications of Leningrad (in Russian, 1929) A. E. Fersmann, the leading geo-chemist of Russia, gives a concise summary of the work done during the last ten years in exploring the Chibina Tundra for apatite. The area is a massif of rocks belonging to the nepheline-syenite family situated north of the Polar circle in the Kola Peninsula not far from the Murmansk railway. The intrusions are laccoliths or ring-complexes in the Pre-Cambrian gneisses of the Fenno-scandian shield. Apatite-nepheline rock occurs in two bands. The one now being exploited has an apatite-rich upper part (average thickness, 50 metres; P_2O_5, 30 per cent.) and a lower part poorer in apatite (average thickness, 150-180 metres; P_2O_5, 10-15 per cent). Parts of the rock range as high as 85 per cent of apatite, and the estimated reserves of the latter amount to more than 500 million tons. The ore was formed at a late stage in the igneous cycle from a residual magma rich in volatile fluxes. It constitutes the greatest of all the Russian phosphate deposits. Preliminary prospecting by borings and construction of roads is now completed and the yield of ore next year is expected to be 200,000 tons. The by-products—nepheline and titanium ore—will be utilised in the ceramic and chemical industries.

Types of Bridges.—An ingenious and original map appears in *Petermann's Mitteilungen*, Heft 5/6, 1930, showing the distribution throughout the world of various kinds of bridges classified first by the material and secondly by the method of construction. The classifications that are mapped include eight types ranging from the simple hanging bridges of lianas and other plants to modern bridges of metal built in spans. Dr. H. Winkler adds a short article to his map. A certain correspondence with forest growth appears in the distribution of all types of wooden bridges, those made of lianas being confined to the region of equitorial rain forests. The Mediterranean forests, how-

ever, do not seem to help bridge construction, for in their area stone bridges in the main predominate. On the whole, the wood bridge in one form or another is found in more than half the land area of the world.

New England Floods.—During the last century, New England has experienced some ten storms resulting in flooding of unusual severity. One of the worst of these was on November 3 and 4, 1927, and it is the subject of a report by Mr. H. B. Kinnison (U.S. Geological Survey, *Water Supply Paper*, 636-C). Torrential rain fell over much of New England, causing very severe floods, and loss of life and destruction of roads, bridges, and houses in Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island. The storm was caused by somewhat exceptional meteorological conditions. A tropical storm appeared on the weather map over Cuba on Oct. 29, and started to move northward three days later, developing unusual severity. By Nov. 3 the storm centre was off the lower end of Chesapeake Bay. It was then expected to continue up the coast with moderately heavy, but not excessive, rains over New England. However, an area of high pressure to the north-east prevented the storm moving in that direction, and at the same time there was another high-pressure area north of New York State. The moving low-pressure area was caught between the two high-pressure areas and was forced upwards. Torrential rain resulted. Over 500 square miles there was a fall of 9 inches, while over another 36,000 square miles more than 5 inches fell. Several power reservoirs in the area were not full at the time and held some of the flood waters, but the ground was saturated by previous heavy rains, and lakes and swamps were almost full, a state of affairs which led to rapid flooding.

Light Rays as null Geodesics.—Einstein's general theory of relativity was based upon several postulates, which subsequent writers have tried to simplify. Thus Whittaker, in vol. 24 (1927) of the *Proceedings of the Cambridge Philosophical Society*, showed that to obtain the equation of light rays as space-time geodesics of zero length, we need only combine the ordinary theory of partial differential equations and of their *characteristics* (which may be roughly described as loci of singularities) with the simple postulate that a light ray is a line of singularities. Levita-Civita, in vol. 11 (1930) of *Rendiconti della R. Accademia Nazionale dei Lincei*, has carried the simplification a stage farther by eliminating all reference to electromagnetism. He shows that the light rays can be obtained as characteristics directly from the *gravitational* equations, independently of any electromagnetic theory of light.

Collisions of α-Particles with Nitrogen.—Prof. W. D. Harkins and Mr. A. E. Schuh have contributed a paper to the *Physical Review* for April 1, in which an account is given of some investigations of the production of oxygen from nitrogen, presumably those to which reference was made recently in NATURE (April 19, p. 611). It appears that 39,000 photographs of 390,000 tracks of α-rays from thorium C and C′ were taken in a Wilson cloud apparatus containing nitrogen. Two 'disintegration-syntheses' were observed, in which it appeared that oxygen (O^{17}) had been formed by the addition of an α-particle to nitrogen (N^{14}), with simultaneous expulsion of a proton. One of the two photographs has been reproduced. The number of collisions per million α-rays of range 8·6 cm. in which reorganisation of the nuclei took place was only one-quarter of the number previously obtained by Mr. Blackett, but the number of elastic collisions in which the α-particle was deflected through more than 90° was 100, compared with Mr. Blackett's 32. With such small numbers, no importance can be attached to apparent differences in yield of this order, but the numbers in question are definitely less than would be expected from the researches of Drs. Kirsch and Pettersson.

Melting-Point of Pure Tellurium.—With the view of a closer study of the strange behaviour of fused tellurium dioxide towards platinum, especially under the influence of a direct electric current, Prof. A. Šimek and Dr. B. Stehlík, at the Masaryk University of Brno, have prepared some elementary tellurium in the purest possible state. These authors then made an accurate determination of the melting-point of this 'metallic' tellurium by an electrical method whereby the temperature of a resistance furnace was raised steadily and uniformly by two, three, or four degrees C. each minute. The temperature was measured by means of thermo-elements of 'Heræus' platinum and a ten per cent. rhodium-platinum alloy. The thermo-electric force of the couple was measured by a calibrated double potentiometer connected to an aperiodic mirror galvanometer giving a deflection of 1 mm. for one microvolt, corresponding to 0·1° C. in the temperature range used. The melting-point *in vacuo* was 452·0° C., but was lowered by about 0·15-0·2° C. in hydrogen and in carbon dioxide at one atmosphere pressure. This the authors explain as being due to the solubility of the gases in fused tellurium.

Chemistry of Menthone.—In an article on recent progress in the menthone chemistry in *Chemical Review*, vol. 7, No. 1, Prof. J. Read explains how much light has been thrown in recent years upon the constitution of products derived from oil of peppermint by researches upon the ketone *piperitone*, which can be obtained in dextro-rotatory, lævo-rotatory, and racemic forms from *Eucalyptus*. The genus *Eucalyptus* which abounds in Australia embraces about 300 species and is of immense scientific and economic importance on account of its timbers, essential oils, exudations, and dyes. By reduction of piperitone in contact with colloidal palladium one molecular proportion of hydrogen is added and a mixture of menthones of reversed and enhanced optical rotatory power is produced. Thus *l*-piperitone, of which $[\alpha]_D = -51·5°$, gave on reduction a mixture of *d*-isomenthone and *l*-menthone with $[\alpha]_D = +65·1°$. By the action of heat or of alkalis, racemisation of piperitone is effected through enolisation which destroys the asymmetry, whereas menthone under similar conditions undergoes an apparent 'inversion'. In this case, however, enolisation affects only one of two asymmetric carbon atoms, so that the product remains optically active, though reversed in sign, and the problem is complicated by the superposition of geometrical upon optical isomerism. Thus the actual product is not the enantiomorph of menthone but its geometrical isomer and the term 'inversion' has been erroneously applied. Study of the menthylamines has furnished interesting data for the development of the principle of optical superposition, the main obstacle to the solution of which problem lies in the great difficulty of gaining access to complete stereo-isomeric series of suitable substances. The last section deals with speculations upon the biogenetic origin of different natural oils from related species. In this difficult field the author finds that striking relationships centre around piperitone. The very delicate control of molecular transformations which may result in producing dextro-rotatory and lævo-rotatory isomers in different plants appears to be still inseparably associated with the vital process.

The Department of Animal Genetics, University of Edinburgh.

THE scheme formulated in 1911 by the Development Commission for the further development of agricultural education and research included the creation of a number of research institutions. To Edinburgh was allotted an Institute of Research in Animal Breeding, and in 1913 a Joint Committee, including representatives of the University and of the College of Agriculture, was called into being. Its activities were completely interrupted by the War, and it was not until 1919 that they were resumed. It was decided, owing to the general uncertainty which prevailed at this time, to make a very unambitious beginning.

The first home of the Department was an old fever hospital in the High School Yards, placed at the disposal of the committee by the University authorities, but by 1924 this accommodation had become entirely inadequate, not only for the experimental animals, but also for the staff and their guests. Emeritus Professor Sir James Walker placed seven rooms in the new Chemistry Department at King's Buildings at the disposal of the Joint Committee, and the University Court granted the use of seven acres of grass land.

In 1927, as a result of a report made by its representative, the International Education Board of America granted a sum of £30,000 toward the building and equipment of the Department, and the endowment of a chair in animal genetics in the University. This offer was conditional on a like amount being raised from other sources, and on the provision of funds adequate for maintenance. Through the generosity of private individuals, notably Lord Woolavington, Lord Forteviot, and others, and of public bodies, including the Development Commission, the Empire Marketing Board, the Highland and Agricultural Society, and the University Court, this sum was raised or guaranteed. Plans of a new building were prepared by Messrs. Lorimer & Matthew, and building operations were commenced in September 1928.

The new building is situated to the west of the Chemistry block and has the form of a T with the cross-bar and the main entrance frontage, 91 feet long, facing due east. It measures 140 feet from east to west, and consists of four floors, including a so-called basement and excellent attic accommodation, these being as well lighted and serving as useful purposes as do the ground and first floors. A feature has been made of the centre of the symmetrically treated front. The entrance doorway is recessed under a wide low arch and is approached by a flight of steps and flanked by shaped parapet walls, the whole being surmounted by a shaped gable after the Dutch style, having carved upon it a symbolical group representing the continuity of life.

FIG. 1.—Department of Animal Genetics, University of Edinburgh.

The building is harled with stone facings and corners and the roof is covered with Ballachulish slates. All the floors are of reinforced concrete and in the corridors they are covered with terrazzo. The lecture theatre with its barrel vault carried up into the roof space is well lighted and is seated for 120. The principal staircase is constructed in synthetic stone and has a simple but very fine wrought iron railing with ornamental panels.

On the ground and first floors are the rooms of the staff and of the guests. In the basement are the

constant temperature and X-ray rooms, animal rooms, staff common room, workshop, store room, lavatories, and also an unloading room in which packages can be transferred from a lorry directly into the electric lift which serves all floors. A caretaker's house of five rooms occupies the west end of the floor. In the attic, which runs the whole length of the building, are the aquarium, aviary, terrarium, and store room.

In the entrance hall are panels framed in oak with the names of students who have taken higher degrees whilst guests of the Department. At the top of the panels there is carved "De fructibus suis agnoscebantur." Under this honours panel there is an oak table and stools.

The heating of the Department is by low pressure steam.

In addition to this main block there lies, to the south-west, a sheep building provided by the Empire Marketing Board and equipped with operating theatre, sterilising and instrument rooms, food stores, and sheep pens. To the north-west there is a large brick intensive poultry house accommodating 200 birds. To the north there are the large pig building and goat house provided by the Department of Agriculture for Scotland. Several wooden buildings house the rabbit, rat, and mouse colonies, whilst others accommodate the monkeys and fowls.

The new building was officially opened on Monday, June 30, by the first chairman of the Joint Committee on Research in Animal Breeding, Sir Edward Sharpey-Schafer, president of the Royal Society of Edinburgh. At the opening ceremony, the degree of Doctor of Laws, *honoris causa*, was conferred by the Vice-Chancellor, Sir Thomas Holland, upon Mr. T. B. Macaulay, the president of the Sun Life Assurance Company of Canada, a Canadian with strong Scottish connexions, who has shown considerable interest in the affairs of the department and has endowed therein a lectureship and several assistantships.

The Museums Association and Museum Extension.

THE forty-first annual conference of the Museums Association, which met at Cardiff, on June 23-27, by invitation of the Lord Mayor and Corporation and of the National Museum of Wales, was successful in all aspects. It was attended by more than 230 delegates and other members from all parts of the British Isles, as well as from the United States, Germany, and Sweden; these represented all classes of museums, from the great national institutions to the smallest village museums. The last statement strikes the main note of the conference: the knitting up of the museum service of the country and its extension to the remoter districts, a subject on which valuable discussions took place. The National Museum of Wales has itself set a brilliant example of such work, and, with its beautiful building and admirable arrangement, formed an inspiring focus of the proceedings. The guidance of its officers, the hospitality of the Lord Mayor, of the Mayors of Newport and Merthyr Tydfil, of Lord Treowen, and of numerous friends combined with the fine weather and the charm of the surrounding country to make the stay of the visitors as delightful as it was profitable.

The president, Sir Henry Miers, referred in his address first to the Report of the Royal Commission on National Museums and discussed the suggestions which it made for the co-operation of the Museums Association. In the event of a Standing Commission being appointed, it was hoped that the Association would have official representation on it. The proposed enlargement of the Circulation Department to include all suitable classes of museum material would be an important factor in co-ordinating museums, while the extension of the method of affiliation adopted by the National Museum of Wales should assist in their co-operation. Plans for a training course, as desired by the Royal Commission, were already published in the *Museums Journal*, and it was hoped that municipal bodies would assist their junior officers to attend. The scheme for a National Open-Air Folk Museum was making good progress in the hands of a strong committee.

Turning to the proposals of the Carnegie Trustees, the president said that the advice of the Association would be asked when grants were allotted to museums; it was necessary that museums should fulfil the conditions laid down in his own published report to the trustees; meanwhile museums might consider plans of work to which they might apply any possible grant. For the Association to perform the duties requested of it by the Royal Commission and by the Carnegie Trustees, it was necessary that it should acquire a legal status; as a first step it was proposed "that the Museums Association be converted into a Company limited by guarantee and not having a share capital." This, with the consequent changes in the constitution of the Association, was accepted by the subsequent general meeting, which fixed the amount of the guarantee at 10s. for each member.

Finally, the president repeated some of his previous recommendations, as that the museums of a district should combine to hold a district loan exhibition; that museums should distribute their surplus material, and render their research material more available for workers; and that they should prepare educational exhibits for circulation to schools and to towns or villages unprovided with a museum.

This last was the subject of two papers by Dr. T. W. Woodhead, of Huddersfield, and Mr. W. C. Sprunt, of Batley, who described the kind of exhibits sent out, the mode of packing, and the system of distribution. It was pointed out in the discussion that museums had been doing this work long before the libraries took it up. There has, however, been no systematic attempt to provide branch museums in the villages for those of more mature years, at least so far as Great Britain is concerned. The numerous rural museums in Sweden, of which Dr. Klein of the Northern Museum gave an entertaining account, are independent folk museums of high value in promoting local patriotism but not educational in the formal sense. The same may be said of the *Heimatmuseen*, now springing up all over Germany, of which the ideals were eloquently expounded by Dr. Otto Lehmann.

The more usual type of small museum was in the minds of Dr. F. J. North and Mr. H. A. Hyde, who showed what it might usefully exhibit in geology and botany respectively. The affiliation of such museums to a central museum was discussed by Dr. Cyril Fox, from his experience as director of the National Museum of Wales. He had found the chief difficulty in any scheme to be the lack of a permanent and competent curator; the parent museum could neither lend nor give material to a museum that was unable to care for it.

The Carnegie Trustees had sent their assistant secretary, Mr. A. B. Hyslop, to glean suggestions that might help towards some scheme of museum extension to rural areas. They were hoping to take counsel with the County Directors of Education and with the Circulation Department of the Victoria and Albert Museum; but it is clear that the burden of the work

must fall on local museum curators, just as that of library extension has been borne by public librarians. There can be no question of the willingness of curators to help; many of them have been doing the work for years, sometimes with the co-operation or at least the sanction of the educational authorities, sometimes in spite of their lethargy, and out of their own slender resources. If the Carnegie Trustees can induce the educational authorities in any one area to co-operate whole-heartedly with the museum curators, an example will speedily be set which the rest of the country will feel bound to follow. It is, however, to be hoped that the benefits will not be confined to school-children, but that the needs and interests of others, especially the adolescent, will be kept prominently in view.

International Congress of Actuaries.

THE ninth international congress of actuaries was held at Stockholm on June 16-20 and was largely attended by actuaries from all over the world. The arrangements were made by the Swedish Society of Actuaries and the Swedish Association of Assurance, and the presidents for the time being of those bodies (Dr. Phragmén and Mr. Sven Palme) being the joint presidents of the Congress. Several subjects were chosen for discussion and the papers submitted were printed in English, French, or German, at the author's choice, with abstracts in the other languages. Each subject was then introduced by a short speech by a Scandinavian actuary and a general discussion followed.

One of the subjects of most general interest discussed at the Congress was the treatment of sickness and disability in social insurance or in connexion with pensions or life assurance, and it was apparent that the granting of these benefits on invalidity has led to far heavier rates of invalidity than those prevailing prior to the institution of the schemes. This effect is noticeable whether we look at State or private schemes of insurance. Attention had already been directed to the point in England, and most other countries are having to face the same difficulties. It is probably inevitable that, even if definite malingering be excluded, some such result should appear, but it makes the actual expense of such schemes greater than the estimated expense on the basis of older experience acquired in different conditions. The subjects of general scientific rather than professional interest were the statistical evidence available with regard to the influence of tuberculosis on mortality and the application of modern statistical treatment to problems of risk. In connexion with the latter, non-Scandinavian actuaries had the opportunity of considering Lundberg's interesting new theory of risk, and it was satisfactory to find a paper giving a definite warning against the assumption of the normal curve, in connexion with the discussion of deviations in assurance work, when Poisson's law would be a proper assumption.

On the strictly actuarial side, the fair distribution of surplus was discussed by many actuaries in written and verbal communications, while on the practical life assurance side the comparison of 'participating' with 'non-participating' assurances and the relative advantages of assurances that merely cover risk, as compared with those that are largely for purposes of saving, evoked a good discussion.

The meetings were held in the new concert hall and the arrangements were excellent. The interpreting was remarkably good; thanks partly to the choice of linguists with a first-class knowledge of the subjects under discussion.

The Congress was graciously received at the Royal Palace for tea by H.M. the King, and the Crown Prince, as Président d'honneur, attended and spoke at the opening meeting. It only remains to record the generous hospitality of our Swedish hosts to the members of the Congress and their wives: it would be hard to imagine greater kindness. W. P. E.

Rayleigh Collection at the Science Museum.

AMONG recent additions to the Science Museum, South Kensington, is a most interesting collection of apparatus used by the late Lord Rayleigh in the course of his scientific research. On the occasion of the unfortunate fire, last year, at Lord Rayleigh's home at Terling, Essex, a considerable quantity of apparatus was destroyed, but the historical apparatus was fortunately undamaged and the bulk of it has been generously given by the present Lord Rayleigh to the Science Museum, where it should prove a continual source of interest and inspiration to professional and amateur scientific workers alike. It is scarcely necessary to remind readers of NATURE of the extent and importance of the late Lord Rayleigh's contributions to science. During a period of more than fifty years he published no fewer than 446 papers, every one of which made a distinct addition to our knowledge of the subject and was characterised by that lucidity and elegance of expression for which its author was renowned.

On viewing this collection, one is struck very forcibly — as were visitors to the laboratory at Terling — by the extraordinary simplicity of the bulk of the apparatus. The ability to attain results of the highest accuracy and importance by the aid of odd bits of wood, glass tubing, wire, and sealing-wax was undoubtedly bound up with Rayleigh's unerring instinct in discriminating between the essential and the non-essential. It is doubtless true that some branches of modern physical research cannot profitably be pursued without the use of expensive apparatus. At the same time, many workers who are apt to grow despondent after a perusal of the price-lists of the scientific instrument makers should find a tonic in the Rayleigh collection, which also serves as a salutary reminder that the man is more important than his tools.

The present collection is thoroughly representative of the vast field which Lord Rayleigh covered, and is exhibited in six cases, two dealing with acoustics, while the remainder come under the headings of optics, magnetism and electricity, argon, and miscellaneous. It is impossible in a short notice to deal adequately with the whole of the exhibits, but a few representative examples may perhaps be mentioned. The acoustics section includes apparatus used in experiments on reflection and interference and on the intensity of aerial vibrations; also the apparatus by means of which it was demonstrated that our lateral perception of the direction of a sound depends upon the phase-difference at the two ears. One of the most important exhibits in the optical section is the apparatus used for the determination of the constant of the magnetic rotation of light in carbon disulphide, while there is also a reminder that, so early as the year 1902, Rayleigh made an attempt to detect motion through the æther. Prominent in the electrical section will be found

apparatus for determining the laws of resistance of periodic currents. The argon collection gives an excellent idea of the course taken in that classical series of investigations extending from 1892 to 1895 in the latter part of which Sir William Ramsay collaborated, while under 'Miscellaneous' the chief exhibits deal with capillarity, fluid motion, and cognate problems. Every piece of apparatus has been provided with a full explanatory label giving references to the original source and to the "Collected Scientific Papers," and public lectures on the exhibits will be given from time to time.

South-Western Naturalists' Union.

THE eighth annual conference of the South-Western Naturalists' Union, attended by individual members and representatives from affiliated societies in the six south-western counties, under the presidency of Dr. F. A. Bather, was held at Gloucester, on June 13–15, at the invitation of the Cotteswold Naturalists' Field Club. Members were welcomed by the Mayor of Gloucester (Councillor S. J. Gillett) and the president of the Cotteswold Field Club (Prof. H. L. Hawkins), and were entertained at a reception in the Museum, where, in addition to the other exhibits, several beautifully executed ancient charters of the city were specially displayed. By the courtesy of the mayor and corporation, meetings were held in the Guildhall, and on the morning of the second day a long business agenda was tackled. A suggestion put forward that the management of the Union's affairs should be entrusted for limited periods to local committees appointed by the affiliated societies in circumscribed areas in rotation was remitted for future consideration.

Dr. Bather in his address, entitled "Evolutionary Enigmas", first sought to make the idea of organic evolution more precise, and, by examples drawn from fossil invertebrates, to present a series of proofs gradually increasing in force. Modern studies in palaeontology and in genetics had, in his opinion, thrown doubt on the older phylogenetic conceptions and on the origin of life-forms from a homogeneous material. He preferred to start with a multitude of diverse units, which by combination produced a great number of organisms differing in qualities and potentialities. These, he thought, had been sifted and assorted by a succession of varied environments, a process which, strictly speaking, was not evolution. Evolution came in when change in the constitution of one or other heritable unit provided new material for sifting. There was reason to believe that such change could be produced by change of outer conditions, though it had not been proved that the change was necessarily in harmony with the conditions. This whole conception was opposed to Herbert Spencer's definition of evolution.

Two excursions were made. On the afternoon of the second day a number of ancient buildings were inspected under the guidance of Mr. Roland Austin, City Librarian; afterwards the party was conducted over the Cathedral by the Archdeacon, the Ven. C. H. Ridsdale. On the concluding day a portion of the Cotswolds was toured by motor cars. A halt was made at 'The Chandlers', Witcombe, where Mrs. E. M. Clifford exhibited and explained in detail numerous Neolithic, Palaeolithic, and Romano-British finds from the Barnwood gravel pits. Many of the objects form the subjects of papers prepared for publication in scientific journals. The special aims on the excursion were a survey of the geological conditions in an area lying between the courses of the Severn and the Thames, particularly with regard to river development, and the inspection of certain exposures, notably a fine one in the Great Oolite at Foss Cross. The physical features of the region were most ably demonstrated and interpreted by Dr. D. E. Finlay, the honorary secretary of the Cotteswold Naturalists' Field Club.

Annual Inspection of the National Physical Laboratory, Teddington.

ON Friday, June 27, the General Board of the

inspection of the laboratory. As is usual on this occasion, a large number of visitors, including representatives of scientific and technical institutions, government departments, and industrial organisations, were present and were received by Sir Ernest Rutherford, chairman of the General Board, Sir Richard Glazebrook, chairman of the Executive Committee, and Sir Joseph Petavel, Director of the Laboratory.

In the duplex wind tunnel in the Aerodynamics Department a large-scale model aerofoil complete with engine nacelle was under test to determine the best position of the nacelle on the leading edge of the aerofoil. To determine the effects of airscrew slipstream on the resistance of the model, it was fitted with its own airscrew operated by an ingenious three-phase motor of small size incorporated in the nacelle. Tests were made with and without the airscrew in operation. The results of the work will be used in the design of a large-size machine of the monoplane type, a complete model of which will then be subjected to further tests to improve it in detail.

A method has been evolved in the department for rendering visible by the use of the dense vapour from titanium tetrachloride the character of fluid motion round bodies used in aerodynamic research. For this purpose a small wind tunnel has been constructed in which models can be placed, the titanium tetrachloride being spread in a thin film along the length of the wing. By suitable means the flow picture can be projected on to a screen, while instantaneous photographs of very short duration can be recorded by focusing a camera on the vapour, which is illuminated by a spark gap and a suitable optical system. By this means photographs showing the departure from laminar to turbulent flow can be obtained.

Of interest also was a method of calibrating the standard pitot tube at low speeds. For this purpose the tube is carried on a small whirling arm and can rotate in a closed circular annulus of mean diameter about eight feet and of one square foot sectional area at controlled speeds, revolutions being recorded electrically. To transmit the pressure difference to the manometric balance the axis of rotation is fitted with a special oil seal. A very sensitive form of manometer embodying the Chattock tilting principle has been designed to measure the small pressures involved. The two cups to which the pressures are communicated are joined by a circuit, which incorporates a length of capillary tube in which an air bubble serves as an indicator, the latter being viewed by a micrometer microscope. The whole instrument can be insulated thermally to avoid temperature effects. With this instrument it is hoped to calibrate the standard pitot tube to a high degree of accuracy at speeds so low as two feet per second.

In the Engineering Department apparatus was

shown for the investigation of the stress distribution in a reinforced concrete column, a matter of interest owing to the complications introduced by the effect of shrinkage on the stress distribution and by the slow yielding of new concrete when stressed. The column was tested in the floor and column testing machine with axial and eccentric loading. The loads are applied through special knife edge end plattens to ensure virtual point loading, any desired load up to fifty tons being obtained by means of a hydraulic ram. The load is measured by means of a system of levers and a jockey weight, and specially designed extensometers are used to determine the small changes in length both in the concrete and also in the steel reinforcing bars.

Other work in progress included an investigation into the effect of surface irregularities and surface conditions in general on the fatigue strength of spring steels. In this investigation specimens are subjected to stresses in rotating cantilever machines running at about 2000 revolutions per minute, in high-speed repeated bending machines or in a torsional fatigue machine. It has been found that surface irregularities, surface decarburisation during manufacture or heat treatment and surface cracks formed during heat treatment have the effect of lowering materially the fatigue strength of specimens, and that their resistance to fatigue can be increased by removal of the surface layer. The research has been conducted in conjunction with the Metallurgy Department, and for the study of the effect of decarburisation a specially designed vacuum furnace has been constructed in which specimens can be hardened and tempered by quenching without contact with the air. Specimens of a spring steel treated in this manner have shown fatigue resistance closely approaching that of corresponding ground and polished specimens.

Among the researches in progress in the Metallurgy Department mention may be made of an investigation into the effects of different forms of heat treatment on the permanence of dimensions of heat-treated aluminium alloys. As a consequence of such treatment, internal stresses may be set up leading to distortion in specimens during machining. Slowly cooled alloys are free from such stresses, and those which are quenched with moderate rapidity are less liable to them than those which are subjected to rapid quenching, and attention is being given to the quenching operation. Specimens quenched in cold water, cold oil, or boiling water have been machined and afterwards examined for distortion by the Metrology Department. The exhibit illustrated the effect of such treatment and of the composition of the alloys on their behaviour.

Work was also in progress in connexion with steels for use at high temperatures, and one object of the work is to ascertain their resistance to scaling when exposed to flame gases. In the investigation in progress, steel wire in the form of a spiral coil is exposed to contact with typical flue gases at various high temperatures, and the effect on it is determined by measurement of the changes in its weight and electrical conductivity. Suitable arrangements are made for the control of the temperature and composition of the gas.

Of interest also was an exhibit showing the effect of the presence of high phosphorus and silicon in wrought iron on the γ-α transformation. This transformation is suppressed and grain refinement prevented if these impurities are present in excessive amounts. This phenomenon has been found to have an important bearing on the strength of wrought-iron chains and hooks in which a coarse structure impairs impact strength.

In the Metrology Department a new primary standard barometer was on view. The design of this instrument is such that the height of the barometric column can be compared directly with a line standard. The barometer, which is of stainless steel and provided with optically flat and parallel windows, and the line standard are mounted on a heavy base, and a pair of micrometer microscopes mounted one above the other on a vertical column can be focused alternately on the mercury column and the line standard. A mercury vapour pump is used to produce the vacuum above the mercury column, any residual pressure being measured by means of a M'Leod gauge. Means are provided for determining the temperature of the mercury column.

Of interest also were two pieces of apparatus for the testing of surface plates. In the first the surface plate to be tested is compared with one whose errors in flatness have been determined. It consists of a metal plate fitted with three adjustable ball feet and equipped with an indicator the ball foot of which is in line with and midway between two of those of the plate. By placing the apparatus first on the known and then on the unknown surface and noting the corresponding indicator readings, it is a simple matter to determine the errors in the plate under test. In the second piece of apparatus the test plate is submerged under mercury and the depth of its surface below that of the mercury is measured at various points by means of the apparatus, which takes the form of a tripod with a central vertical micrometer screw. The legs of the tripod are of ebonite fitted at the bottom with hardened steel balls, and the contact of the micrometer screw with the mercury is indicated electrically. The apparatus has been found to be accurate to 0·0001 in.

In connexion with research work for the Food Investigation Board, a distant reading hygrometer has been developed in the Physics Department for humidity measurements in the holds of ships carrying frozen lamb. The instrument is essentially a wet and dry bulb thermometer in which the conventional thermometers are replaced by thermojunctions arranged differentially. The potential difference between the thermojunctions can be measured on a millivoltmeter the readings of which can be converted to temperature differences by previous calibration. Provision is made for wetting one set of thermojunctions.

Of interest also was a sensitive method of detecting the dew point by the employment of a photo-electric cell mounted below a polished steel plate which serves to collect the dew. The plate is illuminated by a small lamp in such a manner that in the absence of dew the reflected light does not affect the cell. Formation of dew results in light scattering and consequent illumination of the cell. The latter is incorporated in a valve circuit including a telephone earpiece, and the design of the circuit is such that the presence of dew is indicated by cessation of sound in the telephone. The temperature of the steel plate is determined by thermocouples fixed to its upper surface.

For the measurement of noise a portable instrument has been designed in the Sound Division. In this instrument a buzzer supplies alternating current to a telephone, the strength of the current being controlled by a potentiometer. The current is adjusted until the sound in the telephone is judged to be equal in intensity to the noise, or alternatively is just masked by the noise. The sound intensity can be varied in fourteen steps from extreme loudness to an intensity below that of ordinary speech.

In the Radiology Division, an X-ray investigation on the effects of heat treatment on tungsten magnet

steels was in progress. Arrangements have been made for the study of such effects up to a temperature of about 1200° C. The specimen is provided with its own heating coil in the X-ray spectrometer, and provision is made for the adequate cooling of the photographic film by means of a suitable water jacket. The investigation has shown that under appropriate conditions of heat treatment crystals of at least two carbides are present, their amount depending on the quenching temperature.

In the Optics Division various apparatus for the evaluation of total energy flux was shown. The exhibit included horizontal and vertical test benches for the comparison of lamps used as standards of radiation, or of radiometric instruments such as thermopiles, bolometers, radio-balances, etc. The instruments shown comprised various thermopiles, both air-exposed and vacuum types, sunshine receivers both of the bolometric and thermoelectric pattern, gas fire bolometers, and two Callendar radio-balances for absolute measurement of radiation intensities. Special electrical measuring circuits for use in testing these various instruments were also shown. These included a portable equipment for use out of doors with either bolometric or thermoelectric instruments for solar work.

For precision testing of voltage transformers, a new shielded resistor for 30 kilovolts has been designed and constructed in the Electrotechnics Division. In this piece of apparatus the importance of keeping phase errors to a minimum has been the main consideration. The resistor is divided into six sections rated at 5000 volts each, every individual section being composed of forty elements, each of 2500 ohms resistance. To eliminate capacity errors so far as possible, each section is enclosed in a metal container which is maintained at the mean sectional voltage by connexion to a suitable point of a similar unshielded resistor in parallel.

Of interest also was a method of determining the electrical resistance of small irregular samples of metals and alloys. A measured current is led into the specimen through two very small steel balls 9 mm. apart, and the voltage between two selected points is measured by means of a low reading potentiometer, the voltage leads making contact with the specimen through two needles 3 mm. apart. The resistivity is determined by making similar measurements on a piece of metal of known resistivity and of similar shape.

In the High Voltage Building demonstrations were given of flash-over tests on transmission line insulating systems under dry conditions and when sprayed with artificial rain. For the latter tests rain water is collected in a special tank, tap water being unsuitable owing to its conductivity being approximately three times that of pure rain water.

In the Electric Standards Division a method of determining the properties at audio frequencies of alternating current milliammeters incorporating copper oxide rectifiers was demonstrated. Such milliammeters are known to possess frequency errors, and these have been found to be of an unusual type and to be due to the capacity of the rectifiers. It has been found possible to compensate for these errors by providing the instrument with a suitably designed inductive shunt.

In the Wireless Division an automatic method of recording bearings from a rotating beacon transmitter was demonstrated. The transmitter, which is situated at Orfordness, consists of a frame coil rotating uniformly once per minute, the rotation being controlled by a tuning fork and phonic motor. The output from the receiver is supplied to a selective tuned audio-frequency amplifier followed by a rectifier, in the anode circuit of which a relay is included. A magnetically operated pen traces a record on a rotating drum the speed of which is maintained at the rate of one revolution per minute by the same means as in the case of the transmitter. A special signal is sent out when the normal to the coil of the rotating beacon lies in the north and south meridian, and the pen is automatically lifted when the two minima occur. Then since the signal strength is proportional to the cosine of the angle between the plane of the transmitting coil and the direction from it of the receiver, the mid-point of the two minima gives the bearing with respect to the north, which can be read off with a protractor or by degree lines printed on the drum.

In the Photometry Division a new type of high precision spectrophotometer has been developed in which there are no moving optical media. Two tungsten gas-filled lamps are used as light sources, and the photometric scale of the instrument is determined in terms of sector discs of known transmission and the voltage-intensity relation of one of the lamps at a standard wave-length. The voltage intensity relation for other wave-lengths can be computed from that at the standard wave-length. The Maxwellian field of view is utilised to obtain adequate illumination in those parts of the spectrum where visibility is low.

Attention has been given to the measurement of the reflection factor of diffusing surfaces under completely diffused illumination, and a small integrating reflectometer has been designed and constructed for this purpose. The instrument consists of a small internally whitened sphere with two small apertures to admit a beam of light and to allow of observation of the brightness of the sphere wall respectively. A third and larger aperture may be covered by a specimen or by a standard plate coated with the same material as the sphere walls, or left open. Relative brightness measurements of the interior under these three conditions as determined with a Lummer-Brodhun contrast photometer, suffice to determine the reflection factor of the specimen. The advantage of the instrument lies in the fact that direct observation or illumination of the specimen is avoided.

Another interesting exhibit was apparatus for the automatic control of picture gallery illumination. The method involves the use of a photoelectric cell; the current variations in the latter are amplified by means of a valve in the plate circuit of which is included an adjustable relay controlling the gallery lighting. To prevent hunting of the relay due to passing clouds, suitable means are incorporated for introducing a time lag before the relay puts in operation the gallery lights, at the same time avoiding any lag in extinguishing them.

In the William Froude Tank a model of a single screw cargo boat was shown under test in waves. The model was fitted with its own propeller and inboard motor for self-propulsion and equipped with apparatus for recording the speed of the model, the propeller revolutions, and the propeller thrust and torque. The latter were measured by the deflection and torsion respectively of suitably calibrated springs coupled to the propeller shaft and operating recording pens through lever systems. Of interest also was a telescopic pitot-tube for making velocity measurements in connexion with an investigation on ship's wake resistance. The tube is capable of swivelling and is provided with its own ship side valve. With this instrument the velocity of the ship relative to the wake can be measured at various distances from the ship's side and the velocity distribution in the wake thereby determined.

The British Polar Exhibition.

DURING the past few years there has been a remarkable revival of expeditions to the polar regions, and it is to this revived interest in polar lands and seas that the idea of holding a British Polar Exhibition in London is largely due. In opening this exhibition at the Central Hall, Westminster, on July 2, Col. Sir Charles Close, president of the Royal Geographical Society, pointed out that Great Britain had been intimately associated with exploration in the Arctic regions for the past 400 years and in the Antarctic regions for 150 years. It was therefore an opportune moment to recall the great deeds of the past and to direct attention to the possibilities of the future by bringing together a collection of relics, pictures, maps, and documents; to demonstrate more particularly modern means of scientific exploration, especially through aerial methods, and to assist, if possible, the Scott Polar Research Institute at Cambridge with funds for further research work.

Commander L. C. Bernacchi, the organising director of the exhibition, and Capt. L. W. G. Malcolm, assistant director, have been extraordinarily successful in collecting some hundreds of exhibits, every one of which has some personal interest attached to it, and they have arranged the exhibits particularly well so that the ordinary visitor may examine each object without difficulty. The personal kit and notebooks of individual explorers occupy the widest space, and among the numerous interesting exhibits may be mentioned Shackleton's boat in which he made his famous journey of 750 miles from Elephant Island to South Georgia, thus saving the lives of twenty-two members of the crew of the *Endurance*; the sledge used by Shackleton in 1908 when he got within a hundred miles of the South Pole; a large Antarctic camp scene showing the ship *Discovery* in the background; a large group arranged by the Hudson's Bay Company to illustrate Arctic Canada. One room is mainly devoted to the relics of Franklin and Scott; these relics include Sir John Franklin's signature, his sextant and medicine chest; the autograph journal of Capt. Scott showing the last entries he made in it; Scott's camera, satchel, Bible, and many others. Exhibits such as these naturally appeal to human feeling, and are undoubtedly of great value in stimulating interest in exploration.

The various models of Arctic scenes, together with the Arctic products, will enable the visitor to realise to some extent what the polar regions are actually like. The economic importance of the northern seas can be studied from the large map of the north polar region, showing the fishing grounds from which in 1929 Great Britain obtained 280 million pounds weight of cod, 110 million pounds of haddock, and large quantities of other kinds of fish. These statistics are shown on a large chart. For the scientific student, instruments such as thermometers, compasses, and chronometers used on polar expeditions may be examined. A programme of lectures on polar subjects has been arranged by the exhibition committee, and among the lecturers are Commander Bernacchi and Mr. Stefansson. On certain days some of Ponting's films of the Scott expedition are being shown. The educational advantages of the exhibition are still further augmented by the "Polar Book" which has been compiled specially for this purpose; in concise book form, the various aspects of polar work have been brought together in a series of articles written by well-known experts in Arctic knowledge, and two of Bartholomew's maps showing the polar regions are bound up with the book.

In passing through the various parts of the exhibition, one cannot but be impressed by the enterprise, courage, endurance, and achievements of the men who faced the dangers and hardships of polar exploration; also of the changed conditions under which explorers now set out and of the difference in outlook of men taking part in expeditions at the present time. The economic aim of a Frobisher searching for gold in his Meta Incognita, the scientific expedition of Sir James Ross studying magnetic conditions in the Antarctic regions, the spirit of adventure which urged Shackleton to explore polar lands and seas, are still powerful motives. With the more extensive knowledge of the Arctic regions, due to the work of these early explorers, two new ideas have been gradually coming into prominence since the beginning of the present century. First a political factor has begun to present itself with regard to the ownership of polar lands, and secondly a search for suitable stations for air transport. In fact, some recent expeditions have had as their main or partial object the claiming of new territory and the examination of areas for the establishment of landing-places for aeroplanes. Not only then does the Polar Exhibition remind us of the wonderful deeds of men in past times, but it also provides accurate knowledge of the vast regions around the poles at the present day, and suggests some of the problems that still await solution.

University and Educational Intelligence.

CAMBRIDGE.—The vice-chancellor has given notice that a meeting of the electors to the Woodwardian professorship of geology will be held on Friday, Aug. 1. The stipend of the professor is £1200 a year, or, if he holds a fellowship with dividend, £1000 a year. The professor, as head of the Department of Geology, is paid £200 a year in addition to his stipend as professor, or, if he holds a fellowship with dividend, not more than £100. Candidates are requested to communicate with the vice-chancellor on or before Tuesday, July 22.

The Faculty Board of Economics and Politics has received from Mr. Montague Burton an offer to endow a professorship in the University to be called the Montague Burton Professorship of Industrial Relations. The Faculty Board proposes that the duties of the professor should be defined as "to study and give instruction upon the conditions of employment and the relations between employers and employed, with special reference to the causes of industrial disputes and the methods of promoting industrial peace".

The Harkness Scholarship for 1930 has been awarded to Miss K. M. N. Paterson, of Newnham College, and the Wiltshire Prize to R. N. Quirk, of King's College.

The governing body of Corpus Christi College has awarded to Dr. R. Hilton, assistant physician, St. Bartholomew's Hospital, the Copeman Medal for research in medical and biological sciences. This medal was presented by Dr. S. Monckton Copeman, formerly a scholar of the College. The present award is the first which has been made.

DUBLIN.—The honorary degree of Sc.D. was conferred upon Sir James Jeans on July 4, and the honorary degree of Litt.D. upon Mr. C. Leonard Woolley.

DURHAM.—Honorary degrees were conferred on June 26 as follows: *D.C.L.*—Lieut.-Gen. H. B. Fawcus, director-general Army Medical Services, and Baron Alexander Meyendorff, London School of Economics. *D.Sc.*—Dr. F. G. Donnan, professor of inorganic and physical chemistry at University College, London; Mr. Wilfrod Hall (of Newcastle), and Dr. R. E. Slade. *D.Litt.*—Dr. N. Kemp Smith, professor of logic and metaphysics in the University of Edinburgh.

LONDON.—At the meeting of the University Court on July 2, the offer of Prof. S. Smiles and Prof. A. J. Allmand to found a medal to commemorate the services rendered to King's College and to chemical education by Prof. John Millar Thomson was accepted with thanks by the University. Prof. Thomson first became a member of the staff of the department of chemistry at King's College in 1871 and retired in 1914, after having served for twenty-seven years as Daniell professor and head of the department of chemistry. The medal will be known as the John Millar Thomson Medal for chemistry, and will be awarded annually to the student of King's College who most distinguishes himself in the final year of the special honours course in the department of chemistry.

A University postgraduate travelling studentship of the value of £275 for one year has been awarded to J. E. Keyston. Mr. Keyston obtained the B.Sc. (special) degree with first-class honours in physics as an external student from University College, Nottingham, in 1929, and was awarded the Heymann research scholarship. He proposes to carry on research in physics in Germany.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the honorary degree of LL.D., in October, on Prof. J. A. C. Kynoch, emeritus professor of midwifery in the University. Prof. Kynoch was appointed to the midwifery chair in 1898 and retired in 1928. He was for many years dean of the faculty of medicine.

REVISED regulations for the award of Whitworth scholarships in engineering have been issued by the Board of Education (London: H. M. Stationery Office, 3*d*.). The awards for 1931 are two Whitworth Senior Scholarships (£250 a year for two years), six Whitworth Scholarships (£150 a year), and up to 25 prizes (£10) for unsuccessful competitors for Whitworth Scholarships. All the candidates must have been engaged in handcraft in a mechanical engineering workshop for periods amounting to 30 calendar months and must have spent a certain portion of this time at fitting or erecting. Work at the lathe may be counted but is no longer required. The age limit for the Senior Scholarships is twenty-six. Of the Whitworth Scholarships, five are tenable for three years and are open only to part-time students; for them the age limit is twenty-six instead of as hitherto twenty-two. One of these scholarships (ultimately three) is tenable for one year only and is open to students less than twenty-four years of age who may be attending full-time courses.

THE PRINCE OF WALES attended a dinner on July 7 and spoke in support of an appeal which has recently been issued by the National Union of Students for £30,000 for the purchase and endowment of the headquarters in London of the Union and for a hospitality fund. The Prince described the activities of the Union, referring particularly to the hospitality and travel departments. The former makes arrangements for Dominion and foreign students visiting England, either as study-groups or individuals, and £5000 is urgently required for secretarial expenses. The latter acts for British students proceeding abroad, arranging for their reception by the national unions of students of the countries visited. Another important activity of the Union is the arrangement of student exchanges. The present appeal is for sufficient money to purchase the London office at 3 Endsleigh Street, W.C.1, and to provide for its maintenance. The growth of the Union during the seven years of its existence is proof of the need it fulfils, and there is little doubt that, with the powerful aid given by the Prince of Wales' support, funds will quickly be forthcoming to consolidate and extend its work.

Historic Natural Events.

July 13, 1788. Hailstorms. Hailstorms of unexampled severity and destructiveness raged along two parallel stretches from the Pyrenees to the Baltic; in France 1039 communes were devastated and damage caused to the extent of 24,690,000 francs.

July 13, 1910. Highest Temperature in United States.—Death Valley, a depression below sea level in south-eastern California, is noted for its high summer temperatures, and the shade reading of 134° F. on July 13, 1910, is the highest on record in America. From July 8 to 14 inclusive the thermometer exceeded 127° F. every day.

July 13, 1927. Meteorite near Tilden, Illinois.—About 1 P.M. a brilliant meteor fell with detonations like loud thunder. At a distance of more than one hundred miles it was described as " a piece falling off the sun ". At a height of 15 or 20 miles it burst, showing green and then purple, and after a second bursting became invisible. One stone, weighing nine pounds, fell in the village of Tilden, and was glimpsed for an instant as " a dark streak, like smoke ". It was recovered at once, and to the surprise of the finders was not hot but " noticeably cold ". The largest piece weighed 110 pounds, and another 46 pounds.

July 14–15, 1911. Typhoon Rainfall in Luzon.—During a typhoon which crossed the northern part of Luzon, Philippine Islands, the rainfall in 24 hours, commencing at noon on July 14, amounted to 45·99 in. This is probably the greatest known fall of rain in twenty-four consecutive hours. In the four days, July 14–17, the total fall was 88·14 in.

July 15, 718. Thunderstorm and Hail. About this date the Saracen fleet, after raising the siege of Constantinople, was struck by a severe hailstorm mixed with fire, so that only twenty (according to another authority five) ships could save themselves.

July 15, 971. St. Swithin's Storm. Swithin, Bishop of Winchester, died in 862 and was buried in the churchyard of Winchester, having asked, says William of Malmesbury, to be laid where passers-by might tread on his grave, and where the rain of the eaves might fall on it. A century later he was canonised, and a splendid tomb was constructed within the cathedral for the reception of his remains, but it is related that on the day appointed for their removal, July 15, 971, he manifested his displeasure at the disturbance by sending a great storm of rain, followed by forty wet days. No contemporary writers mention this storm, however, and probably it is a later invention to account for the well-known proverb which, referring to July 15, became associated with his name.

July 15, 1558. Thunderstorm and Whirlwinds in France.—About this date part of France was visited by severe thunderstorms and whirlwinds. A great cloudburst occurred in Thuringia and a powerful whirlwind at Nottingham, which unroofed numerous houses and churches, lifted a child in the air, and raised a great waterspout on the Trent; hailstones said to be 15 inches long fell.

July 15, 1808. Hailstorm at Gloucester.—During the night, after several days of oppressive heat, a violent thunderstorm passed over Gloucester from south to north, accompanied by a hailstorm which did a great deal of damage. The hailstones were very irregular, broad, flat and ragged, and many measured from 3 to 9 inches in circumference. They appeared like fragments of a vast plate of ice, broken into small masses in its descent to the earth.

July 15, 1888. Eruption of Bandai-san (Japan).—After remaining practically dormant for more than a thousand years, the volcano Bandai-san in central

Japan suddenly burst into brief activity. A few earthquakes were felt and then a great explosion occurred that rent the north-eastern wall of the crater. It is estimated that the total volume blown away was three-tenths of a cubic mile; it descended the mountain-side with a velocity of 48 miles an hour and devastated an area of 27 square miles at its foot. The total land-area covered by the falls of dust was 790 square miles. The explosions were accompanied by wind-blasts that tore up trees by their roots and levelled houses with the ground. The number of lives lost was 461, mostly from the fall of rocks and debris.

July 16, 1494. Hurricane off Santa Cruz.—According to Southey's "Chronological History of the West Indies", during his second voyage Columbus anchored off Cape Santa Cruz, and while there "upon the 16th July a violent hurricane occasioned the Admiral to declare that nothing but the service of God and the extension of the monarchy should induce him to expose himself to such dangers".

July 16, 1565. Thunderstorm at Chelmsford.—In Stow's "Annals" it is recorded that on this date "about nine of the clocke at night, began a tempest of lightning and thunder, with showers of hail, which continued till three of the clocke the next morning, so terrible that at Chelmsford in Essex 500 acres of corn were destroyed: the glass windowes on the east side of the Church were beaten downe with also the tiles of their houses: besides diverse barnes, chimnies and the battlements of the church which were overthrowne."

July 17, 1921. Low Thames.—During the great drought of 1921 the flow of the River Thames at Teddington fell on July 17 to little more than a quarter of the normal flow in July. (See Feb. 7, 1921.)

July 17, 1925. Thunderstorms at Hong Kong.—Very severe thunderstorms, accompanied by heavy rainfall, passed over Hong Kong during several days in the middle of July. The most intense storm occurred on the morning of July 17, when a fall of 10·24 in. occurred in 11 hours. The water poured down from the high ground of Victoria Peak in great streams; floods and landslides were general and much damage was caused, especially in the Chinese quarter. In one part of the Chinese district a high retaining wall collapsed, demolishing a row of five houses, and most of the inmates, numbering 150, were killed.

July 18, 1794. St. Petersburg Haloes.—A remarkable display of haloes occurred during the morning. There were visible the haloes of 22° and 46°, the tangent arcs on both haloes, circumzenithal arc, five mock suns, and a number of other unusual features. This display has long been a standard of reference in works on atmospheric optics.

July 18, 1820. Mirage on Greenland Coast. The coast of Greenland in 71° 20′ N., 17° 30′ W., as observed by Scoresby through a telescope from a distance of 35 miles, presented a curious appearance. The hills were drawn out vertically and distorted into the semblance of pagodas and other fantastic erections.

July 19-22, 1515. Floods in Central Europe.—On July 19 six weeks of rain began over the whole of central Europe, causing very extensive floods, especially on July 22. On July 24 there was a violent thunderstorm followed by great floods in Duisburg, and on Aug. 3 a cloudburst in Prussia.

July 19, 1926. Heavy Rain in Hong Kong.—During the filling up of a typhoon which crossed the coast about 100 miles to the eastward, a heavy thunderstorm broke over Hong Kong, and continued for nine hours, during which time the rainfall amounted to 20·43 in., 3·96 in. of which fell between 3 and 4 A.M. The city was flooded and great damage was done.

Societies and Academies.

LONDON.

Royal Society, June 26.—**A. V. Hill** and **P. S. Kupalov**: The vapour pressure of muscle. There is a considerable increase of osmotic pressure in muscle as the result of stimulation. This was measured by observing the change of vapour pressure. The osmotic pressure of resting muscle is exactly accounted for by assuming all the known soluble constituents of muscle to be dissolved in its observed 'free' water. The osmotic pressure of fatigued muscle is in excess of that calculated on the same assumption: presumably some substance, hitherto unrecognised, is liberated as the result of activity. **A. V. Hill**: The state of water in muscle and blood, and the osmotic behaviour of muscle. The 'free' water fraction (defined as the weight of water in 1 gm. of fluid or tissue which can dissolve substances added to it with a normal depression of vapour pressure) has been determined in blood, in protein solutions, and in muscle (resting and in rigor). The amount of 'bound' water in these is very small. The osmotic behaviour of muscles immersed in hypo- or hypertonic solutions is considered.—**W. Sucksmith**: The gyromagnetic effect for paramagnetic substances. A method of measuring the gyromagnetic ratio for paramagnetic substances is described. Hitherto, measurements have been made only on various ferro-magnetic materials, all of which show that the source of magnetic moment is entirely due to the spin of the electron. For a paramagnetic substance, the angular moment produced by a change in magnetic moment is very small, and it has been necessary to utilise low-frequency resonance for building up the resulting impulse to a measurable magnitude. Errors of measurement are discussed in detail, and shown to be eliminated.—**J. C. McLennan** and **R. Turnbull**: The absorption of light by gaseous, liquid, and solid xenon. The inert gases are probably monatomic in the solid and liquid states, as well as in the gaseous. Hence a study of the resonance lines in absorption for the gas at various pressures, and in the solid and liquid states, should reveal important features relating the atoms of the gas to the atoms in the liquid and solid state. The absorption band corresponding to the line λ 1469 A. of xenon is the only one belonging to the inert gases that can be readily investigated; niton is too rare, and all the other resonance lines lie beyond the limit of transparency of any substance which is required to contain the gas or liquid. Liquid xenon is clear and colourless; solid xenon is transparent and like glass. The limit of absorption on its long wave-length side was determined for liquid and solid and found to be between λ 1770 A. and λ 1850 A. The asymmetrical type of absorption obtained with xenon, corresponding to λ 1469 A., is similar to that obtained with mercury vapour, corresponding to λ 2536·72 A., and both these wave-lengths are given by a frequency-formula $h\nu = {}^1S_0 - {}^3P_1$. **L. E. S. Eastham**: The embryology of *Pieris rapæ*—organogeny. The development of the main systems of organs, with the exception of the germ cells, from gastrulation stage to that of completely developed caterpillar is described.—**K. Clusius** and **C. N. Hinshelwood**: Homogeneous catalysis of gaseous reactions. I and II. The decomposition of isopropyl ether, $C_3H_7OC_3H_7 = C_3H_8 + CH_3.CO.CH_3$, is catalysed not only by iodine, but also by various alkyl iodides, and to a smaller extent by alkyl bromides. Chlorides have little influence. Hydrogen bromide is also good catalyst. During decomposition of the ether the alkyl iodides are themselves decomposed even when stable in absence of the ether. The decomposition reaction, whereby a hydrogen atom is

transferred under influence of catalyst from one part of the ether molecule to another, with accompanying rupture of molecule, is a general one. Every collision between ether and iodine in which kinetic energy of approach exceeds 34,300 calories probably leads to decomposition. Heats of activation of this and similar reactions are lower than those of corresponding uncatalysed reactions, and mechanism of activation simpler. Catalyst seems to attack molecule at one specific point. —**C. N. Hinshelwood, K. Clusius, and G. Hadman**: Homogeneous catalysis of gaseous reactions.—III. The assumption that energy of activation is supplied by collisions between aldehyde and iodine molecules leads to a calculated rate of reaction ten times smaller than the observed. The assumption that energy is also derived from one internal degree of freedom brings calculated and observed rates into agreement.—**R. H. Fowler**: A possible explanation of the selective photo-electric effect. A theory of the selective photo-electric effect is proposed, which refers the effect to a selective transmission coefficient of the surface layer for incident electrons of a certain energy. Such a selectivity is found theoretically when the potential energy curve near the surface contains two hills separated by a fairly deep valley. Experimentally, retentive emission is only found for surfaces covered with a rather complicated surface layer with first electro-negative and then electro-positive material deposited over the original metal. The proposed theory seems to be in full accord both with the nature of the effect and the peculiar conditions of its occurrence.—**Lord Rayleigh**: The ultra-violet transmission band of metallic silver as affected by temperature. The ultra-violet transmission band of metallic silver at λ 3200 is examined at various temperatures. Heating shifts it towards the red. The shift from 180° C. to 254° C. is 120 Angstroms. **L. H. Gray**: The scattering of hard γ-rays. Tarrant has shown that the absorption coefficient of hard thorium-C″ γ-rays in certain elements is considerably greater than the value predicted by the Klein-Nishina formulæ, while in other elements the measured absorption coefficient is in good agreement with theory. To test whether the extra energy absorbed by the abnormal elements was re-emitted as quantum energy, the secondary radiation emitted between 16° and 90° by aluminium (abnormal) was compared with that from sulphur (normal) using as a primary beam radium-C γ-rays filtered through 4 cm. of lead (mean quantum energy about $1 \cdot 7 \times 10^6$ e-volts). Taking into consideration probable experimental error, it is unlikely that secondary radiation from aluminium exceeds that from sulphur by more than 0·25 per cent. Having regard also to the fact that the same γ-ray beam produces equal ionisation per unit volume in chambers of which the walls are composed of carbon, aluminium, and sulphur, it appears that the new absorbing mechanism is almost entirely inoperative in aluminium, in the case of quanta of energy $1 \cdot 5 \times 10^6$ e-volts, and only becomes of considerable magnitude as quantum energy approaches close to that of the hard thorium line ($2 \cdot 65 \times 10^6$ e-volts). **G. Temple**: The operational wave equation and the Zeeman effect. This paper gives a treatment of the Zeeman effect based on the operational wave equation discussed in two previous papers. —**H. Dingle**: The spectrum of ionised fluorine (F II). The spectrum of ionised fluorine from the infra-red to the Schumann region has been obtained by passing discharges of appropriate intensity through silicon tetrafluoride, and 469 lines have been obtained and measured. The spectrum has been analysed and 173 lines have been classified as term combinations. The analysis has been discussed in relation to theoretical expectations.

ADELAIDE.

Royal Society of South Australia, April 10.—**Chas. Fenner**: The major structural and physiographic features of South Australia. One of a series of papers dealing with the general geography of South Australia. Maps and diagrams were presented to illustrate the various earth movements whereby the coastlines, mountains, valleys, and plains of South Australia have been formed, with plans and sections to show the way in which the work of wind and running water have modified the landscape as we now know it. A modified theory of the origin of the Mount Lofty Ranges was put forward in the endeavour to account for the complex features of that region.—**H. K. Fry**: Physiological and psychological observations on the Australian aborigines. Tests of visual spatial perception showed that the natives reacted to standard illusions similarly to Europeans, but that visualisation of perspective depended on school training. Numerical sense of natives was excellent in guessing differences in contrasted groups of numbers, but ability to arrange a sequence of numbers was a result of arithmetic education. Various problems were solved more or less effectively. Visual acuity of native children was abnormally keen. Tactile and pain sensation, contrary to expectation, were found to be almost the same as that of whites.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Jan. 17.—**Johs. Lindhard** and **Jens P. Muller**: On the origin of the initial heat in muscular contraction. The usually accepted explanation of the initial heat curve of an isometric muscle cannot be maintained; the deformation of the muscular fibre during contraction may be responsible for the surplus of heat in the first phase of heat production.

Feb. 14.—**O. B. Boggild**: The structure of mollusc shells. Previous examinations of the structure of calcareous shells were of a rather sporadic kind, and a more systematic investigation has been undertaken. The examination essentially includes the distribution of the two substances, calcite and aragonite, and the manner in which they are arranged in the shells.

April 11.—**Harald Bohr**: The variation of the argument of an almost periodic function.

May 9.—**Martin Knudsen**: Radiometer pressure and coefficient of accommodation. Radiometer forces have been investigated under such conditions that all the quantities on which the radiometer force may be conceived to depend have been measured, more especially the differences of temperature. The importance of the coefficient of accommodation for the radiometer pressure is shown, and from measurements at low pressures it is found that, in the case under investigation, the coefficient of accommodation for the internal energy (rotational energy) of a diatomic gas may be put equal to the coefficient of accommodation for the translation energy.

SYDNEY.

Linnean Society of New South Wales, April 30.—**Ida A. Brown**: The geology of the south coast of New South Wales. Pt. 2. Devonian and older Palæozoic rocks. There is a progressive increase in the intensity of the folding from north-east Gippsland, Victoria, through the Eden district northwards to Yalwal, near the Lower Shoalhaven River, while the arcuate arrangement of the trend-lines suggests compression against the massif of older rocks lying to the east. Rocks of proved Silurian age are only known to occur in the Bendithera-Wyanbene belt, west of the Deua River. Ordovician graptolite-bearing slates outcrop near Cobargo; the age of the

slates, cherts, and schistose rocks outcropping over the greater portion of the south coast area is not definitely known.—**A. L. Tonnoir**: Notes on the genus *Apistomyia* (Diptera) and description of a new species. A key is given to the species of *Apistomyia*, one of which, from Mt. Malabar, Java, is described as new. —**H. J. Carter**: Australian Coleoptera: notes and new species (7). Nineteen species are described as new. The Buprestidæ described testify to the continuous value of close co-operation with the British Museum. The remaining descriptions are chiefly the result of correspondence with various Australian collectors. —**W. L. Waterhouse**: Australian rust studies. (2) Biometrical studies of the morphology of spore forms. Spore measurements of æcidiospores, uredospores, and teleutospores of physiological forms of varieties of *Puccinia graminis*, and of uredospores of *P. triticina*, revealed striking morphological likenesses and differences between certain of the forms, but parallelism between physiology and morphology does not necessarily exist.

Official Publications Received.

BRITISH.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 5, May. Abstracts Nos. 902-1121. (London: H.M. Stationery Office.) 9*d.* net.

Records of the Geological Survey of India. Vol. 62, Part 4. Pp. 391-455+xxxvii+plates 10-20. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s.*

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 3: The Reptilia and Amphibia of the Malay Peninsula from the Isthmus of Kra to Singapore, including the adjacent Islands. (A Supplement to Dr. G. A. Boulenger's Reptilia and Batrachia, 1912.) By Malcolm A. Smith. Pp. xviii+149. (Singapore.) 1 dollar; 2*s.* 6*d.*

Survey of India. General Report, 1928 to 1929, from 1st October 1928 to 30th September 1929. Pp. iv+79+6 plates. (Calcutta.) 1 rupee; 1*s.* 9*d.*

Nigeria. Eighth Annual Bulletin of the Agricultural Department, 1st August 1929. Pp. 316. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 5*s.*

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1930. Pp. 27. (London.)

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1929. Pp. 125. (Harpenden.) 2*s.* 6*d.*

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 13: On some curious Fossils from the Downtonian and Lower Old Red Sandstone of Scotland. By Dr. R. Crookall. Pp. 175-178+1 plate. 6*d.* Vol. 50, Part 2, No. 14: Maturity in the Female Mouse. By L. Mirskaia and F. A. E. Crew. Pp. 179-186. 1*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Ministry of Health. Second Report of the Joint Advisory Committee on River Pollution: The Reception of Trade Effluents into the Sewers of the Local Sanitary Authorities. Pp. 29. (London: H.M. Stationery Office.) 6*d.* net.

The British Research Association for the Woollen and Worsted Industries. Publication No. 127: Scientific Aid for the Wool Industries. By S. G. Barker and Arnold Frobisher. Pp. ii+36+12 plates. (Leeds.)

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1929. Pp. 17. (Birmingham.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 1, 27th June. Pp. 116. (London: Edward Stanford, Ltd.). 5*s.*

The Journal of the Armstrong College Mining Society. Vol. 6. Pp. 69+xxv. (Newcastle-on-Tyne.) 1*s.*

FOREIGN.

Bulletin of the American Museum of Natural History. Vol. 59, Art. 3: Tertiary Land Mammals of Florida. By George Gaylord Simpson. Pp. 149-211. (New York.)

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Numero jubilaire en l'honneur de M. Bohuslav Brauner. Année 2, No. 5-6, Mai-juin. Pp. 209-440. (Prague: Regia Societas Scientiarum Bohemica.)

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 134: Klimatographie von Österreich. 10: Der jährliche Gang der meteorologischen Elemente in Wien (1851-1920). Von Arthur Wagner. Pp. 88. (Wien: Gerold und Co.)

A Series of Eight Radio Talks on Science in the Kitchen: the Selection, Care and Service of Foods. By Dr. Lawrence W. Bass, Dr. George D. Beal, Dr. R. F. Beard, Dr. Gerald J. Cox, Dr. W. W. Duecker, E. R. Harding, Dr. E. W. Morrison, Dr. R. N. Wenzel. (Radio Publication No. 58, University of Pittsburgh.) Pp. ix+82. (Pittsburgh, Pa.: Mellon Institute of Industrial Research.) 60 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 19, Nos. 1, 2 and 3. No. 1: Marine Mollusca of Guadalupe Island, Mexico, by A. M. Strong and G. D. Hanna; No. 2: Marine Mollusca of the Revillagigedo Islands, Mexico, by A. M. Strong and G. D. Hanna; No. 3: Marine Mollusca of the Tres Marias Islands, Mexico, by A. M. Strong and G. D. Hanna. Pp. 22. (San Francisco.) 50 cents.

Ergebnisse der Internationalen Pflanzengeographischen Exkursion durch die Tschechoslowakei und Polen 1928. Redigiert von E. Rübel. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 6.) Pp. 828. (Bern und Berlin: Hans Huber.) 16.50 francs.

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 132: June Beetles or White Grubs in Michigan. By R. H. Pettit. Pp. 10. Circular Bulletin No. 133: Soft Scales injurious to Deciduous Ornamentals. By E. I. McDaniel. Pp. 17. Special Bulletin No. 196: The Farm Woodlot in Michigan. By A. K. Chittenden and P. W. Robbins. Pp. 28. Special Bulletin No. 197: Oat Tests at the Michigan Experiment Station. By E. E. Down, H. M. Brown and F. H. Clark. Pp. 12. Technical Bulletin No. 105: The Results of a Five Year Mineral Feeding Investigation with Dairy Cattle. By O. E. Reed and C. F. Huffman. Pp. 63. (East Lansing, Mich.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 245: Experimental Studies on Form and Structure of Sparks, Part 7. By Torahiko Terada, Ukitiro Nakaya and Ryûzo Yamamoto. Pp. 207-230+plates 19-33. (Tôkyô: Iwanami Shoten.) 70 sen.

Annotationes Zoologicæ Japonenses. Vol. 11, No. 4, December 20, 1928. Pp. 269-417. Vol. 12, No. 1, July 25, 1929. Special Number dedicated to Professor Goto. Pp. 385. (Tokyo: Zoological Society of Japan.)

Publications of the Washburn Observatory of the University of Wisconsin. Vol. 15, Part 3: The Constancy of the Light of Red Stars. By Joel Stebbins and C. M. Huffer. Pp. 137-174. (Madison, Wis.)

Publikationer fra det Danske Meteorologiske Institut. Communications magnétiques, etc., No. 10: On Tides of the Upper Atmosphere. By J. Egedal. Pp. 15. (København: G. E. C. Gad.)

República Argentina: Ministerio de Agricultura de la Nación. Anales de la Dirección de Meteorología. Tomo 18: Conteniendo las observaciones practicadas en los años 1924, 1925, 1926 y 1927. Vol. 1: Precipitación e Hidrometría. Pp. 116+101 plates. (Buenos Aires.)

First Annual Report of the Museum of Science and Industry founded by Julius Rosenwald, July 1, 1928-December 31, 1929. Pp. 34. (Chicago.)

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 8, No. 3: Wave Lengths in the Spectra of the Vacuum Copper Arc. By Keivin Burns and Prof. Francis M. Walters, Jr. Pp. 27-35. (Pittsburgh, Pa.)

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 6, June. Pp. 17. Publication L3: The Progress of Nickel Deposition in Recent Years. By D. J. Macnaughtan and R. A. F. Hammond. Pp. 27. (London: The Mond Nickel Co., Ltd.)

A Catalogue of Books on Zoology and Allied Subjects, including Ornithology, Entomology, Conchology, Anthropology and Naturalists' Travels, also Geology and Medical Books. (No. 7.) Pp. 60. (London: Henry Cook.)

Cambridge Alternating Current Instruments for High Frequencies. (List No. 162.) Pp. 40. Some Methods of Measuring Inductance, Capacitance and Resistance. (Supplement to List 162.) Pp. 16. (London: Cambridge Instrument Co., Ltd.)

Catalogue of Fine Chemical Products for Laboratory Use, including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (July.) Pp. 130. (London: The British Drug Houses, Ltd.)

Electrically Heated Laboratory Apparatus. (List No. 231F.) Pp. 24. Small Electric Furnaces for Laboratory and Works. (List No. 7616.) Pp. 20. Addenda List for General and Industrial Laboratory Apparatus Catalogue, Eighth edition. Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

Diary of Societies.

MONDAY, JULY 14.

INSTITUTION OF NAVAL ARCHITECTS (Summer Meeting) (at Liverpool). (*Continued until July* 18.)

TUESDAY, JULY 15.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ANNUAL MEETING.

JULY 14 TO 19.

SOCIETY OF CHEMICAL INDUSTRY (at Birmingham).

July 15, at 11 A.M.—Dr. H. Levinstein: Only an Apprentice in Nature's Workshop (Presidential Address).

July 16, at 11 A.M.—Dr. A. E. Dunstan: The Chemical Aspect of Petroleum.

July 17, at 10.30 A.M.—Presentation of the Messel Medal to Lord Brotherton of Wakefield.—Lord Brotherton: Fifty Years in Chemical Industry.

COLLOQUIUM.

JULY 19 TO 30.

ST. ANDREWS MATHEMATICAL COLLOQUIUM (in University Hall, St. Andrews).

Prof. H. F. Baker: Rational Curves and Surfaces.

Dr. H. W. Richmond: Arithmetical Properties of Curves and Surfaces.

Prof. C. G. Darwin: The Wave Mechanics.

Prof. H. W. Turnbull: Elementary Mathematics from the Higher Standpoint.

Dr. A. C. Aitken: Recent Developments in Symmetric Functions, Determinants, and Algebraic Equations.

Theory of Functions.

Prof. E. T. Whittaker and others: Informal Talks.

SATURDAY, JULY 19, 1930.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Research Workers in Industry.

IN a letter published in NATURE of July 5, Mr. K. Hickman refers to the passing of the old academic feeling that there is something vaguely discreditable in a discovery which could be put to practical use. Relations between the universities and industry have undoubtedly become much closer in recent years, and increased contact has enhanced mutual respect, but there is still in some quarters a disinclination to accord to a piece of industrial research the same respect or academic recognition that would be paid to a similar research carried out in the university itself. The publication of scientific work carried out by industrial organisations of the type that Mr. Hickman cites will accelerate the passing of this attitude, although it must be admitted that industry in Great Britain is more reluctant to allow publication than is the case in the United States of America.

To leave all scientific research to industry would, however, be a dubious policy. There are large sections of industry where the value of scientific research is unrecognised, and there are other sections where the research department is still the first to be curtailed at any time of stringency. Even in those sections of industry where the most enlightened view of research prevails, in the main the lines of research which are undertaken must have some relation to production or economic possibilities. Few research workers in industry have not had repeatedly to pass by problems of scientific interest in favour of more urgent industrial ones. This inevitable limitation is recognised by some industrial firms, and an appreciable proportion of the purely scientific research carried out in British universities has probably been suggested or inspired by contact with industry. It may be a tragedy that the universities are unable to provide the whole environment of research, leisure and remuneration necessary to secure the best men to train young scientific workers for industry; it is no less a tragedy if they do not offer conditions which attract the best brains for a career of scientific research.

The realisation that the conditions and remuneration offered to those adopting a career of scientific research do not, to say the least, ensure attracting the ablest young men of science, or still more, in the absence of a definite bent, induce the most promising young men to undergo training in science in preference to training for careers

in law, medicine, or applied science, is responsible for much of the anxiety as to the position of fundamental research. There is no lack of candidates for positions in industry. Only in a few cases in recent years have the principals of technical colleges and similar institutions found themselves with more applications for graduates than they were able to supply. The unemployment situation, of course, affects the employment of science graduates in industry, and the existence of unemployment on a large scale in Europe seriously prejudices the employment of alien scientific workers anywhere. This is our reply to a correspondent from Bucharest, who, quoting the remark "not even a handsome salary has been able to attract a really first class organic chemist of the younger generation", from the leading article on "The Position of Fundamental Research" in NATURE of May 31, asks what prospects exist in Great Britain for an alien scientific worker fully qualified to occupy an academic or an industrial post. The engagement of an alien is quite naturally resented when unemployed nationals are available, and particularly when, as has frequently been the case, the alien is willing to accept a salary and conditions which scientific workers in Great Britain have declined.

The efforts of the British Association of Chemists have done something to redress the employment of alien chemists to the prejudice of British chemists. While no barrier exists to the engagement in industry of an alien chemist or other scientific worker, if it can be shown that he possesses special qualifications which are not possessed by available British workers, the Ministry of Labour, the permit and approval of which are required for any such appointment, is unlikely to sanction the engagement of an alien at a salary lower than that which a British man of science of equal standing could reasonably be expected to accept. Such a permit is, moreover, usually given for a limited period and on condition that a British chemist, for example, is appointed to study under the alien.

Purely scientific appointments would, of course, largely be influenced by similar considerations, and only an improvement in the general European employment situation and an abatement, through the efforts of the Committee on Intellectual Co-operation and others, of national prejudices, of which the growth of tariff barriers is only another example, is likely to promote the employment of scientific workers by other than their own nationals.

Discursive Meteorology.

Manual of Meteorology. By Sir Napier Shaw, with the assistance of Elaine Austin. Vol. 3: *The Physical Processes of Weather.* Pp. xxviii + 445. (Cambridge: At the University Press, 1930.) 36*s.* net.

THE New English Dictionary defines a manual as a small book for handy use, a concise treatise, an abridgment, a 'handbook'; 'often used as a title for books'. Probably the average reader thinks of a manual as a book of a systematic character, fairly complete and, probably, rather dry and colourless, kept at hand for information on any topic within its scope that may arise from time to time. But while Sir Napier Shaw is not careless in his choice of words, his book somewhat belies the hopes and the fears which its title might inspire; for it is both worse and better than this suggests.

On one hand, the work is far from being complete or systematic; but the author forestalls comment on this score, by a candid account of his thoughts while choosing a sub-title for this, the third of the four projected volumes of his manual:

"As far as may be" (he says) "we desire to give an insight into the physical processes that are operative in the control of weather. Our purpose is in fact to call the attention of the reader to the processes which can be recognized as physical, in the hope that he will be sufficiently interested to seek for any additional guidance that he may find necessary in the recognized treatises on the different parts of the subject. The achievement of that purpose implies the selection of a number of subjects from the recognized text-books on physics. Our presentation may be incomplete and disjointed, and for that reason a suggestion was made to define the scope of the volume with the title 'Miscellanea physica', but that was found to be more recondite than wise."

The title, however, does less than justice to the volume, in that much of the book is delightful 'popular' science, using the adjective in a wholly complimentary and respectful sense. Sir Napier is probably capable of doing for meteorology what Sir James Jeans and Sir Arthur Eddington have done for astronomy—make it a subject of keen intelligent interest to a considerable lay public, not by a mere recital of natural marvels, but by an attractive and simplified yet serious exposition of its progress and present problems. This, however, is not his object in the manual. His aim is rather to expound his subject in a wide discursive way, primarily for the benefit of the meteorologist and physicist; and though the book is not mathematical

in character, he does not shirk formulæ and difficult ideas. But he reverts frequently to fundamental principles—too often lost sight of during attacks on complicated problems—and often illuminates the mysteries of meteorology in a vivid and attractive way. In doing so he makes effective use, from time to time, of quotations from great writers of a past generation, with whose works present-day students may have little direct acquaintance.

The book is divided into ten chapters. The first three are only slightly connected with the remaining seven: they are devoted to gravity waves in water and air; sound waves; and atmospheric optics. They will be among the most interesting to the lay reader, because of the pleasant way in which they are treated: to the serious worker, however, they may appear superficial, omitting much that might, and perhaps should, be included in any general discussion of these topics. Another chapter (ix.) which stands slightly apart from the rest of the book is devoted to electrical energy in the atmosphere; this deals with atmospheric electricity and thunderstorms in an interesting way, without attempting to reconcile opposing views.

Here and there, in these and other chapters, the details are treated rather too casually, though usually with no serious ill result. Two examples must suffice: on p. 102 McLennan's work on the green auroral line is cited in a quotation from an article on the physics of the globe by another writer; here a direct reference to, or quotation from, McLennan himself would surely have been better. Again, on p. 74, in connexion with the blue of the sky, the size of molecules receives mention as follows: "Molecules are much smaller than the particles which form clouds. According to Rutherford and Geiger there are $\cdot 272 \times 10^{20}$ in a cubic centimetre. Whetham suggests that there are not more than ten million in a row of the length of a millimetre." The last sentence may leave the uninstructed reader with the impression that good authorities incline to think, but at present only tentatively, that the diameter of a molecule is not less than 10^{-8} cm.; but the middle sentence, which the physicist will recognise as referring to the number of molecules in a cubic centimetre of gas at normal temperature and pressure (in which actually the molecules are rather widely separated from each other), may seem to invoke the name of Rutherford in favour of a diameter rather larger than 10^{-7} cm.

A feature of the book is the considerable number of technical terms and usages adopted in it, many of them of the author's introduction. Every science requires its own technical terms and symbols, but one cannot always sympathise with the author's complaint of unsuitability and redundance in those of physics, on which he partly bases the advocacy of new terms and units. Some of his own usages arouse criticism, in particular, that of *tt* to denote absolute temperature (not only in the form 300° *tt*, but also in formulæ); why should not meteorologists adopt the now growing physical practice of writing 'K' to denote the Kelvin absolute scale, just as 'C' and 'F' are used for the Centigrade and Fahrenheit scales?

The scientific importance of the book must be judged, however, mainly with reference to the six chapters that deal with the atmosphere as a heat engine. Their scope and nature may be indicated by quotation of the chapter titles: Radiation and its problems; the controlling influence of radiation; air as worker; the liability of the environment; side-light on convexion and cloud; convexion in the general circulation (Ch. x.). It is impossible here to discuss these chapters in any detail, but the author may be congratulated on his courage in attempting an extraordinarily difficult task, and on the degree of success which he has achieved in it. The development of heat engines for industrial purposes has occupied large numbers of able minds for several generations, and despite all the facilities for experiment and trial, finality in this field still lies far ahead. The meteorologist is confronted with an infinitely more difficult problem, that of unravelling the workings of the atmospheric heat engine. Like the engineer, he has been forced to invent measuring instruments for the input and output of energy: the author has conferred a benefit in making a knowledge of this work, and its results, more readily available than would otherwise be the case. He shows how meteorological circumstances, themselves ultimately controlled by the supply of solar radiation, modify the effective input of this radiative energy into the atmosphere, by letting it reach the ground in some places and on some days, while in other cases it may be largely turned back into space by reflection from clouds without being able to exert much influence on the atmosphere.

The greatest difficulties that arise in the meteorologist's quest are those encountered when the influence of radiation on meteorology is examined, in conjunction with the secondary influences of the earth's spin, the distribution of land, water, and ice with the associated water vapour, and also the dust present in the air. Sir Napier here introduces us to "a succession of notes of interrogation; the

one undeniable achievement in that part of the subject " (dealing with the balance of radiation) " is apparently that within 2 per cent, by suitable redistribution, the radiation which is gained from the sun is lost again to space within the month ".

In attempting to trace the energy in its transformation in the atmosphere, it is necessary to combine the theory of heat and heat engines with hydrodynamical theory; in this volume, however, the author confines himself to " the assistance meteorology can expect from the theory of heat before making an appeal " (in volume 4) " to those universal providers the general equations of motion ". This may seem like presenting " Romeo and Juliet " with one of the two lovers left out of the play; but the author may justly reply that they are not together on the stage in every scene, and he has at any rate thrown valuable light on some of the heat processes in the atmosphere, by his discussion of them from the entropy point of view, using entropy-temperature diagrams. Opinions may differ as to the relative merits of different ways of regarding and representing a given set of facts, but in the present state of meteorology it is good to have the phenomena examined from many angles; in the application and development of his own special views and methods, Sir Napier here shows all his accustomed thoroughness.

In conclusion, a tribute of admiration and respect may be paid to the devotion with which the author has followed his chosen plan of gathering together into these volumes the knowledge gained in his long and active service to his science; his readers will hope ere long to see the completion of this work by the publication of the remaining volume.

Soil Genesis and Morphology.

The Great Soil Groups of the World and their Development. By Prof. Dr. K. D. Glinka. Translated from the German by C. F. Marbut. Pp. iv+235. (Ann Arbor, Mich.: Edwards Bros.; London: Thomas Murby and Co., 1928.) 15*s*. net.

TO paraphrase the words of Wurtz regarding chemistry, "Pedology is a Russian science; it was founded by Dokutschajeff of immortal memory". Such a statement would receive a much more general assent than that of Wurtz, because in no other science is the influence of one country so marked: the Russian names of some of the important soil groups have already become so anglicised that such a word as 'podsolised' is widely used and understood.

In recent years, much of the Russian work on soils has been made accessible to English-speaking people by the issue by the Russian Academy of Sciences of a series of bulletins in English; whilst their American colleagues have assisted in respect of the work of Gedroiz and Glinka. A large selection of the papers of the former has been translated and issued privately in a series of multigraphed bulletins dealing with soil chemistry and physics, and in the volume under consideration, Dr. Marbut has done the same for Glinka. This book deals with pure pedology—soil genesis and morphology—and is one of the first in English on the subject. As stated in the preface to the original, Glinka wrote it in German in order to bring Russian views on pedology before western readers. It was published in 1914, and no subsequent edition appears to have been published. In 1917, Ramann published his small book on the same subject based largely on Russian work: it was translated into English by Dr. C. L. Whittles in 1928, and these two translations appear to constitute the entire pedological library in English. Both belong to the pre-War period.

The post-War interest of English-speaking students in pedology has been greatly strengthened by the meetings of the International Society of Soil Science inaugurated in Rome in 1924: both Ramann and Glinka were present at the meeting, and the respect and affection in which they were held by all nationalities was memorable. Ramann, then an old man, died soon afterwards. Glinka, much younger, took an active part in the International Congress held in Washington in the summer of 1927, and was to have presided over that being held in Russia this month. His death in the November following the American meeting was a great loss to soil science and to a large number of friends in many countries.

Dr. Marbut has carried out his task of translation in a self-effacing manner. The original is faithfully followed, and there is an absence of editorial footnotes or square-bracketed insertions by which translators so often convey their own views. He has, however, found it necessary to translate the title according to American nomenclature, "Typen der Bodenbildung" becoming "Great Soil Groups". This is presumably due to an important difference in the meaning of 'soil type' as used by American and continental writers: the former use 'type' as the smallest subdivision in soil classification, and the latter as the largest. This unfortunate lack of uniformity has probably gone too far to correct. (It may be mentioned

that Great Britain is apparently following America as regards the use of 'soil-type').

The publishers are evidently not optimistic as to sales, as the book is multigraphed and not printed; only one side of the paper is used, and this results in a somewhat bulky volume, notwithstanding that the second part (120 pages), dealing with the soil-zones of Russia, is omitted altogether. The same applies to the 63 photographs and the soil map of Russia. It would have been well, perhaps, to mention these omissions in the translator's preface. More important and somewhat inconvenient is the absence of both table of contents and index.

As has been stated, the translation follows the original faithfully: its course is leisurely, space being found for a quotation nearly half a page long, from J. S. Mill, on classification.

The greater part of the book is devoted to *ektodynamomorphic* soils, that is, those in which climatic and other external factors in soil formation predominate over internal ones such as geological composition. Glinka accepts moisture conditions as the dominant factor in classification, and distinguishes six classes the moisture contents of which are optimum, average, moderate, insufficient, excessive, and temporarily excessive, respectively. *Endodynamomorphic* soils are those in which external factors have not yet exerted their full influence and which are therefore immature: they are dealt with only briefly.

The profiles are described with a wealth of morphological detail and are supported by a mass of analytical data almost bewildering in their profusion. It is to be hoped that future authors will give more guidance in interpreting such data, and will perhaps effect considerable economies in space. For example, it does not seem necessary to recalculate a long table of figures to show the results of analysis on an ignited basis as well as on the original soil, especially as no conclusions are drawn from them. The reviewer also hopes that the time is coming when the analysis of complete (unfractionated) soils will be a rare event. A soil can be separated into parts having various functions, and it is the analysis of the separated parts which alone can throw light on the relation of composition to properties and mode of formation. The analysis of a whole soil seems analogous to passing the whole body of an animal through a mincing machine and analysing the resulting mixture of bone, fluids, and soft parts, a procedure which would effectually conceal the facts of physiological chemistry.

The book will undoubtedly further the object of the translator in making the pioneer work of Glinka and the Russian school more widely known. It is to be hoped that it will also bring home to our own pedologists the lack of an original treatise in English on the subject, and so stimulate the production of a modern account of the soils of the British Empire.

Campbell Swinton's Reminiscences.

Autobiographical and other Writings. By Alan A. Campbell Swinton. Pp. ix + 181 + 18 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930). 10*s*. 6*d*. net.

IN the preface to "Rob Roy" Sir Walter Scott remarks that no introduction can be more appropriate than an account of the singular character whose name is given on the title-page, who owed his fame in great measure to his residing on the very verge of the Highlands, and who possessed the advantage of descent from a clan famous for their misfortunes, and for the indomitable spirit with which they maintained themselves. Equally appropriate as an introduction to an enchanting story—though this time of men and things that have influenced the advance, during the last half-century, of physics and engineering—is the autobiography of Campbell Swinton. His kindly hand, that had just completed the writing of this book, has vanished; his friendly voice is still, yet his name will be perpetuated, not as he hoped in the legend of his descent, but in the useful part he took in the border struggle of natural science and its applications. Readers of this attractive volume of reminiscences may not all be acquainted with the fact that the author's thoughts were ever oscillating between the memory of his family's antiquity and the most recent activity in optics, telephony, turbines, or public affairs that required comment from him. His progenitors ranged through about eight centuries, from Hernulf son of Odard, son of Liulf. His happiest moments were when somebody could be beguiled into hinting that to refer too often to personal ancestry is to be a bore; for then he would laugh heartily, and cite the dictum of Silvanus Thompson, that all the élite of the intellectual world are bores, including ourselves.

Campbell Swinton was born in Edinburgh in 1863. He was educated there and in France, until eighteen years of age, when he came to England. His impressions of schoolboy life in a Scottish educational establishment remained to the end clear, penetrating, and embittered. He states in this volume that he "always loathed games, from earliest childhood", and he looked back with horror

upon the three years at a school where all spare time had to be given to compulsory games. Being the kind of boy he was, his school may have been an unfortunate choice on the part of his parents. In the next phase of his career, however, they made full amends by apprenticing him, in 1882, to Sir William Armstrong, for this gave to his activities full scope. Upon mechanical and electrical devices, photography, and the last word concerning the last miracle in natural phenomena, he was ever intent, but as he applied himself to mathematics with as little zest as he did to games, his movements were in some directions restricted. Nevertheless, as he possessed shrewd native knowledge of quantities, his judgment on broad issues was usually sound.

Those who knew Campbell Swinton best were aware that although he sought information in discourses at the Royal Society, the Royal Institution, and the Royal Society of Arts, about material things, his mind was set as much upon determining who's who as upon what's what. Circumstances, and his propensities, as well as his descent, brought him into the company of people of distinction and some of eminence. One consequence was that he accumulated anecdotes and photographs, many of which illustrate if they do not adorn this tale. His wide and intimate knowledge of the facts of progress, particularly of those relating to electrical science, render his contributions to history, here and there, very precious. For example, what he did in tribute to the work of David Hughes, and what he now has written concerning Graham Bell, Swan, R. W. Wood, Lane Fox, and Creed, shows with what perception and equity he could hold the balance. Concerning his own contributions he is modest and amusing, with the result that the autobiography is a fitting reminder of one who did much for his time, and did it pleasantly.

Photo-electric Cells.

Photo-electric Cells: their Properties, Use and Applications. By Norman Robert Campbell and Dorothy Ritchie. Pp. vii + 209. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 15*s*. net.

WITH the remarkable growth in the application of the photo-electric cell to almost all branches of industry, the need for a book dealing specially and fully with it has become increasingly acute. This want is now well filled by the publication of the volume under review. It is a striking fact that while the immense literature dealing with the selenium cell is concerned mainly with its use, the yet larger literature on the photo-electric effect is concerned almost entirely with theoretical considerations. As the authors state in their preface, the aim of their book is to redress the balance.

The subject matter falls naturally into three parts, which deal respectively with the theory and properties of photo-electric cells, their use, and their application to various special problems.

In the first part the authors have largely avoided the error of introducing too much theory—a fault which sometimes occurs in books which are essentially practical. We say 'fault' because it seems to us that the right place for general theoretical considerations is in a theoretical text-book, and that in a practical book on photo-electric cells only such general theory of the photo-electric effect as is essential to ensure the rational and most efficient use of the cell should be introduced. In the reasonable amount of theory given in Part 1 there are few criticisms that we would make; perhaps the most serious one is that the authors' statement that the photo-electrons are the 'free' electrons of the metal (p. 12) is not one which is generally accepted. Part 1 is crammed with useful information; Chapters v. and vi., dealing with the electric discharge and voltage current characteristics, are intensely interesting and need only to be read to be appreciated by those who use photo-electric cells. The last chapter in Part 1 is on the choice of a photo-electric cell, and here the authors' known preference for the vacuum rather than the gas-filled type is emphasised, perhaps too strongly. For though they admit that gas-filled cells are the only kind worthy of consideration for many important purposes, they say that they "need skilful handling, and are never wholly trustworthy"—a statement which seems rather exaggerated.

Anyone who intends to use photo-electric cells for the first time cannot possibly do better than read Part 2 of this book, where, after dealing with some general principles of their use, electrostatic and valve amplification circuits are discussed. The latter are specially interesting, although even already they do not represent the latest ideas, as Dr. Campbell showed at the recent joint meeting of the Physical and Optical Societies, when photo-electric cells were the subject under discussion.

In the third section, dealing with the applications of photo-electric cells, there are four chapters on the measurement of luminous flux, illumination, colour and light absorption.

There are extremely few misprints, and such small mistakes in an extremely valuable book can easily be rectified in a second edition, which we hope and expect will soon be necessary. F. C. T.

Our Bookshelf.

A German-English Technical and Scientific Dictionary. By A. Webel. Pp. xii + 887. (London: George Routledge and Sons, Ltd., 1930.) 36*s.* net.

THERE is every reason to suppose that this dictionary will quickly assume and long retain a place on the most easily accessible shelves of both private and public libraries. The translation of technical German is a task which falls frequently to the lot of scientific people: most of the members of the scientific professions probably have what is euphemistically called a 'reading knowledge' of the language (if they have not they would be wise to repair the omission), but probably comparatively few are in possession of an exhaustive and intimate acquaintance with the less common words and niceties of expression appropriate to their subject. To most people a good dictionary is frequently a necessity in ascertaining the exact meaning of technical expressions, and most people require that the dictionary shall not only serve their subject, but also be up-to date. It is sometimes alleged that the English equivalents of German technical terms are easily guessed, this is no doubt sometimes true, but more often a delusion and a snare, and in any event scientific people have little use for guesswork. Mr. Webel has provided us with a substantial book of reference, and he has striven to clarify the alternative technical meanings by indicating the branches in which they are used and sometimes by including formulæ, properties, or systematic nomenclature. The publishers, too, have seen to it that the type and paper are such as to be convenient in use.

The true test of a dictionary is, of course, service, and a reviewer can scarcely report critically on performance until he has used the book constantly for a long period. The vocabulary is, however, obviously fairly exhaustive as regards chemistry, mineralogy, and botany, and substantially adequate as regards general words and terms in allied and applied sciences. Random tests with a few dozen terms encountered in chemistry and chemical technology were highly satisfactory, except perhaps in one or two cases in the field common to chemistry and medicine. There are sixteen pages of abbreviations, and 143 pages of botanical names with their English and German equivalents. Every word has been provided with a five-figure code number. The author's friends were indeed well advised in persuading him to publish what was originally intended to be a private work of reference. A. A. E.

The Bridle of Pegasus: Studies in Magic, Mythology, and Folklore. By Warren R. Dawson. Pp. xv + 203. (London: Methuen and Co., Ltd., 1930.) 7*s.* 6*d.* net.

IN this volume Mr. Dawson has gathered together a number of essays on various subjects of cognate interest. Each deals with some manifestation of the magical idea in antiquity, usually in Egypt, which is then followed up in its historical setting to modern times. As will be anticipated by those who have followed Mr. Dawson's previous work, his subjects are for the most part connected more or less immediately with medicine and its practice. Thus one chapter deals with the use of the mummy as a drug—an interesting example of the working of the mind in transferring the supposed attributes of one substance to another under the influence of a magical concept. Another deals with the use of birthwort as an example of the progress of medical botany in twenty-three centuries.

The first two chapters are ingeniously suggestive. In the first the author deals with the rite of Amphidromia in Ancient Greece, in which the father on a certain day after a birth ran around the hearth with the child in his arms. This custom he brings into relation with the modern belief in the fairy changeling, and suggests that it was a test of the genuineness of the child. May it not have been something more, and does this explanation give full weight to the significance of the hearth? May it not have been both a test and a ceremony in the nature of bestowing the 'freedom' of the family on the new member. The second chapter suggests that the Harpies of Greek legend may have been a distorted memory of the great fruit-eating bats of India—an ingenious explanation of a curious example of the monstrous in Greek lore.

In dealing with nose-rubbing and salutations, Egyptian ritual practice is suggested as the origin of the kiss. The physiological explanation is set aside: but surely the author here ignores certain obvious facts. Even in smelling, to which the Egyptian philological evidence points as the original form of the salutation, there is a fundamental sexual and physiological element, which is strengthened in the transfer of the salute from the nose to the mouth. Both smelling and licking are so obviously gratificatory in the animal world that it is difficult to believe that in man the gratification—and there can be no question as to the fact—is derivative as a secondary character from a ceremonial practice.

The Terminology of Physical Science. By Dr. Duane Roller. Pp. 115. (Norman, Okla.: University of Oklahoma Press, 1929.) 1 dollar.

THIS little book, not much more than a pamphlet, is praiseworthy as an attempt to fill a gap increasingly felt as science teaching extends. It discusses the meaning of a number of terms found troublesome to the students of the physics department of the University of Oklahoma. The author also aims at simplifying innovations which have not yet gained general usage. Force, gravitation constant, radiation are examples of terms thus discussed, at greatest length. There are three shorter chapters on pronunciation, suffixes and prefixes, and the names of the elements—all quite elementary, but none the worse for that.

The book and its obvious utility remind one of the problem which is already serious in all countries where modern science is being taught to persons of another language and culture, for example, India, China, Egypt and other Arabic-speaking lands. Are such people to try to find equivalents in their

own speech for Western terms, or are they to adopt the original words of the founders and thus ultimately create a common fund of scientific terminology? There surely can be no two answers to this question. Every consideration, of clearness, of filiation to the original conception, of the community of men of science all over the world, points to the latter course. Dr. Roller's work should be an encouragement to those engaged in such classes to do something of the same kind. His is purely physical; no doubt in other branches other people elsewhere have tried the same thing. There was once a useful popular book by Stormonth on scientific terms. Is there a more recent work on similar lines? F. S. M.

X-rays. By Dr. B. L. Worsnop. (Methuen's Monographs on Physical Subjects.) Pp. ix + 101. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.

IT is appropriate that one of the early volumes of Methuen's Monographs on Physical Subjects should deal with X-rays, which have proved so powerful a tool of modern physics in the elucidation of the fine structure of atoms and of the solid state. Whilst Dr. Worsnop's book gives a good general survey of the subject, it lacks the almost faddy attention to detail that one expects from an editor. For example, in the excellent bibliography of books, only one date is given, and in the text a reference appears as merely "*Physical Review*, 1923". The essential features of X-ray tubes could have been as well illustrated with the modern as with the old-fashioned sealed types (Figs. 1 and 2), in which the large spherical bulb prevents a close approach of one end of the collimating system to the focal region. Shearer and line-focus tubes are not mentioned.

Although a later volume in the series is devoted specifically to X-ray crystallography, the use of crystals as gratings for the study of X-rays is of such importance as to necessitate a brief account of some crystallographic details. These are not all explained so clearly as is desirable in a book intended for students. For example, a highly symmetrical arrangement of spots such as that shown in Fig. 7 is not an essential feature of a Laue photograph, since it is obtained only in very special circumstances. The section on crystal structure, pp. 24-26, should be rewritten with a clearer distinction between general results and those applicable only to orthogonal crystals. The final chapter wisely deals with the recent successful experiments on reflection, refraction, and ruled-grating diffraction in which the early attempts were failures.

Microscopic Pharmacognosy. By Prof. William Mansfield. Pp. x + 211. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 15*s*. net.

THIS work contains detailed descriptions of the minute structure of nearly a hundred of the more important vegetable drugs. The text consists of descriptions of the different tissues of the plants dealt with, the species being described under both botanical and pharmaceutical names. The species are divided into one of several main categories according to the part of the plant used—whether leaf, stem, root, or bark, etc. An important feature of the book is the clear full-page drawings of the anatomical structure of each plant described, which show the more important diagnostic characters.

As some of the plants dealt with are not official drugs, according to the U.S. Pharmacopœia, their inclusion in the work might be objected to on the ground that their exclusion would have made room for other more important drugs. However, as the space occupied by them is small and is devoted to such everyday substances as insect powder (*Chrysanthemum cinerariæfolium*), horehound (*Marrubium vulgare*), etc., their inclusion is not a serious matter. The work is a useful addition to the literature of medicinal botany, and will serve as an authoritative text in microscopic pharmacognosy for students of pharmacy and as a reference book for pharmacists and drug analysts.

Gari-Gari: der Ruf der afrikanischen Wildnis. Von Hugo Adolf Bernatzik. Pp. vii + 144 + 80 Tafeln. (Wien: L. W. Seidel und Sohn, 1930.) 10*s*.

IN this volume the author describes a journey through the Sudan in which he attained the ambition which had held him since his boyhood—a hunting and fishing expedition in Africa. His visit to the Sudanese tribes—Shilluk, Nuer, and Dinka—inspired him with an enthusiasm for the black man of the Sudan equal to his interest in its wild life. He describes their tribal life, their daily routine, their dances, and their festivals and feasts as he saw them, in something more than an impressionist spirit. While the book has no small merit as a description of the country and its people, its special attraction lies in its illustrations. These, 160 in number, in their happy choice of subject and in their technical excellence, form a collection which is probably unique in any printed book on the Sudan.

Experimental Physics: a Laboratory Manual. By Prof. A. E. Caswell. Pp. ix + 181. (New York: The Macmillan Co., 1928.) 6*s*.

ALTHOUGH it is usual for every teaching laboratory to have its own scheme of practical work, description of a course adopted elsewhere will often suggest useful changes either in general procedure or in the details of certain experiments. Prof. Caswell's book offers several such hints, notably for experiments in mechanics; impulse and momentum, and the general properties of machines are studied by two neat devices involving flowing water, the extension of a wire is measured by an optical lever method, and the density of air found from the mass of an old incandescent lamp before and after it has been cracked open. Two good calorimetric experiments are also described with ordinary gas burners, and an electrolytic method given for mapping fields of force.

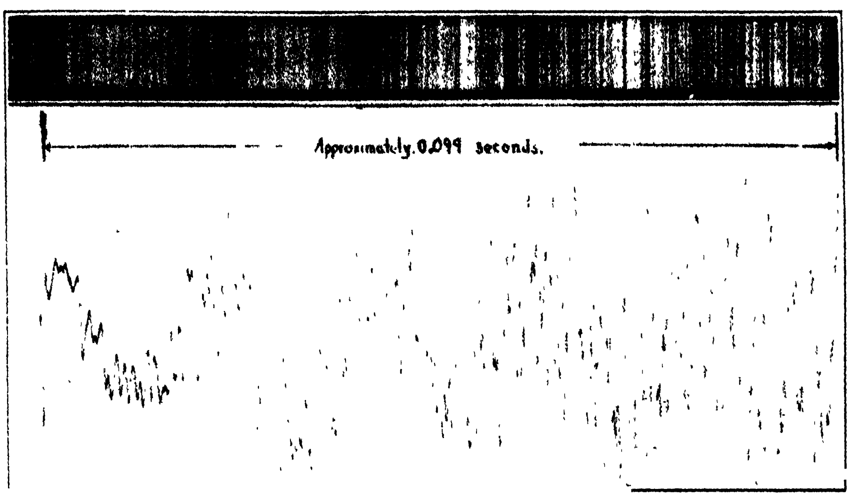
Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Microphotometric Analysis of Movietone Sound Records.

IT occurred to me while attending tests of a new modification of a fog alarm at Buffalo on Oct. 22, 1929, that use could be made of the 'Movietone camera' to obtain valuable information as to the nature of the signals and at the same time provide a permanent record for detailed study. A good instrument is nearly as sensitive as the human ear, and everything pertaining to the recorded sound is registered.

Some years ago I designed, but have not yet actually constructed, a sound unit of variable pitch, the emission of which may be recorded. It is based on the tunable diaphragm of variable frequency described in the *Journal of Scientific Instruments*.[1] The formula by means of which emission may be calculated can be found in a short article by me on the characteristics of telephone receivers.[2]



With such a sound standard at a known distance from the movietone microphone, a record of pitch and intensity of pure notes covering a wide range of frequencies and intensities may be recorded on the film immediately before and after the signal to be studied.

By passing the film through a Mohl microphotometer, as is done in the analysis of complex optical spectra, a record capable of interpretation in terms of intensity, quality, and frequency may be obtained.

Fig. 1 is a reproduction of a movietone film of an orchestra and the microphotometric record of the music recorded. I am indebted to the courtesy of Dr. G. O. Langstroth, of McGill University, for his skill in making the above Mohl record.

It is obvious that a more detailed study of this method of sound analysis and measurement is worthy of further study, not only in its application to the study of complex musical sounds, but also in the study of noise, so characteristic of our rapidly developing mechanical civilisation.

LOUIS V. KING.

Macdonald Physics Building,
McGill University, May 31.

[1] "Characteristics of Continuously Tunable Diaphragms." *Jour. Sci. Instr.*, May 1926.

[2] "On the Determination of the Electrical and Acoustic Characteristics of Telephone Receivers." *Journal of the Franklin Institute*, May 1919.

Formation of Streamers in Sedimentation.

DR. C. E. MARSHALL has recently described a method (*Proc. Roy. Soc.* A, 126, pp. 427-439; 1930) by which he claims that the size distribution of particles in a weak suspension of clay or similar material with particles of 2μ-$20\mu\mu$ diameter can be accurately determined. A high-speed laboratory centrifuge is used, each tube being nearly filled with a solution of cane-sugar or urea and a small quantity of the aqueous suspension (which has a lower density) is carefully poured on the top. A determination of the weight of sediment collected on the bottom of the tube in a measured time is used by Marshall to determine the weight of the particles which exceed a certain size, it being assumed that all the particles start from the top of the column at approximately the same time and settle through the solution in accordance with Stokes's Law. In discussing the method the author remarks: "It has not been found possible, so far, to apply these principles with any accuracy to the case of sedimentation under gravity. . . . Owing to slight variations in temperature or concentration the upper liquid sends down 'streamers' of suspension into the heavier liquid below." In advocating the use of the high-speed centrifuge he says: "The boundary between the two liquids actually becomes more sharply defined as centrifuging proceeds, and even if 'streamer' formation has begun, the liquid of low density moves rapidly back into place under its action."

We have repeated the experiments under gravity, and conclude that the explanation of 'streamer' formation is as follows.

As the sugar solution is denser than the suspension the system is initially stable. This stability is only transitory, however, as under the action of gravity the particles pass from the suspension through the interface and enter the sugar solution the uppermost layer of which, being now laden with particles, has a greater density than the rest. It consequently breaks up and 'streams' down through the clear solution. As long as the dense layer is reformed by the entrance of more particles into the sugar solution so long does streaming continue, with the result that many of the clay particles reach the bottom of the vessel very much sooner than if they had settled individually through a stationary solution in accordance with Stokes's Law.

Marshall's statement that streamers do not form during centrifuging is presumably based on the belief that the streamers have a *lower* density than the solution, which is clearly implied in the quotations given above. There appears to be no justification for this belief, and it is difficult to see why liquid lighter than the sugar solution should move rapidly downwards through it for many centimetres in a normal gravitational field. If, however, it be admitted that this streaming liquid is sugar solution containing particles and is therefore denser than the clear solution, it is very singular if it really "moves rapidly back" on centrifuging.

Naturally the arguments based on observed behaviour in a normal gravitation field cannot safely be transferred unaltered to the condition in the centrifugal field used in Marshall's method. A mathematical examination of the fate of the 'streamers' in the latter case presents great difficulties, but an

experimental examination is no doubt feasible. It is to be hoped that Dr. Marshall will be able to show that his ingenious method is not seriously affected by the point to which we have directed attention.

B. A. KEEN.
K. R. SCHOFIELD.
Rothamsted Experimental Station,
Harpenden.

MY belief that 'streamer' formation does not occur to any appreciable extent under the influence of the high-speed centrifuge is based on the following observations:

1. Since publishing the paper to which Dr. Keen and Dr. Schofield refer I have adapted the centrifuge to the determination of the fraction 2μ-1μ, by reducing its speed. This determination can be checked by the pipette method and a good agreement between the two has been found. Since 'streamer' formation would affect this fraction more than any other, the experimental evidence would appear to be against its playing an appreciable part.

2. If a clay is centrifuged for so short a time that the largest particles present can only traverse half the lower liquid, then a satisfactory boundary is found in approximately the calculated position, the lower half of the liquid remaining clear.

The above facts would appear to provide sufficient evidence that the centrifuge method is not affected by 'streamers'. The question as to the true explanation of 'streamer' formation under gravity is one on which I am not prepared to undertake a long investigation. It should be noted that the movement of the 'streamers' downwards under gravity does not exclude the operation of factors other than those considered by Keen and Schofield, and that it is still not certain that the 'streamers' are of greater density than the liquid in which they move.

C. E. MARSHALL.
Dept. of Agriculture,
University, Leeds.

The Feeding of Ammocœtes.

IN accounts of the Cyclostomata it is generally said that the Ammocœtes larva of the lamprey feeds by means of a current of water caused by the action of its pharyngeal cilia, and that food particles, entangled in mucus, are carried back to the gullet in the same way as in *Amphioxus* or in an Ascidian (cf. "Encycl. Britt.", 14th ed., art. Cyclostomata).

The presence of a mucus-secreting gland in the floor of the pharynx, and of a ciliated tract leading forward from the opening of this gland by way of lateral tracts—to a dorsal ciliated ridge, are arrangements so similar to those found in *Amphioxus* that it is natural to assume that they serve the same purpose, and in the same way, in both animals. When we add that Ammocœtes passes the whole of its life, until metamorphosis, buried in sand or mud, and that it has in its buccal hood a 'velum' and a straining apparatus in the form of tentacles, the resemblance seems almost complete.

During the last two years, I have had access to a fairly abundant supply of larval lampreys, and my observation of the living animals—confirmed by the examination of serial sections—makes it clear that their similarity to *Amphioxus* is deceptive.

The gill-bars of the larval lamprey bear no cilia that could cause a current of water through the pharynx. Indeed, a very cursory examination of a living animal, as it lies at rest, shows that the whole pharynx is in constant motion and acts as a muscular pump. Young larvæ (1 cm. to 2 cm. long) are transparent, and in them the action of the velum can be well observed under the microscope. The two velar folds execute a constant rhythmical movement, backwards and forwards, the right and left folds beating synchronously. The backward motion of one of these folds, seen from above or below, may be likened to the grasping or 'snatching' action of a hand in which the thumb is held parallel with the fingers. When a small larva is immersed in a suspension of Indian ink, and the pumping action of the pharynx temporarily ceases, it is seen that the velar movements alone can maintain a current of water through the pharynx.

I believe, however, that these movements have a second function. The ciliated tracts which sweep round the sides of the pharynx, to meet in the median

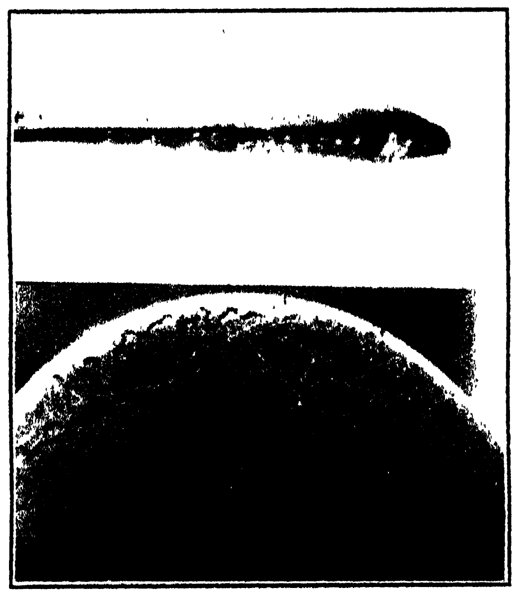


FIG. 1.—Above: a young larva fed on Indian ink and showing the blackened cord of mucus in its pharynx. Below: the burrows of young larvæ seen through the glass bottom of an aquarium.

dorsal ridge, take the form of grooves, each situated on the crest of a salient ridge. I have been able to demonstrate a ciliary current in these grooves, passing forwards and upwards, carrying mucus from the ventral gland. Now, the position and aspect of the lateral grooves place them in the trajectory of the edges of the velar folds when these folds execute their grasping movement; and in this way, I believe, the mucus is dislodged, to pass backwards in strands in the respiratory current.

What can be directly observed in the living animal, fed on Indian ink, is the formation of a single cord of blackened mucus passing down the middle of the pharynx to the gullet, the cilia of which haul it in rapidly, and pass it on to the 'stomach'. The front end of the blackened cord is frayed out into a hollow cone of strands, which in sections can be traced to the ciliated grooves. Thus the whole of the respiratory water with its suspended food particles must pass through a conical net of mucus strands before reaching the gill-clefts.

How strands of mucus, issuing from the circumpharyngeal grooves, become united into a single cord is not plain. The dorsal ciliated tract may initiate this, or a rotatory movement of the œsophageal cilia may twist the originally discrete strands together—but, so far, observation does not support either of these possibilities. What is certain is that the mucus cord, once established, lies quite free in the pharynx,

and does not move under the influence of dorsal cilia as in *Amphioxus*. In larger animals, which are not transparent, I have found it hitherto impossible to determine whether the feeding process is the same. The study of such animals killed while feeding on ink is unsatisfactory, and I propose to apply to them the method of radiography during an opaque meal.

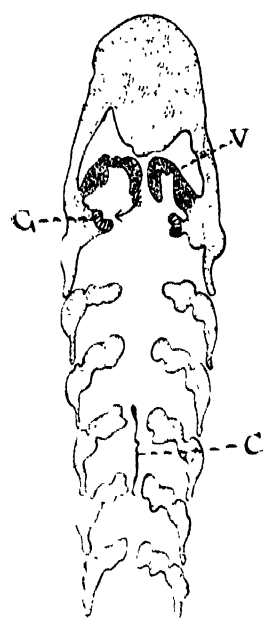


FIG. 2 Horizontal se the ant ior end of Amm

One other point may be mentioned. Though I have tried many times, and always in vain, to verify the existence of the neat U-shaped burrow, open at both ends, in which Ammocœtes is supposed to live, it is true that the animal's track in the sand or mud does persist for some distance as a tube the walls of which do not easily collapse. Ammocœtes appears to produce considerably more mucus in its pharyngeal gland than is used in feeding. Some of this mucus issues from the gills, and, in animals left in a glass dish without sand, tends after a time to become an encumbrance. In more natural surroundings it is removed by the friction of th d, the particles of which are at the same time cemented together. To this—rather than to a secretion from the skin—I attribute the formation of the burrow.

My drawing (Fig. 2) shows horizontal section through a young larva, and the letters *V*, *G*, and *C* indicate, respectively, the velum the ciliated groove, and the cord of mucus.

H. G. NEWTH.

Faculté de Médecine
Brussels, May 18.

Phagocytosis of Internal Insect Parasites.

DR. W. R. THOMPSON, in NATURE of April 12, presents convincing arguments to the effect that living parasitic eggs and larvæ do not form centres of attraction for the phagocytes of their insect hosts. While this is doubtless true in the majority of cases, it would not appear to be an invariable rule.

A few years ago I made a somewhat intensive study into the bionomics of a number of Hymenopterous and Dipterous parasites of Noctuid larvæ (*Bulletin* 26, Dominion of Canada, Department of Agriculture, 1923). Among these were a number of species of the Tachinid genus *Gonia* which lay minute eggs on vegetation. When swallowed by a Noctuid larva the eggs hatch and the liberated larvæ ultimately pass through the wall of the mesenteron into the body cavity. Here they invariably succumb, enclosed within dense phagocytic cysts, unless they can rapidly travel to, and enter, the supra-œsophageal ganglion of the host. No feeding occurs until the ganglion has been entered.

I have dissected hundreds of unfed larvæ from the body cavity of their hosts. They were invariably surrounded by phagocytic cysts. Many of these larvæ were alive and moving within the cysts at the time of dissection. The latter were occasionally more than three times the diameter of the contained parasites. This would indicate that the foregathering of the phagocytes had commenced at least two days earlier.

Whether the surrounding phagocytes actually killed the enclosed larvæ I am not able to state with certainty. In so far as could be judged, encysted larvæ died within about four days after entering the body cavity. That death was not due to starvation is indicated by the fact that other larvæ have been found, in an unfed condition, still attached to the inner wall of the mesenteron, thirty days after the eggs had been swallowed. The subsequent life of the larvæ that reach the supra-œsophageal ganglion would indicate that they are well able to live a free life in the body cavity without succumbing to asphyxiation. It would thus appear that the rapid death of these small larvæ is due, in some manner, to their enclosure in a phagocytic cyst. It certainly presents an impassible barrier against their all-essential trip to the supra-œsophageal ganglion.

The more successful larvæ travel rapidly to the ganglion and remain here for a few days. During this period, for the first time, a little alimentation is found in their stomachs. They now re-enter the body cavity, where, for many days, they remain unattached to any host tissue and are simply floating in the blood. For as long as they remain healthy they are entirely 'disregarded' by the phagocytes.

Provided they are in a suitable host, these larvæ rarely succumb from any cause other than that of their destruction by fellow-parasites. Whenever superparasitism occurs one larva always attacks and destroys all rivals. After their death it was observed that phagocytic attraction to their dead bodies was less pronounced than it was to living, though unfed, larvæ that had not gained access to the supra-œsophageal ganglion.

Experiments were conducted, also, with the Braconid, *Meteorus vulgaris* Cress. Females of this Hymenopteron were induced to oviposit in Noctuid larvæ that were in varying stages of maturity.

In the case of the more immature hosts the eggs hatched and liberated larvæ which were not 'molested' by phagocytes except in the event of their death. When, however, *Meteorus* was induced to oviposit in host larvæ that were already contracting in preparation for pupation, it was found that, after three days, the eggs had increased in size as do all living eggs when introduced into the body cavity of a suitable host, but that they were all surrounded by dense phagocytic cysts. The embryos in these eggs were all dead when we made our dissections. In this case it is, therefore, possible that they had already succumbed before the phagocytes were attracted to the eggs, even though the enlargement of the latter indicates that they were viable after they had entered the body cavity of the hosts.

E. H. STRICKLAND.

University of Alberta,
Edmonton, Canada,
May 20.

Mortality amongst Plants and its Bearing on Natural Selection.

IN his letter to NATURE, June 28, Dr. R. A. Fisher asserts that there is a concealed fallacy in my statement that "the mortality and therefore the operation of natural selection is almost entirely confined to the juvenile stages of development". But the reasons that he gives for this assertion would appear to involve a failure to distinguish between the effect of mortality on the number of offspring and its effect as a selective agent.

If I understand Dr. Fisher's contention aright it would be true only if the survivors at the later stage of development were an unselected sample of all the heritable variants present in the original progeny and

in the same proportions. Every seedling, for aught we have any right to assume to the contrary, is potentially capable under favourable conditions of attaining maturity and leaving progeny. But if 95 per cent of a species perish in the juvenile state the probability of an heritable variant surviving to leave offspring is only appreciable if the variation be associated with some feature of survival value in the seedling stage or has itself survival value at this phase of development.

Actually, so far as my observations on monocarpic species are concerned, and it was these I chiefly dealt with in my letter, mortality may be confined entirely to the juvenile state, or where death occurred at later stages there was considerable doubt as to its selective character. That the same may be true of polycarpic types is suggested by the extreme rarity or total absence in Nature of individuals of intermediate ages of arboreal species which have died from natural causes, although dead individuals in the seedling and senile phases are sufficiently familiar. In the monocarpic species at least there is the possibility that the question of the relative importance of any selective mortality at different stages of development does not arise, although, as Dr. Fisher rightly emphasises, mortality in the later stages will more profoundly affect the *number* of progeny produced than an equivalent mortality in the earlier.

Prof. MacBride in his interesting letter in NATURE of June 28 justly lays stress on the complexity of the factors involved in the survival of the early stages of development. May I mention one case in illustration of Prof. MacBride's very pertinent remark regarding the causes of survival, that doubtless in every particular case a special investigation would be required. The interesting endemic British plant *Helianthemum Breweri* has, as I have elsewhere pointed out, a peculiar mode of germination ("The Biological Equipment of Species in Relation to Competition", *Jour. Ecology*, 1929). Of the seeds shed by a particular individual at the same time some germinate in the autumn and the remainder in batches in a discontinuous manner of which the last may not germinate until late in the following spring. If the winter be a mild one, the first batch of seedlings will probably survive and by their priority of occupation compete successfully with those seedlings appearing later. If, however, there be a severe winter, all but the final batch may perish. Hence apart from selective mortality between individuals of the same batch the characters which here determine which age class shall be represented in the survivors will vary with the climatic conditions. This is a comparatively simple instance but indicates sufficiently the complexity of the problem of causation in selective survival.

E. J. SALISBURY.

Botanical Department,
University College, London,
July 2.

Transmission of Potato Leaf Roll.

MAY I be permitted to comment on Dr. Whitehead's interesting letter appearing in NATURE of June 28, on the transmission of potato leaf roll by the aphis *Myzus circumflexus* Buckt? We are using this insect in our potato virus transmission experiments at Cambridge and have been doing so for some years. As regards its efficiency as a vector of potato leaf roll, I prefer to say nothing at present, as our experiments are still incomplete. I cannot, however, quite agree with Dr. Whitehead in his recommendation that *M. circumflexus* is a suitable insect for use in studies upon potato viruses, at least in respect to the mosaic group. I have found it a poor transmitter of potato mosaic, and moreover, the saliva contains a toxin—absent apparently in *Myzus persicæ*—which reacts upon several of the Solanaceous plants which we use in virus studies, including the potato. This aphis thus produces, by its feeding alone, a false 'mosaic' which is likely to mislead and confuse the inexperienced worker. Again, as regards the ease of identification of *M. circumflexus*, I would like to point out that the characteristic black markings on the back of the insect are liable to be very misleading. It is no uncommon thing for these markings to be entirely absent and we have had whole colonies of *M. circumflexus* in which the colour was a uniform green or pale yellow. In such cases, the differences to the casual eye between *M. circumflexus* and certain potato feeding aphides are not great.

Dr. Whitehead criticises potato virus workers in regard to their alleged preference for *Myzus persicæ* as the only insect vector of potato leaf roll. He will see in my paper on the insect transmission of potato leaf roll (*Ann. App. Biol.*, **16**, p. 14, No. 2, May 1929) that I state: "That it (*M. persicae*) is the only carrier of leaf roll is probably not the case." The importance attached to *Myzus persicæ*, which Dr. Whitehead deplores, in its relation to potato leaf roll is based on the following reasons:

(1) There is little doubt that it is the most efficient insect vector of potato leaf roll *among potato feeding insects*. (*M. circumflexus* is almost wholly a glass-house aphis.)

(2) *M. persicae* is one of the commonest aphides occurring on the potato, and in addition is an almost omnivorous feeder; it has been recorded from 52 plant hosts—a fact which, incidentally, renders it exceedingly suitable for virus transmission studies.

(3) Besides attacking the haulm of the potato, *M. persicae* is to be commonly found feeding upon the sprouted tuber in the store, and it is probable that much virus dissemination takes place by this insidious mode of attack. Finally, it is my opinion that *M. persicæ* has a definite affinity for the virus of potato leaf roll, but the evidence is still insufficient to allow of the conclusion that an absolute affinity exists such as appears to be the case between the virus of aster "yellows" for example and its insect vector, *Cicadula sexnotata* Fall.

KENNETH M. SMITH.

Potato Virus Research Station,
School of Agriculture,
Cambridge, July 3.

Eyeball Movements in Tests of Visual Acuity.

IN all published accounts, to which I have access in physiological literature, of testing visual acuity by the discrimination of two points as two and not as one, there is no mention made of a factor which must assuredly play an important part. The three qualities usually considered are the angle subtended, the illumination, and the contrast between the points viewed and their background. In all the discussions which I have read it is tacitly assumed that the eyeball is fixed. Now we know that a limb, and the eyeball is physiologically a limb, cannot be kept in a position of rest unless it is at an extreme of movement, as when the knee is fully extended or when gravity alone determines the posture. The best marksman is aware of the tremor of his rifle when it is supported solely by muscular action; indeed physiological theory demands that such tremor must exist. By no possibility can we assume that the eyeball, held in any ordinary position by muscular action, is free from such tremor. The fact that tremor is not obvious does not proclaim

its absence; when it is obvious we speak of it as nystagmus. Microscopic examination of the pupil tells us that the inner iridic margin, to the observing naked eye apparently fixed, is really in a state of tremor of small amplitude. The only recognition of the possibility of this movement of the eyeball which I have found is an article "The Application of the Physiology of Color Vision in Modern Art", by Henry G. Keller and Prof. J. J. R. Macleod in *Popular Science Monthly*, November 1913:

"There can be little doubt that a great part of the peculiar impression produced by pointilism depends upon the slight movements which the eyeballs are constantly undergoing, even during our most intent fixation. This of course produces a certain amount of overlapping of the colors of the retina."

It is obvious that if the eyeball moves during the test fixation, simple geometrical deductions from the subtended angle of the two points cannot immediately be applied to the retinal elements affected.

When double stars are observed we have another disturbing factor, namely, the variable refraction of the air, which gives a further displacement of the images on the retina. W. A. OSBORNE.

The University,
Melbourne.

The Crystal Structure of Hydrogen Iodide and its Relation with that of Xenon.

USING the apparatus already described (see NATURE, Mar. 22, vol. 125, p. 457; *Rend. Acc. Lincei*, vol. 11, p. 679), I was able to obtain good photograms of crystalline hydrogen iodide at about 170° C. An iron anticathode was used. The lines correspond to a face-centred cubic structure with lattice constant a 6·18 A. The cell contains 4 molecules hydrogen iodide; the calculated density is 3·59.

It is remarkable that the lattice constant of hydrogen iodide is practically identical with that of xenon as found by A. G. Nasini and myself (NATURE, Mar. 22). This confirms what we then pointed out, namely, that the ionic radius of I^- is identical or very near to the atomic radius of Xe, which was then calculated to be 2·18 A.

From our present determinations we deduce for I^- the same value, while from the metallic iodides Goldschmidt (Geochem. Verteilungsgesetze d. Elem., *Norsk. Vid. Ak.*, **7**; 1926) found 2·20 A. in very good agreement with ours. The dimensions of the HI-lattice seem to be determined by the I-ions only, since the empty spaces amply suffice for the location of the hydrogen ions, the radius of which is surely less than 0·6 A. (Natta: *Giorn. Chim. Ind. e Appl.*, **12**, 36; 1930; *Gazz. Chim. It.*, **58**, 356; 1928).

There appears to be a possibility of obtaining solid solutions between xenon and hydrogen iodide, which would be a first instance of a mixed lattice in which neutral atoms alternate with ions. G. NATTA.

Laboratory of General Chemistry,
Royal Polytechnic, Milan, Italy,
June 8.

Soldering Tungsten.

IT does not appear to be generally known that it is not difficult to solder metals to tungsten: Angerer states that Neusilber (German silver) can be used, but with this exception the general opinion seems to be that welding is the only practical method. In fact, there are a number of metals that will run on tungsten, of which gold, palladium, zinc, and (I believe) nickel are the most important.

Pure zinc is useless, since it crystallises afterwards and may be broken off again; any brass, however, that contains a fairly large percentage of zinc seems to be satisfactory. 'Tobin bronze', a common brazing alloy, is an example. German silver also sticks in virtue of the zinc it contains; it shares with brasses the disadvantages that if it be heated too long the zinc evaporates and renders it useless, and also that of course no joins so made can be baked out in vacuum work.

Gold seems to stick firmly, but does not run very easily as a rule, especially if the borax has once burnt off (borax is a suitable flux for all the metals tried). Palladium runs somewhat better, but it is difficult to get the work hot enough in a flame; it may be applied with an arc (35 volts are enough for small jobs), and neither flux nor reducing atmosphere is essential. Perhaps the most satisfactory method for general use is to apply some gold, using an oxy-coal-gas flame and borax, and then to wrap a little fine palladium wire round the gold, apply fresh borax, and reheat until the palladium has been melted into the gold; as a rule the alloy will then also have run over the whole join. The melting-point may be altered by this means, and the vapour pressure is in all cases very small; work can be glowed out at quite high temperatures.

A patent has been applied for to cover the use of palladium, but in any case this will not affect private work in laboratories. R. D'E. ATKINSON.

Rutgers University,
New Jersey,
June 9.

The First Spark Spectrum of Antimony.

WHILE investigating the relationship of the (sp) transition of the successive elements from indium to cæsium in their normal as well as ionised states, it was found that the data were insufficient. It was therefore proposed to investigate the necessary arc and spark spectra of the elements. The first uninvestigated element is antimony in the first state of ionisation. With the help of a one-metre concave grating set according to the Paschen-Runge mounting, I have photographed the entire spectrum from λ8500 to λ3000. The spectrum is analysed and identified as arising from the transitions ($P_1 \leftarrow P_2$), ($P_2 \leftarrow P_3$), and ($P_2 \leftarrow Q_1$). The lines $^3(P_2D_3)$, $^3(P_2P_2)$, $^3(P_2S_1)$ of the ($P_1 \leftarrow P_2$) transition are 12863, 16714, 19310 respectively. The difference $^3P_1 - {}^3P_2$ is 0·4814.

D. G. DHAVALE.

Department of Physics,
University of Allahabad,
Allahabad, India,
May 15.

Gas Discharge Wave-length List in the Extreme Ultra-Violet.

WE have prepared a list, arranged in order of wave-length, of the published lines in the extreme ultra-violet (λ2500 to λ100) arising from discharges in gases. The elements included are hydrogen, helium, carbon, nitrogen, oxygen, neon, sodium, silicon, argon, and mercury. Thanks to support from the Carnegie Institution of Washington, it has been possible to publish a limited mimeographed edition of the list, copies of which have been sent to a few spectroscopists to whom we thought it might be of particular use. We should be glad to give copies to any others who may write requesting them. JANET M. MACINNES. JOSEPH C. BOYCE.

Palmer Physical Laboratory,
Princeton University,
Princeton, New Jersey,
June 25.

The Equi-Signal Zone Radio Beacon and Air Navigation.

By Dr. R. L. Smith-Rose.

THE application of directional wireless methods to assist aerial and marine navigation has been progressing steadily during the past few years. After passing a period of uncertainty as to its accuracy and reliability, the wireless direction-finder has established itself as a very useful aid to marine navigation. Many hundred ships of all nationalities are now fitted with direction-finders, and a large number of fixed beacon transmitting stations are now in operation in various parts of the world for the specific use of such direction-finding installations.

As an alternative means of obtaining wireless bearings, the rotating loop beacon developed in Great Britain by the Royal Air Force is now undergoing a full scale trial with the installation erected last year at Orfordness, Suffolk. The advantage possessed by this method of operation is that the whole of the directional part of the system is at the transmitting station on shore, and any ship fitted with a radio receiver can take bearings with the aid of a suitable watch or chronometer. From reports already received from various ships which have taken bearing observations upon the Orfordness rotating beacon, it appears that this method of obtaining bearings is likely to prove at least a very useful auxiliary to the wireless aids to marine navigation. A survey of the progress made of recent research on both the above methods of directional wireless and their application to marine navigation was given in a lecture before the Royal Institution, an abstract of which appears in NATURE for April 5 and 12.

In the search for a suitable means of applying directional wireless methods to aeroplanes, two points become of vital importance. The first is that any additional apparatus in the machine, such as a direction-finding installation, is objectionable from the point of view of the otherwise unnecessary weight which it entails. Secondly, the normal travelling speed of aircraft is so high that it is necessary that bearings should be obtainable as rapidly as possible. This factor seriously limits the utility of the rotating beacon method, since bearings on the system are only obtainable at half-minute intervals, during which the position of the machine may have changed by distances of the order of one mile. It is further desirable that the whole of the receiving and recording apparatus in the aeroplane should be as automatic as possible, in order to avoid the infliction of unnecessary duties upon the pilot or wireless operator.

To meet these objections of the ordinary methods of direction-finding, considerable attention has been devoted in the United States during the past six years to the development of a method of course-indicating by wireless, which was patented by O. Scheller in Germany in 1907. Scheller's patent covered essentially the use of a transmitting station which was provided with two equal directive aerial systems pointing in different directions. The transmitter was arranged to send alternately on each aerial two letters with complementary Morse characters, such as *A* (dot dash) on one aerial and *N* (dash dot) on the other. At a receiver situated anywhere on either of the bisectors of the angle between the aerials the two letters would be received at equal intensity and would form a continuous dash. If the receiver is moved to one side or the other of this direction, one letter would predominate and would indicate to the observer to which side the receiver was displaced. In this way the four directions of equal signal strength are well defined, and a ship or aeroplane keeping the two received signals of equal intensity would pursue a straight line course directed to or away from the transmitting station. During the War, attempts were made by E. Buchwald [1] to apply this method to assist the navigation of aeroplanes towards the transmitting station, which for the purpose was constructed with two inverted *L* aerials at an angle of 60° to each other. Some erratic results were obtained at first, due to the effect of the orientation and inclination to the horizon of the trailing wire antenna employed on the aeroplane. It was also found that the finite conductivity of the earth influenced the reliability of the results obtained.

In a later communication, F. Kiebitz [2] described further experiments made in the navigation of ships with this system of transmission. Difficulties were experienced due to a variation in the conductivity of the earth in the proximity of the transmitter, but it was ultimately found possible to obtain a sharply defined course along which the ship was navigated.

The system does not appear to have received further attention in Germany, but in 1924 a paper was published by F. H. Engel and F. W. Dunmore [3] which showed that attention was being devoted to this method of directional wireless by the U.S. Bureau of Standards. Since that date, and particularly during the past two years, considerable research and development of the application of this beacon system in the United States has taken place. The work has been largely carried out at or with the assistance of the Bureau of Standards for the Aeronautics Branch of the Department of Commerce. The technical results of the work have been described in a series of papers published in the *Proceedings* of the Institute of Radio Engineers and the Bureau of Standards *Journal of Research*, and the success of the system is evidenced by the recent proposal to establish a chain of some fifty directive beacons along the chief air routes of the United States.

The American type of radio beacon applies what is essentially Scheller's principle of directive transmission to two coil antennæ crossed at an angle of 135° to each other, the signals being transmitted alternately from each coil. The early type of beacon was supplied from a quenched spark transmitter, and distinctive Morse signals, such as *A* and *N*, were sent from each of the two coils

respectively. In the zone of equi-signals, these two Morse characters would merge or 'interlock' into a steady dash, which thus served as an aural signal to mark out the course defined by the beacon. The polar radiation diagram of each transmitting coil is of the familiar figure-of-eight form, and with two such coils crossed at right angles to each other it is evident that along the four lines bisecting the angles between the coil the equi-signal zones will be of equal strength. By changing the angle between the coils to 135° as stated above, two of the equi-signal zones provide stronger but less well defined signals than the other two. The quality of the equi-signal zone is usually specified by the width at a certain distance in which no inequality of the two sets of signals can be detected. The angular width of this zone for the experimental beacons already developed on the lines indicated below is of the order of 1° to 4°.

In a paper published in 1928 by Messrs. Dellinger and Pratt [4] the continued development of this type of beacon towards its present state is described in some detail. The first modification introduced was to employ two large fixed loops at right angles in place of the rotatable frame coils previously used, and to supply these coils with the necessary oscillatory current through a special type of goniometer. This goniometer comprised two primary coils fixed at right angles to each other and supplied with the necessary signal currents from the transmitter, and two secondary coils also fixed at right angles to each other, one coil being connected to each of the loop antennæ. Each of the two primary coils was supplied by one of the two sets of characteristic signals from the final 'push-pull' stage of the transmitter. The field created inside the goniometer by these primary coils was thus similar in form to the field radiated in space by the previous arrangement of frame coils. The secondary coils served to link up the fixed loop antennæ with this goniometer field and to reproduce it as a space radiation field. The advantage of this arrangement is that, by rotating the pair of primary coils relative to the pair of secondary coils inside the goniometer, the same effect is produced as that formerly obtained by rotating the frame coil antennæ. The whole installation thus enabled the equi-signal zones to be rotated in space by a setting of the goniometer.

The next important development in the course of the work concerned the elimination of the necessity for receiving an audible signal from the beacon. This has been accomplished by supplying each of the two phantom loop antennæ with current of the same carrier frequency but with a different modulation frequency. The modulation frequencies employed have been chosen at 65 and 87 cycles per second. This enables a mechanical vibrating reed to be used as a signal detector in place of the telephones, and by supplying two reeds adjusted to resonate at the two modulation frequencies mentioned above, a simple indicating instrument is provided by means of which the equality of the two signals radiated by the beacon is determined. Along any one of the four equi-signal zones radiated into space from the transmitter the intensity of the received modulation signal is the same on the two frequencies; both reeds of the indicator will therefore vibrate with the same amplitude. Immediately the receiver is displaced to one side or other of this course, the amplitude of one of the vibrating reeds becomes larger than the other. With the receiver and indicator mounted in an aeroplane, it is a simple matter to mark the indicating instrument in accordance with the direction to which the pilot must turn in order to get back on to the course marked out by the equi-signal zone.

By the employment of a third modulation frequency of about 108 cycles per second and a three section goniometer, it is possible to emit a space radiation field which has twelve directions of equal signals on one pair of modulation frequencies. If then the receiver is supplied with three pairs of vibrating reed indicators, it is possible to select each of these twelve courses in turn.

In the above discussion, it has been assumed that the electrical characteristics of each series of circuits in the goniometer and antenna loops are equal and that, therefore, the currents obtained at the various modulation frequencies are the same. If the currents in the antenna loops are made unequal, it becomes possible to alter the angle between adjacent zones of equal signal strength. A somewhat similar effect can be obtained by combining an open vertical antenna with the radiating loops in order to superpose a uniformly disturbed field upon the figure-of-eight polar fields generated by the loops. The possibilities of such combinations in providing means of varying the courses marked out by a beacon are described in a paper by Messrs. Dellinger and Diamond,[5] while a more detailed theoretical discussion of the methods of alining several courses from a beacon on this principle is given in later publications. This paper also contains an account of a method by which small amounts of shift in the course can be obtained by the adjustment of a suitable resistance in shunt to one of the vibrating reeds in the indicator installed in the aeroplane.

The practical application of the methods of alining four course beacons of the aural signalling type is described in a recent paper by F. G. Kear and W. G. Jackson.[6] These methods have been used in the alinement of three radio beacons to cover the air route from Cleveland, Ohio, to New York, a distance of about 400 miles. It appears from this paper, which was published in December 1929, that only the aural type of four-course radio beacon, or 'radio range' as it is termed in the paper, has so far been put into routine daily operation, although the visual type is nearing the end of its experimental development.

Concerning the operation of the type of radio beacon under discussion, reference may be made to an interesting paper published in 1928 by C. C. Shangraw [7] which describes the application of the visual type of two-course beacon by the United States Army Signal Corps, to a long distance flight of more than 2000 miles from San Francisco to Honolulu. A successful flight was made in August 1927 during which the operation of the special

beacons erected near the terminal points was found to be of great service. Over the central part of the course signals from both beacons could be heard, and it was estimated that at the distance of 1200 miles from Honolulu the width of the equi-signal zone was about eight miles, which indicates that the zone employed was unusually sharp (about 0·4°).

Some experiments carried out at an altitude of 2000 feet and described by H. Pratt indicate that at night the radio beacon system may be subject to erratic shift of the beacon course when the distance of transmission exceeds some fifty miles. In general, the changes in direction observed were less than 25°, but they were considered sufficiently serious to make the further study of this phase of the subject an urgent necessity. Apparently the errors are much reduced in magnitude by the use of a vertical antenna in the aeroplane, but this does not effect a complete cure and there will possibly be a limited range, of the order of about a hundred miles, over which this type of beacon may be considered to give results of the highest accuracy.

According to a recent publication,[8] the Airways Division of the U.S. Department of Commerce proposes to build fifty directive radio beacons of the aural signalling type in addition to the nine such stations already in operation. These beacons will all operate on a wave-length band 950-1050 metres (285-315 kilocycles per second) allotted by international agreement to beacon stations, and will be located along the main air routes at distances apart not exceeding 200 miles. In addition, these routes will be equipped with the low power non-directional 'marker' beacons which will give an aural signal to the pilot for a period of one or two minutes as he is flying overhead. These 'marker' beacons serve to inform the pilot as to his exact position along the course, and also to give him any local weather reports or other information of importance to the navigation of aircraft along the route in question.

Simultaneously with the development of these beacons special receiving equipment has been developed for use on the aeroplane. These receivers are designed to be sufficiently sensitive to work from the 6 ft. vertical aerial standardised for the aeroplane, and to give sufficient output for use with either the aural or visual methods of indication. Attention has been devoted to reducing the weight of the whole receiving equipment to the absolute minimum. It is likely that in the near future all mail and passenger carrying aeroplanes in the United States of America will be equipped with such receivers in order to make use of the extensive scheme of beacons now being erected for the specific purpose of assisting the navigation of aircraft.

[1] E. Buchwald: "Scheller's Wireless Route Indicator Applied to Aeroplanes". *Jahrbuch. d. drahtl. Tel.*, vol 15, pp. 114-122; 1920.
[2] F. Kiebitz: "New Experiments with Scheller's Directional Transmitter". *Ibid.* pp. 299-310.
[3] F. H. Engel and F. W. Dunmore: "A Directive Type of Radio Beacon and its Application to Navigation". *Scientific Papers*, Bureau of Standards, vol. 19, pp. 281-295; 1924.
[4] J. H. Dellinger and H. Pratt: "Development of Radio Aids to Air Navigation". *Proc. Inst. Radio Eng.*, vol. 16, pp. 890-920; 1928
[5] J. H. Dellinger and H. Diamond: "Radio Developments Applied to Aircraft". *Aeronautical Eng.*, pp. 57-66; 1929.
[6] F. G. Kear and W. G. Jackson: "Applying the Radio Range to the Airways". *Proc. Inst. Radio Eng.*, vol. 17, pp. 2268-2282; 1929
[7] C. C. Shangraw: "Radio Beacons for Transpacific Flights". *Proc. Inst. Radio Eng.*, vol. 16, pp. 1203-1235; 1928.
[8] *Radio News*, April 1930, p. 906.

The Second World Power Conference at Berlin.

THE Second Plenary World Power Conference which was held at Berlin on June 16–26 was probably one of the most ambitious and one of the most elaborately staged international meetings of recent years, and it is difficult on that account to follow with accuracy the main lines of development which were traced throughout the discussions. In the first place, the weight of documentary material was very large. Prior to the opening of the Conference, about 390 papers submitted by 37 or 38 countries had actually been printed and were available for examination; but during the Conference itself a number of additional papers appeared, mostly from Germany and Austria, with the result that the official collection will probably be rather more than 430. In addition to that, the principal scientific and technical associations in Germany and Austria, and, to some extent also, Russia, had prepared special monographs surveying the position in their respective territories. These monographs did not form an intrinsic part of the Conference, but they should be considered as an additional contribution to the information collected.

The delegates and members assembled at the various sessions totalled about 3900, while the papers were divided into 34 main sections corresponding roughly to the main aspects of national and international power development. During each full day six of these sections came up for examination at six meetings and the average number of speakers lay between 20 and 25, with, in certain cases, more than 30 taking part in the discussions. In all, therefore, during the period of the Conference, more than 1000 actual contributions were made to the work of assessing and judging the material submitted. These statistics are necessary to a comprehension of what might have been and what was actually achieved. In no case did discussion elicit any new information of value or record experiences which were not already described in the papers themselves, and, if one were able to bring the discussions into line with the actual documents, one would find considerable duplication and little real originality.

The importance of the Conference lay, therefore, not so much in any survey of the international power situation it attempted, as in the work of direct personal co-operation which took place unofficially before and after the Conference meetings. It also served to illustrate the reality of the industrial recovery which has taken place in Germany since 1924, since one important feature was the very extensive series of visits to German industrial works which was staged during and after the Conference. It is unnecessary to touch on this

side of its activities since the process of rationalisation and re-equipment of industry in Germany has been followed with great care by economists and by technical experts in Great Britain, and has already been fully recorded.

The Berlin Conference afforded an opportunity for discussion of the achievements of engineers from the principal industrial countries, and some decisions of value regarding British industry may well emerge from it.

The organisers of the Conference worked on a definite plan. They appreciated quite clearly the need for some degree of guidance throughout the complicated mass of material and arranged accordingly. Thus, the original papers were summarised in general reports extending to about 3000 words each. These reports numbered 34, were prepared each by a German engineer or industrialist, and they indicated what were the broad lines of progress and what were the most urgent questions still to be examined. In addition to this work of simplification, the main points of policy and of international progress were covered in a series of seven addresses arranged by the principal countries participating. Thus in the purely scientific sphere must be placed the addresses of Prof. Albert Einstein and Sir A. S. Eddington; in the purely administrative and economic those of Dr. Serruys on rationalisation and its latest forms, and Dr. Oskar Oliven on the Central European main transmission zone; in research considered generally the speech delivered by Mr. H. Foster Bain on the place of minerals in a power sustained world, and perhaps that of Dr. Vallauri on technical and general conditions governing the use of electricity. A seventh address which was due to be delivered by Mr. D. N. Dunlop, chairman of the International Executive Council, on the function performed by power in the evolution of the world, was not delivered owing to the sickness of its author; and in many ways it is a pity that this address could not be given, since, so far as one can understand from the summary given in advance, it did constitute a broad survey which might have served to have placed the details furnished by the original documents and by the discussions into an ordered design capable of immediate appreciation.

The weakness of this whole arrangement was undoubtedly to be found in the quantity of the original papers submitted, in the lack of uniformity shown by the reporters responsible for summarising those papers in the main sections, and for the lack of synthesis in the general addresses themselves. This observation does not apply to the contributions by Prof. Einstein and Sir A. S. Eddington, but it certainly applies to the remaining four speeches, and, through this circumstance, they had practically no value as a guide to deliberations during the Conference. The result was that the International Executive Committee passed no resolutions referring to the work of the Conference, even when arrangements are being made for a Third Plenary Conference to be held in America in 1936 and there may be a Sectional Conference at Stockholm in 1933—this latter still undecided. One was really unable to select from a mass of conflicting resolutions submitted by various countries any single resolution which would embody one contribution by the Second World Power Conference to the progress of power production and utilisation. That in itself is very significant and illustrates the inconclusive nature of the discussions which took place.

It was clear even at Berlin that technical progress in itself is now of less immediate importance than it was, and one felt a vague impression that something should really be done to bring discussions more closely into line with investigation of the real difficulties confronting electrical development and the growth of public utilities. One expert was courageous enough to state that in his opinion we had now reached a definite turning-point in this whole matter of power expansion. We had advanced so rapidly during the last few years that we had not yet taken the measure of that advance, and, through our inability to take that measure, we were in danger of embarking on unnecessary and costly experiment and of introducing a regime of economic as apart from technical inefficiency.

This observation can be confirmed, I think, by examination of the papers and to some extent also of the discussions: and the necessity for a real economic assessment of what has been achieved emerged more and more clearly as the Conference went on. One example of what I mean may be given. One German paper described the possibility of transmitting electrical energy at 380,000 volts pressure from Scandinavia to Germany. A general address given by Dr. Oliven outlined proposals for a European main-transmission system operating at 400,000 volts. At the present moment those proposals are quite fantastic; and they are fantastic not because they cannot be translated into practice technically, but because economic and political considerations are such as to rule them out. Even technically, we have no experience yet of operating conditions on a 380,000 volt circuit. It is in the regime of economics that the greatest obstacles are to be found. The transmission of electrical energy from Scandinavia to Germany would only justify itself if German resources proved themselves inadequate to the power consumption demand of the country, or if the exploitation of such resources were so expensive that it would pay to import electrical energy. It is obvious, however, that Germany would rather import energy from Switzerland, Austria, and even Italy through Switzerland, where it can tap existing power stations and fairly easily accessible existing power resources, than embark on a costly experiment across the Baltic.

The fundamental economic problems are to be found in the effective co-ordination of electrical power production and the control of the new main transmission systems evolved with the view of ensuring the maximum reliability of service and the maximum reduction in costs. Undoubtedly many technical experiments are being carried out. There was an impressive number of papers describing

power storage schemes built in Saxony and in the Ruhr, and in a number of European countries. Again, in the city of Berlin itself and in Hamburg, Diesel plants have been built of very large capacities to meet wide fluctuations in demand, in addition to existing steam power plant; while in Berlin again a steam accumulator battery at Charlottenburg has been attached to the peak-load station. In the Ruhr again, the gas pool created by the big iron and steel and coke oven plants has been in operation for some time. The technical problem appears, therefore, to be approaching solution; it is the administrative and economic which escapes definition.

There are indications also of a definite reaction against the theory of the big unit. There was less discussion in Berlin of giant power stations and giant power units than of the development of an economic load for such stations and such units. The development of such a load enters, at once, into the economic sphere and is inseparable from the consideration and assessment of the general economic activity ruling in the areas of supply. This brings the supply undertaking at once into touch with national economic problems and national economic prosperity.

The Berlin Conference was remarkably weak both in research and pure science contributions and in economic studies. It had a number of papers from the United States dealing with certain phases of power economics, especially in the elaboration of a sound price policy and in the definition of the various types of load, industrial or otherwise. But to give only one indication of what had become really urgent: the Conference failed to touch, even indirectly, on the following:

Whether it is more economic to close down fairly efficient medium-sized generating stations, aged ten years or more, none of which are being operated on a base load within an interconnected system, and build new stations with Diesel engines, or similar plant capable of interrupted operation without serious loss of efficiency?

The question here bears on depreciation factors, on the relation between the capitalised value of efficiency and the capital loss incurred by the closing down of such power stations and on the distribution of costs within the interconnected network itself. This is not a matter for mere calculation, it is really a matter for a genuine survey of the industrial and other potentialities of the area of supply. It is in the last degree the first movement towards a genuine economic assessment. The Conference made no effort to examine the problems in research advanced by C. F. Hirschfield in his paper "Research relating to Power Development" and avoided discussion of broad questions of industrial efficiency, rationalisation, and competitive efficiency based on power.

One outstanding requirement was really the co-ordination of essential information; while, at Berlin, statistical surveys of power resources were not given in any great number, owing to the general impression that preceding conferences had covered this side fairly adequately, yet there was almost a complete lack of statistics bearing on the utilisation of electricity, on the various types of power consumption, and on national productive capacity, measured with reference to power. One or two papers touched on this question tentatively; but this field is almost wholly virgin and requires to be cultivated before the next important forward movement can take place.

We are coming to the end of what might be regarded as a technical cycle and entering on the economic cycle. But, whereas in the case of the technical cycle, some background had actually been established merely through the process of evolution, no such background is available in the economic sphere. It may be objected that the general economic principles governing power production and consumption have not yet been formulated, and until they are formulated effective discussion of economic data is really impossible, but in the technical sphere the broad principles along which development is now taking place were not formulated in the first place. They were defined by purely empirical means and resulted from material experience. It was merely a case of trial and error.

The World Power Conference should find in the economic cycle its most valuable and most effective source of activity, and it should concentrate on this to the exclusion of almost everything else. It should examine all the possibilities of assessment on an economic basis; examine all the factors which govern the economic expansion of power production and consumption and link it up with general international industrial activity. It should aim at the standardisation of statistical forms and arrange for the exchange of essential data, drawn up in such a way that international comparisons can be carried out without difficulty.

HUGH QUIGLEY.

The Bristol Meeting of the British Association.

LOCAL ARRANGEMENTS.

AN interval of thirty-two years has passed since the British Association last met in Bristol. The 1930 meeting on Sept 3–10 under the presidency of Prof. F. O. Bower will be held in that city under conditions differing in many respects from those of the year 1898. In 1898 there was no University of Bristol and the Sections were housed in a scattered variety of buildings adapted for the purpose. Since that time, however, through the munificence of the Wills family, the University can provide within its walls accommodation for the reception room and general offices as well as for practically all the Sections. Moreover, the main buildings as architectural features form a landmark in the history of provincial universities.

A large attendance of members is anticipated, and amongst the foreign guests who have accepted invitations are the following in order of the Sections: *A*, Profs. Heisenberg, Siegbahn, F. Bloch, Van Vleck, Mulliken, Bureau; *B*, Prof. J. M. Hildebrand; *C*, Prof. Delepine; *D*, Prof. Van de Lange; *E*, Prof. A. E. Douglas; *F*, Prof. A. Plant; *G*, Prof. A. E. Kennelly, Herr Direktor W. E. Doerr; *K*, Profs. T. H. Goodspeed, F. A. F. Went, D. H. Campbell, W. J. V. Osterhout.

Two evening receptions will be given, one by the Lord Mayor in the Museum and Art Gallery on Sept. 4, and one by the Council of Clifton College on Sept. 8. In addition, garden parties will be offered by the University in the grounds of Wills Hall, by the Zoological Society of Bristol in the Clifton Zoo, and by the Hon. Mrs. Smyth at Ashton Court. Numerous visits to works, including the Avonmouth Docks, Messrs. Wills' tobacco factory, and Messrs. Fry's chocolate works, have been arranged.

The evening discourses are two in number. The first, on Sept. 6, is by Prof. E. V. Appleton on wireless echoes, and the second, by Dr. R. E. Slade, on the nitrogen industry and our food supply. In addition, public lectures have been arranged in Bristol and the surrounding district, including addresses by Sir Daniel Hall, Sir Josiah Stamp, and Sir Richard Gregory. A memorial lecture to a famous Bristol anthropologist, Dr. Beddoe, will also be given by Sir Arthur Keith.

The Bristol district is rich in features of historic, archæological, and scientific interest. In fact, owing to the wide choice of material considerable difficulty has been experienced in arranging excursions which do not omit points of special importance; but it is believed that all tastes have been catered for.

One interesting feature of the week will be a series of short tours during the day of historic Bristol and of the Avon Gorge and its vicinity. Also the list of sectional excursions is unusually large.

Like many large cities of to-day, Bristol is not blessed with a surplus of hotel accommodation, but the ancient city of Bath and also Weston-super-Mare are in easy distance of Bristol by car or train, and have special features which may appeal to many for the week of the meeting.

Obituary.

MR. VICTOR BRANFORD.

VICTOR BRANFORD, whose death on June 22 is widely regretted, was of an old East Anglian family; and his ancestry included descent from a sister of Sir Isaac Newton. In hard times his father had to part with his property, and he applied himself ably to a veterinary career, first as professor in Edinburgh, and then as consulting expert to the Army at the Cape. Victor and two of his brothers were so distinguished in mathematics at the University of Edinburgh as to be advised by Prof. Chrystal to take up that career; but he next took to chemistry and then to zoology and botany, and was for several years a successful coach. He also took active interest in the surveys of Edinburgh and Scotland then beginning at the Outlook Tower as a school and laboratory of social studies, and mainly prepared its comprehensive and comparative chart of general history.

Thus embarked on social study and exposition, Branford wrote for various magazines and reviews; and for a time he acted as editor of the *Dundee Advertiser*. He next camped for a season in the Highlands, spent some time on biology and social science at the University of Montpellier, and made observant visits to Switzerland and Italy, and later to South and North America, thence acquiring that combination of geographic observation with historic, economic, and social interpretation which characterised at once his practical life and his scientific career. Thus, turning to social finance, first as accountant and then as bankers' agent in the city, he early realised the important position and future of Paraguay, and became active towards its development, as a director and chairman of its railway, etc. From 1904 his ever-widening social knowledge and insight made him the active leader among the founders of the Sociological Society, and also its indefatigable secretary, first as editor of its 'Papers', and then of its *Sociological Review*, from its outset until the present number: and writing many of its most important contributions.

Branford's lectures in American universities were published as "Interpretations and Forecasts"; and his "Papers for the Present" led to "The Making of the Future" Series, with "The Coming Polity" and other volumes: which were next followed by "Living Religions" and by his comprehensive masterpiece of social synthesis and prevision, in glowing exposition—"Science and Sanctity". With Mrs. Branford (*née* Gurney), he established Leplay House as a home for the Sociological Society, and as part of the 'Sociological Trust', to which the residues of their socially expended fortunes have been essentially devoted, after provision for their two adopted sons. Here, then, is one of those still too rare careers—broadly akin to those of his old friends and the Society's successive presidents—Sir E. Brabrook, Frederic Harrison, Lords Bryce, Avebury, and Balfour, and Sir F. Younghusband—one and all conducting important affairs with many-sided scientific insight and socially philosophic advance, at once widely educative and inspiringly suggestive, since with ideas and purposes, thought and action harmonised in strenuous and generous lives.

Branford's still too rare preparation in mathematics, physical and biological science, through geography and history, and with active participation in current events, thus made his career of that high success which happily follows the sower and planter after his life-work is done; since anticipating that movement from the physical and natural sciences towards the social, which is again in progress.

P. G.

News and Views.

The seventh annual report of the Grand Council of the British Empire Cancer Campaign, which was presented at the annual meeting on July 14, indicates that the organisation continues to give useful support to cancer research in a variety of ways and at a number of centres. About £28,000 has been expended on topics which cover the whole range of the cancer problem, including the treatment of human cancer with radium at one end and fundamental work on tissue growth and plant viruses at the other. No striking new discovery of importance is announced in the summary of the different inquiries given in the report, but everywhere there is gratifying progress of the detailed kind that is useful and interesting to specialists. At the Fulham Cancer Hospital, Drs. Kennaway and Hieger have been tracking down the carcinogenic activity of tar through the fluorescent spectra of active preparations (see Nature, June 21, p. 932), and it looks quite likely that they may succeed in identifying the elusive substance or substances to which tar, shale oil, and the like owe their property of causing malignant tumours of the skin. At Leeds, Dr. Berenblum has continued his study of various skin irritants and has reached the rather remarkable conclusion that concurrent irritation with two different agents may be less effective than either of them by itself. From Sheffield, Prof. Mellanby reports that the greasiness of an animal's skin has a considerable influence on the facility with which repeated applications of tar cause cancer, which is perhaps one of the reasons why cancer of the skin is so much more frequent in the lower than in the higher social grades. On the whole, the theory that cancer is caused by a virus capable of transmission from one individual to another seems to be losing ground. Attention is being concentrated more on (1) the action of external irritating agents and the relation between cancer and occupation; and (2) the efficacy of radium and penetrating X-rays in the treatment of established human cases of the disease.

Prof. Elliot Smith has recently expressed the opinion (*Times*, June 26) that Peking man, furnishing a connecting link between *Pithecanthropus* and the Piltdown skull, "added stability to our conception of the qualities likely to be found in the earliest common ancestor of all three, the as yet undiscovered Pliocene Man". He went on to say that Peking man "afforded new and emphatic testimony of the closeness of the kinship of man and anthropoid apes". Prof. Elliot Smith's views afford an interesting commentary on those put forward by Prof. Fairfield Osborn in his presidential address to the American Association for the advancement of Science in December last (see Nature, Jan. 11, pp. 53-57). Prof. Osborn, accepting the Upper Pliocene date claimed by some for the Piltdown skull, regards it as confirming his prophecy of the discovery of a large-brained tertiary man, and also as supporting his conception of a 'Dawn Man' separating from the anthropoid stock in pre-Miocene times before the specialised adaptation of the Miocene anthropoids to arboreal conditions. In holding these views Prof. Osborn is in opposition to the theory of Darwin and his followers that man has arisen from an anthropoid ape not higher in the scale than a chimpanzee, which, however, he admits is held by "all the leading and most brilliant men of our time". The case against Prof. Osborn's view that the evolution accompanying the change from arboreal to terrestrial conditions on the generally accepted ape-man hypothesis involves an impossible reversion from the highly specialised characters of the miocene anthropoids to the more generalised characters of the human stock is ably stated by Prof. W. K. Gregory in *Human Biology* for May last. He there points out certain considerations against Prof. Osborn's inferences from the change in the relative length of the limbs in man and in the anthropoids, and suggests that he has ignored the essentially gorilla-like underlying character of the human hand and foot notwithstanding differences in form.

In taking *Eoanthropus* as his big "brained" tertiary man, Prof. Osborn cited as evidence of Piltdown man's ability to make use of that brain and of his skill with his hands the flints of tertiary age discovered in East Anglia by Mr. Reid Moir. In a letter we have received from Mr. Lewis Abbott, he suggests that the arguments of Prof. Osborn and other palæontologists might be much reinforced did they make greater use of the collateral evidence afforded by archæology and what is called by some 'lithoclassiology' a term which we cannot regard with complacence. Mr. Abbott rightly dwells upon the importance of the East Anglian evidence in any discussion relating to the antiquity of man, and especially of tertiary man, and enumerates some of the finds which might have gone to strengthen Prof. Osborn's case. He refers to the first "indisputable" find - the stiletto made from the base of a deer's antler found in the Corraline Crag at Allborough, Suffolk, some fifty years ago. A well-made flint implement was found in the Foxhall Crag pit, Ipswich, in 1888. This is the pit which was afterwards the site of Mr. Reid Moir's discoveries. At Thorpe Neswick several worked flints were found while digging out the rib of an elephant, and were accepted by the late H. B. Woodward--a very cautious observer--as of human workmanship. Mr. Abbott also refers to the finds made by Mr. Savin and others in the Cromer Forest Bed. These flints were first brought to light at Runton in 1888 on the same occasion as the finds at the Foxhall pit, during the East Anglian Excursion of the International Congress of Geologists, when the party had been joined by the principal East Anglian geologists. Mr. Savin resumed work on the Cromer Forest Bed in 1895, and an exhibition of his finds was held at Burlington House, arousing much interest. These finds, Mr. Abbott points out, show that evidence

for tertiary man had been obtained from the Forest Bed thirty-one years, and from the Corraline Crag thirty-nine years, before the date claimed by Prof. Osborn.

THE Ministry for Social Welfare in Austria has been carrying out observations with the aid of Prof. Conrad, Prof. Hausmann, and others, on the climatic conditions of sanatoria, in order that these should be placed in the best positions; for example, at mountain altitudes, where the maximal degree of sunshine and snowshine and cool dry air free from much wind are obtainable. Measurements of the ultra-violet radiation and of the cooling power of the air as indicated by the kata-thermometer, have been taken in addition to the usual meteorological measurements. In Britain the most sunshine and driest climate are obtained on the south-east, but sanatoria are scattered all over the country. No doubt the most ideal conditions are afforded by the Alpine climate, but excellent results can be obtained in the various parts of Britain by open air treatment. Shelters can be arranged to mitigate wind and artificial sunlight used to make up for deficiency of light. Even in Salford, rickety, weakly children have been made robust and healthy by being put to live in an open air shelter and playground, well clothed and fed, and given no artificial heat other than that used for drying clothes and warming food. For adults who cannot be disciplined as children, there is advantage in treatment at an isolated Alpine sanatorium. If cases of tuberculosis of the lungs went there in the early stages of the disease and stayed for a couple of years, so as to avoid catarrhal infections which result from coming home, cure would result in almost all. Mischief is caused at the sanatoria in popular Alpine resorts by the winter visitors carrying thither catarrhal infections. Isolation from such infection is a chief requirement while the warm sun and calm, cold, clean air of the mountains works its effect.

THE presidential address of Mr. Edwin Thompson, chairman of the Water Committee of the Liverpool Corporation, at the annual meeting on July 9 of the British Waterworks Association, was an interesting discursive survey of various matters connected with the supply of water to cities and towns generally, with some allusion in particular to certain notable features and incidents, historic and economic, in the genesis and development of the waterworks of the City of Liverpool. In the course of his address, Mr. Thompson touched upon the chemical analysis of water, river pollution, supplies from wells, methods of purification, hardness, water for power purposes, per capita consumption, domestic fittings: in fact, on quite a number of topics of importance to municipal authorities. Among points of interest may be noted his statement that the consumption of water in Liverpool is 36 gallons per head per day, and his confident anticipation "that the time is not far distant when the demand will be much greater than it is to-day and that it will become a very serious consideration". He went on to contrast the low quantitative standard of British supplies with that obtaining in America (200 gallons per head per day) and the defects in Great Britain in regard to fittings for domestic water supply. Liverpool, it appears, was probably one of the first authorities to require no additional payment for water for water-closets and baths, the extra charges for these purposes being done away with in 1860. The cost of providing and maintaining all communicating pipes supplying domestic services in the Liverpool area of distribution is more than £7500 per annum, and for this there is no direct charge. Finally, Mr. Thompson gave it as his opinion that, in spite of national shortcomings in other directions, "when it comes to the question of the purity of public water supplies Great Britain stands pre-eminent".

THE Water Power Resources Committee in its final report issued in 1921 recommended that investigation should be made into the problem of compensation water to riparian interests and appointed a sub-committee to inquire into the problem. The present method was adopted some seventy years ago and based on purely empirical lines. The procedure is to deduct from the average annual rainfall over the catchment area one-fifth or one-sixth in order to arrive at the rainfall that might be relied on during a period of three consecutive dry years. From the remainder 14 inches was deducted to cover losses due to evaporation and absorption. The amount thus reached, called the available yield, was divided between the needs of public water supply and riparian interests in certain proportions, generally two to the former, and one to the latter. The sub-committee (Assessment of Compensation Water, Ministry of Health, 1930) proposes to retain the method of estimating rainfall over three dry years by deducting 20 per cent from the long period average, but to alter the basis of allowance for evaporation and absorption. It is proposed that this loss should be measured for every river by the difference between the rainfall and the run off as ascertained by stream gaugings, which should measure all flows of the stream for a period of seven years. This period should be prior to or during the construction of impounding works. From this a method is suggested for arriving at the assessable flow on which the amount of compensation water should be determined in relation to the use of the stream by riparian interests.

FROM a communication in the *Times* by the curator of Sir John Soane's Museum, the welcome news is forthcoming of the recovery of thirty-two large drawings by Sir Christopher Wren, the details of which refer to Whitehall Palace (1698), Windsor Castle (1705), and Greenwich Hospital (1694–99). The drawings had found a home at All Souls, Oxford, though no record existed respecting their acquisition. The first dispersal of the collection of "Drawings of Architecture of the late Sir Christopher Wren", together with a series of antique marbles, gems, medallions, and other articles, took place in the Great Piazza, Covent Garden, in April 1749. A sale catalogue mentions the recovered drawings; also, a note therein gives the purchaser's name as Dr. Stack, F.R.S. This interested person would appear to be identifiable as Dr. Thomas Stack, who was elected into the Royal Society on

Jan. 26, 1737 [1738 N.S.], signing the charter book on formal admission a little later. At that time Sir Hans Sloane was president of the Society. If one may judge from a paper of his in the *Philosophical Transactions* for 1739, he seems to have been of a credulous turn of mind. Perhaps better opportunity was given in work connected with the writings of the celebrated Dr. Richard Mead (Newton's physician). He translated from the Latin, Mead's "Treatise concerning the influence of the Sun and Moon upon Human Bodies" (1748) and "Medical Precepts and Cautions" (1751). Posterity now connects him, however indirectly, with All Souls, Oxford.

DURING the World Power Conference held in Berlin last month a visit was arranged to the new high-tension testing room of the well-known porcelain factory of Messrs. Ph. Rosenthal and Co., Ltd., in Bavaria. The rapid increase in the high-tension voltages used in practice has made necessary the use of high-tension testing pressures of two million volts. In Germany 220 and 360 kilovolts are at present in use, and for the European grid Dr. Oliven has proposed 400. As the firm manufactures high-tension insulators it was necessary to test with very high pressures so as to increase the knowledge of sparking phenomena. It had the benefit of the experience gained in similar laboratories in other countries. The building is of reinforced concrete; it has no windows and has a flat roof. It was necessary to make the room lightproof, so that photographic studies could be made. Two independent sets are installed, one for alternating current and the other for direct current impulse testing. The firm has succeeded in building a single transformer which produces two million volts. The height of the transformer is 26 feet and the voltage produced is measured by the sparking gap between two hollow copper spheres, each eight feet in diameter and weighing 1600 lb. The direct current impulse plant is the largest in existence. When the condensers are connected in series a voltage of 2,200,000 is produced. The spherical electrodes, five feet in diameter, are arranged so that the spark gap is vertical, and thus floor space is saved. Photographs of the outside and inside of the testing laboratory are given in the *Electrician* for July 4. It is said to be a most impressive sight to see the flash-over on an insulation chain, composed of 14 large insulators, the spark attaining lengths up to 12 feet.

IT is announced by Science Service, of Washington, D.C., that a bill is shortly to be reported out from the House committee on the Library which will allow the President of the United States to decorate men and women who, while in the employ of the Federal Government, have "made outstanding contributions to the advancement of scientific knowledge or the application of its truths in a practical way for the welfare of the human race, and to citizens who, while in the employ of the Federal Government, have rendered conspicuous service to humanity at the voluntary risk of life or health over and above the ordinary risks of duty." There will be two medals. For the scientific worker who has made a specific contribution to the knowledge of the world, there will be the Thomas Jefferson Medal of Honour for Distinguished Work in Science. This medal is named after President Jefferson, who was an early patron of science. The other medal will be known as the Jesse W. Lazear Medal of Honour for Distinguished Self-Sacrifice for Humanity, and will be awarded to those who risk life and health that the cause of science may be advanced. This medal is named after Dr. Lazear, who, as a member of the famous Yellow Fever Commission, allowed an infected mosquito to bite him, giving him a fatal infection with the disease, which has been conquered through the information that this and similar heroic sacrifices have given to medical science. Only three medals in each class will be awarded each year by terms of this bill, and the National Academy of Sciences will pass on names recommended to it by heads of departments and independent offices of the Government. It is conceivable that one person might be awarded both medals, either in one year or in different years. Recipients of these medals would, in addition, receive 1000 dollars each. The bill will probably pass at the next session of the 71st Congress, beginning in December.

MESSRS. Adam Hilger, Ltd., have just published a new edition of their general catalogue, containing particulars of apparatus in sections D to X of their complete list and a statement of the contents of supplementary catalogues of more specialised manufactures. It includes a considerable number of items, marked as now appearing for the first time, of which a few may be specially noticed. In Section E (spectrographs) there is a description of a 1-metre vacuum grating spectrograph following the lines laid down by Sawyer (*J.O.S.A.*, 15, p. 303: 1927) and also embodying features not appearing in his design, such as an efficient means of raising or lowering the plate-holder and of withdrawing and replacing the shutter of the plate-holder *in vacuo* so that the instrument may be used in a well-lighted room. The slit system is arranged so that gas discharge spectra may be photographed without using a window. In the same section an X-ray crystallograph is described, designed for chemists, metallurgists, geologists, and others who desire the analysis of crystalline structure in comparatively short periods of time and with the smallest amount of unfamiliar technique. Section F (accessories for spectrometers and spectrographs) includes a new apparatus for sparking solutions in which the liquid drops steadily from an upper tube into the spark gap. It would have been of advantage if it had been stated whether the window supplied was of glass or quartz. Arrangements for carrying out de Gramont's method of sparking materials, including powders, are also provided, and a special powder has been prepared containing fifty elements in such proportions as to show only about seven spectrum lines, including the *raies ultimes*, of each element. This should greatly facilitate spectrum analysis. A star-plate measuring machine, accommodating plates up to seven inches square, is described and illustrated in

Section L (micrometers, etc.), and Section M (polarimeters and refractometers) contains particulars of an ultra-violet étalon refractometer requiring only a thin film of liquid. The catalogue as a whole shows a very adequate provision for all types of spectroscopic and allied investigations.

IN his seventeenth annual report to the board of trustees of Mellon Institute of Industrial Research of the University of Pittsburgh, Dr. E. R. Weidlein has summarised the activities of the institution during the fiscal year ended Feb. 28 last. The sum of £186,000 was contributed by industrial fellowship donors in support of research - an increase of £26,000 over the preceding year. The total amount of money appropriated to the Institute by companies and associations for the nineteen years ended Feb. 28, 1930, was 6,749,273 dollars. Throughout the year 71 industrial fellowships, requiring the services of 209 full-time research men, were in operation. Sixty-one industrial fellowships - 21 multiple fellowships and 40 individual fellowships - were active at the beginning of the new fiscal year. Eight are being sustained by industrial associations. The industrial research personnel consists of 21 senior industrial fellows, 88 industrial fellows, 34 full-time fellowship assistants, and a number of part-time assistants. Especially notable results have been forthcoming from the following investigations: air pollution, bricklaying, carbonated beverages, cooking utensils, food varieties, heat insulation, iodine, laundering, organic synthesis, petroleum production, and vitrified sewer pipe. Ten fellowships completed their research programmes: beds, cast iron (two fellowships), chrome plating of aluminium, gum, hats, industrial alcohol, licorice, stearic acid, and surgical supplies. Nine fellowships became active during the fiscal year: can, fatty acid uses, garment, hemp paper, nicotine, oxygen, rosin oil, steel treatment, and wood by-products. Five new fellowships have been accepted and their operation will be begun during the early part of the new fiscal year. The Institute's department of research in pure chemistry has continued its work on acidic carbohydrates occurring in plants and on other problems in the province of sugar chemistry. Of the 61 fellowships now active, 15 have completed more than ten years of work.

IN pursuance of its policy of founding meteorological and geophysical observatories in high latitudes, the Soviet Government last year sent an expedition in the icebreaker *Sedov* to found an observatory in Franz Josef Land. After some trouble with pack-ice Cape Flora was reached and eventually Hooker Island, where a site was chosen on the west coast in lat. 80° 19′ N., long. 52° 48′ E. Prof. R. Samoilowitch gives an account of the work of the *Sedov* in *Petermanns Mitteilungen*, Hefte 5-6, 1930, with a track chart and a map of Hooker Island. The *Sedov* pushed north to the Victoria Sea and visited Rudolf Island before returning to Archangel. This station is the most northerly observatory functioning.

FROM the Annual Report of the National Museum of Wales it is easy to discover the secret of the recent progress of that institution. Here is a national museum in more than name, for its governing body embraces the widest interests and the nation unites behind it with a will. During the year the Building Fund received from private donors £10,487, and £57,000 has been accumulated towards the erection of much-needed new galleries and a lecture room. The total aimed at is £150,000, and of this the Government has promised £50,000; pending the raising of this large sum, the Government has permitted a proportional expenditure of grants, and the building of gallery and reserve accommodation in an east wing is being proceeded with. In the Museum itself the gradual purchase of new exhibition cases is making itself noticed, both in permitting the addition of new objects of interest and in improving the general appearance of the exhibits by allowing the elimination of old ill-assorted cases.

THE city of Vancouver, British Columbia, has reason to thank its Art, Historical, and Scientific Association for the efforts made to increase public interest in the Museum and Art Gallery. The publication of the quarterly *Museum and Art Notes* should be good propaganda, for the journal contains a proper blend of articles of general interest and of more definite scientific value. The results are apparent enough in the response of the public. The Curator's report for 1929 (contained in the December *Notes*) shows an attendance of 86,228, an increase of almost 10,000 in two years, and the acting president's address states that although every section, art, natural history, mineralogy, Indian, etc., has attracted its following of students, residents, and tourists, the outstanding feature has been the greatly increased use of the Museum by school children, both individually and in classes conducted by the teacher and, where requested, by the curator. But there is a fly in the ointment: valuable collections have been lost to the museum because of lack of space and funds to exhibit them suitably, and material which has been given by generous donors is crowded out of the galleries. More accommodation is required, and the city authorities would do well to consider with sympathy this clamant need of one aspect of the educational progress of the citizens.

THE annual special issue of *The Chemist and Druggist* published on June 28 contains among other historical articles the fourth instalment of Dr. Charles Singer's "Sketches in the History of English Medicine", which deals with the beginnings of the scientific method in the seventeenth century, as exemplified by Harvey, Paré, Sydenham, and the Royal Society, the text being liberally interspersed with contemporary portraits and illustrations of books and instruments. In addition to giving an appreciation of the works of Fabricius of Acquapendente, Harvey, Paré, and Sydenham, as well as an account of the famous medical school at Padua, where Harvey pursued his studies, and of contemporary British pharmacy, of which Thomas Johnson was an eminent representative, Dr. Singer points out that it was in the seventeenth century that the study of tropical medicine in Great

Britain first originated, owing to the discovery of new lands bringing men into contact with new diseases. The earliest English work on this subject was published in 1598 by George Wateson, under the title of "The Cure of Diseases in Remote Regions", to which Hakluyt alludes in his "Voyages" published two years later. In conclusion, Dr. Singer refers to the change in the chemical outlook achieved by Robert Boyle, who not only liberated chemistry from alchemy, but also made chemistry independent of medicine, with which it had hitherto been too closely associated, to the detriment of both.

WE welcome the appearance of a new series of the *Quarterly Journal of Mathematics*, a formerly well-known journal, published by the enterprise of the Clarendon Press. The old *Quarterly Journal* published as a private venture at Cambridge appeared regularly until the War, but only at rare intervals from 1916 until its death on completion of the fiftieth volume in 1926. It is to be hoped that a subject index to the whole fifty volumes will be published in due course. Opportunity has been taken to increase the size of the page in beginning a new series. The style of printing is a great improvement on the former and only possible by the use of fine-quality paper. A strong editorial board is behind the new enterprise, and from the contents of the opening part we foresee that this journal will soon become a recognised medium for the publication of first-class mathematical research. The new journal also incorporates the old-established *Messenger of Mathematics*.

THE University of Brussels, on the proposition of the Faculty of Science, has conferred the degree of doctor *honoris causa* on Sir William J. Pope.

AN Imperial Horticultural Conference, called by the Imperial Bureau of Fruit Production, East Malling Research Station, Kent, under the ægis of the Imperial Agricultural Bureaux, will be held in the Conference Hall of the Royal Society of Arts on Aug. 5-7. The main purpose of the Conference will be to discuss the best methods of approach to horticultural problems and the technique involved. The opening address will be delivered by Sir Robert Greig, chairman of the Imperial Agricultural Bureaux, and papers have been promised, among others, by several workers from the Dominions. The work of the Imperial Bureau of Fruit Production will be described, and groups of papers are to be devoted to horticultural research in the Dominions, applications of pure science to horticultural problems, soil and climate surveys, and fruit storage. The discussions will be open to the public.

THE proposal to establish a college for postgraduate medical study in London has advanced a stage, for the Minister of Health, Mr. Arthur Greenwood, has appointed a provisional organisation committee to proceed with the action necessary to secure the institution of a British Postgraduate Hospital and Medical School. This committee is to consider and report on the action requisite to lead up to the planning and construction of the School, the form of government appropriate for it, and the relation of the School to the London County Council and University of London. The chairman of the committee is the Right Hon. Viscount Chelmsford, and the committee consists of representatives of the Ministry of Health, the London County Council, the University of London, and a number of distinguished medical members, with Mr. M. Heseltine, of the Ministry of Health, as secretary.

THE fifth Pacific Science Congress is to be held in Canada on May 23–June 4, 1932, under the auspices of the National Research Council. Meetings will be held in the cities of Victoria and Vancouver, B.C., and a short tour is planned to follow the congress meetings so that the delegates may see something of the Dominion. The Congress has a twofold purpose, namely, (1) to initiate and promote co-operation in the study of scientific problems relating to the Pacific region, more particularly those affecting the prosperity and well-being of Pacific peoples; (2) to strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientific workers of all the Pacific countries. The first Pacific Science Congress was held in Honolulu in 1920; the second in Sydney and Melbourne, Australia; the third at Tokio; and the fourth in Batavia and Bandoeng, Java, in 1929. Thus, when the next Congress is convened in Canada, it will be the first of these meetings to be held on the eastern side of the Pacific Ocean.

AN executive committee to organise the fifth Pacific Science Congress, headed by Dr. H. M. Tory, president of the National Research Council of Canada, has been appointed. There are two vice-presidents: President L. S. Klinck, of the University of British Columbia, and Dr. Frank D. Adams, emeritus dean of the Faculty of Graduate Studies, McGill University, Montreal. The treasurer is Mr. S. P. Eagleson, secretary-treasurer of the National Research Council, and Mr. S. J. Cook, also of the National Research Council staff, is general secretary. The office of the Congress is in the National Research Council Building at Ottawa, Canada. There are to be two main divisions of the Congress. The division of biological sciences will be headed by Dr. C. M'Lean Fraser, professor of zoology in the University of British Columbia; the division of physical sciences will be under the chairmanship of Dr. R. W. Brock, dean of the Faculty of Applied Science, University of British Columbia. The Congress will bring to the Dominion and to the study of Pacific problems, in which Canada has a great interest, an international body, including among its members many distinguished men of science from different parts of the world, as well as many others who will influence the development of improved scientific and commercial relations between the Dominion of Canada and the other countries bordering on the Pacific Ocean.

A VALUABLE index to the contents of the forty completed volumes of the *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, from 1821 to 1930, has been compiled by John Briquet, and is

published as the final fascicule of Volume 40. It is not a subject index in the ordinary sense, for there is no alphabetical arrangement of the subjects of the papers, but a general alphabetical list of authors is followed by authors' lists grouped according to the various branches of science. In addition, a table shows the year of publication of each part, and a separate list indexes the biographical notices which have appeared, 234 in number.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A deputy chief engineer and an assistant engineering superintendent of works under the Metropolitan Water Board—The Chief Engineer, Metropolitan Water Board, 173 Rosebery Avenue, E.C.1 (July 21). A junior assistant in the pathological departments of the Royal Victoria Infirmary and the University of Durham College of Medicine—The House Governor and Secretary, Royal Victoria Infirmary, Newcastle-upon-Tyne (July 23). An assistant lecturer in agriculture under the Cornwall County Council Education Committee—The Secretary for Education, County Hall, Truro (July 24). A chief assistant under the Scottish Society for Research in Plant-Breeding, for work on virus disease of potatoes—The Secretary, Scottish Society for Research in Plant-Breeding, 8 Eglinton Crescent, Edinburgh (July 29). A professor of education in Rhodes University College—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (July 31). A chief agricultural lecturer and adviser under the Dorset County Council, County Agricultural Committee—The Clerk of the County Council, County Offices, Dorchester (July 31). An assistant lecturer in physics in the University of Birmingham—The Secretary, The University, Birmingham (Aug. 1). A research assistant in the department of mathematics of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7 (Aug. 7). An assistant professor of anatomy in the University of Manitoba—The Dean of the Faculty of Medicine, Medical College, Winnipeg, Canada (Aug. 8). A principal of the Stranmillis Training College, Belfast—The Secretary, Committee for the Training of Teachers, Ministry of Education, Parliament Buildings, Belfast (Aug. 16). Research studentships at the London School of Hygiene and Tropical Medicine in, respectively, entomology and protozoology—The Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (Sept. 1). A Samuel Turner research fellow for work on cancer and the pathology of growth, in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 30). A graduate mistress with good qualifications in botany, at Newport, I.W., Secondary School—The Director of Education, County Hall, Newport, I.W.

Our Astronomical Column.

The Planet Saturn. Mr. W. F. Denning writes: "Saturn is now favourably situated in some respects for observation, being visible nearly all night. The rings are now widely open and their northern side is presented to the earth. The apparent diameter of the planet is at present 16·4″. It was in opposition on July 1 at a distance of about 838,500 miles from the earth. Being placed amongst the southerly stars of Sagittarius, its altitude will be very low and only 16° when passing the meridian on July 20 at 10.40 P.M. Telescopic definition will not often favour the observer under the conditions, though in southern latitudes the object will attain a greater height and induce more successful results. The belted aspect of Jupiter's disc is repeated in the case of Saturn, and from their character and the changes affecting them, it seems probable that the atmospheric phenomena are very similar on these large planets. On Saturn, however, they appear less conspicuous and are not so frequently noticed, but this is due in a large measure to the fact of their being fainter and smaller than the features of Jupiter."

Nature of Hagen's Dusky Nebulosities.—Much controversy has raged about the reality of these difficult objects. Father Hagen has been able to collect a considerable body of visual evidence in support of their existence, going back to Sir W. Herschel, and including some well-known observers of the present time. A good many astronomers have felt the weight of the objection that the objects cannot be photographed either on ordinary plates or on red-sensitive ones.

Prof. J. Hartmann makes the suggestion in *Astr. Nach.*, No. 5716, that they may consist of diffused sodium clouds. He notes that, in addition to the well-known stationary lines of calcium, some stars show the *D*-line of sodium as stationary. The *D*-line comes in a region of the spectrum where neither ordinary plates nor red-sensitive ones have much sensitivity; on the other hand, it comes near the maximum of visual sensitivity. The colour of the Hagen clouds has been variously described as brown, yellow, and red. It is difficult to assign an exact colour to very faint objects, so this would not be inconsistent with the wave-length of the *D*-line.

Prof. Hartmann proposes himself to take photographs with a camera of focal ratio $\frac{1}{5}$, using plates as sensitive as possible to this region and a suitable light filter (OG1 on the list 4213 of Schott und Gen.; 2 mm. thick). The exposures will last several hours. He asks that similar photographs should be taken in Europe and North America. He notes that if the light is really monochromatic, it would not be much more difficult to photograph the spectrum of the clouds than the clouds themselves. This would serve to verify his conjecture as to the wave-length.

The Planet Pluto.—Harvard Announcement Card, No. 137, gives the following positions of Pluto deduced by Mr. Ross from plates exposed at Yerkes Observatory.

U.T.	R.A. 1930·0.	N.Decl. 1930·0.	Mag.
1921. Jan. 29·0896	6^h 31^m $21·9^s$	19° 43′ 14″	15
1927. Jan. 6·25	7 4 3·2	21 13 3	15

The positions are in good accord with the recently published orbits.

Prof. P. Stroobant has remeasured the image of Pluto photographed at Uccle 1927, Jan. 27, 21^h 27^m 41^s U.T. using six comparison stars. The new position for 1927·0 is 7^h 1^m $59·965^s$ N. 21° 17′ 44·0″. This should be substituted for the previously printed value 7^h 1^m $59·7^s$ N. 21° 17′ 59·7″, which was inexact. The new value accords well with the calculated orbit.

Research Items.

Tubuai.—An account of Tubuai, one of the Austral Islands, based upon material collected by the Bayard Dominick Expedition, is given by Mr. Robert T. Aitken in *Bull.* 70 of the Bernice P. Bishop Museum of Honolulu. This island lies about 400 miles south of Tahiti and is evidently of volcanic origin. The material culture of the inhabitants is characterised by the taro, coconut, manioc, and banana, and by fish rather than animal foods. The dwellings are Polynesian in design. The islanders fish with the spear and use the outrigger canoe propelled by paddle and sail, but not with the pole. They weave in coconut leaf and lauhala. Their material culture is thus closely related to that of modern Tahiti. The mythology is distinctly Polynesian, containing elements found in New Zealand, Tahiti, and Hawaii. In the social organisation of former days, there were definitely recognised districts, each occupied by a leading man or chief with family, relatives, and followers. There was constant warfare between districts. Powerful leaders from other islands, especially Raivavae, invaded the island and conquered the families of the various districts. The modern language is almost entirely a Tahitian dialect introduced by missions. A few words remembered from pre-mission days indicate that the former dialect approached more nearly to the old Polynesian language. Archæological remains point to a former religious ceremonial life differing from that of Tahiti and similar to that indicated by similar remains in Rurutu and Raivavae. Remains of ancient villages suggest a much larger population in olden times. It is clear from local records that the influence of Raivavae on Tubuai has been very great and that there was frequent interchange of culture and blood.

Peruvian Textiles.—Miss Lila M. O'Neale and Dr. A. L. Kroeber have made an intensive study of the textiles of ancient Peru based upon the collection of the University of California. Some 650 pieces have been examined, and though about 1000 more await investigation, it has been thought expedient to summarise the results to date. These are now published as No. 2, vol. 28 of the *Publications in American Archæology and Ethnology* of the University. These prehistoric textiles are derived from sites on the Peruvian coast from about 300 miles north of Lima to about 250 miles south of that city. In time they cover the whole of Peruvian prehistory from Early Nasca and the primitive fishing period down to Inca. No material from the Highlands was available. The chronological sequence is based primarily on pottery, secondly on building, head deformation, and other cultural traits. The following inferences are drawn: (1) Certain habits persisted, characterising certain regions; (2) changes in period manifest themselves in style rather than in technology and in the preferences given to certain techniques rather than in invention; (3) the fundamental technological control of the art was established at the beginning of the discovered record. In regard to the last it appears, for example, that cotton and wool are used in all periods. The percentage of pieces containing all wool fabrics is as a matter of fact highest in the early period while all cotton fabrics are highest in the latest period. The free use of wool in the early period means that the textile art was then already elaborate and that trade between coast and interior was regular, as the latter alone produced wool. A second point indicating the unity of the art was the loom, which throughout was of the type attached to the weaver's belt. Nearly all the fundamental weaves appear already in Early Nasca. This also holds for the dyes. As regards the decorative designs, these changed to correspond approximately with the designs of the pottery—from typically semi-realistic (pre-Tiahuanacu) to stiffly representative (Tiahuanacu-epigonal) to purely geometric and conventionalised (Late).

North Atlantic Scopelid Fishes. Dr. Å. V. Táning, in his "Synopsis of the Scopelids in the North Atlantic" (*Vidensk. Medd. fra Dansk Naturh. Foren.*, Bd. 86, 1928), surveys those forms which are met with in the Atlantic north of the Equator. The material, which consists of "many tens of thousands of specimens", was collected by the *Dana* and other Danish vessels under the guidance of Prof. Johs. Schmidt. The author has examined for comparison many others from various localities, including some from several European museums. Fifty-seven species or subspecies are noted in the present work, nineteen of which are new. The scopelids, which possess photophores in different positions on the body, are classified chiefly by these organs, and the present survey consists of keys to the species of each genus, giving a clear diagnosis and the distribution in each case.

Californian White Sea Bass. Mr. S. S. Whitehead, in his paper "Analysis of Boat Catches of White Sea Bass (*Cynoscion nobilis*) at San Pedro, California" (Division of Fish and Game of California. *Fish Bulletin* No. 21. Contribution No. 86 from the Californian State Fisheries Laboratory, 1930), summarises the information regarding depletion in the White Sea bass fishery. This fish is important commercially, with an increasing demand. It may reach a length of four to six feet and weigh 50-60 pounds. It was found that the best way of understanding existing conditions was by estimating the catches per month. The averages for both boat catches per month and boat catches per trip were decidedly downward during the period 1918–28. Thus the availability of the White Sea bass has decreased each year, which, unless the fish have changed their habitat, means depletion. The reduction may be due to natural fluctuations over a period of years, or to adverse spawning seasons, or an increase of natural enemies, or to over-fishing. Whatever be the cause, the conclusions are that the White Sea bass fishery needs protection in order to ensure it against extinction in the future.

Halticine Beetles.—Dr. D. Ogloblin of Poltava, Russia, has published in *Eos*, **6**, 1, April 10, 1930, Madrid, an interesting study of thirty-five of Motschulsky's species of Halticine beetles. At one time it was thought that these were lost, but now it is known that they, or at least some of them, exist in the Zoological Museum of the University of Moscow. Entomologists who have to deal with Motschulsky's species suffer from the lack of an exact knowledge of the condition of his types. Dr. Ogloblin's study will remedy this to a certain extent, because, besides many text-figures, his paper is accompanied by an excellent plate of twelve coloured illustrations which were all drawn by the author from the cleaned and remounted types. Dr. Ogloblin is to be congratulated on his work, and it is hoped that he will have more opportunities to publish further studies of Motschulsky's types. The present paper has been edited by Mr. S. Maulik.

Japanese Monograph on *Rhizopus*.—The genus *Rhizopus* was originally separated from *Mucor* in 1820

by Ehrenberg, but the species of this genus are so variable in culture that their systematic study has always presented great difficulties. Yoshihiko Yamamoto has grown as many species as possible in pure culture under different conditions, obtaining species from other workers in the group also; his results are presented in a systematic monograph published in the *Journal of the Faculty of Agriculture*, Hokkaido Imperial University, vol. 28, part 1, March 1930. As a result of this very complete re-examination of the group, fifteen species are accepted, described, and figured.

Cyanogenesis in Plants.—The production of prussic acid in plants is a phenomenon which has considerable economic importance in view of casualties from this cause amongst grazing stock, or even in the case of cyanogenesis in crushed feeding cakes from some sources. The function of cyanogenetic compounds in the normal plants is still completely obscure and a subject of considerable interest, so that the review of the literature of cyanogenesis in plants, by Muriel Elaine Robinson, in *Biological Reviews*, vol. 5, April 1930, will be useful to workers in very varied fields. Prussic acid has now been obtained from plants from about fifty different families, whilst some ten different cyanophoric glucosides have been isolated in crystalline forms; five of these have been prepared synthetically. Seven of these glucosides are derivatives of benzaldehyde cyanhydrin, two others contain ketone groupings. Three of these glucosides, amygdalin, prunasin, and prulaurasin, seem to be restricted to the Rosaceæ, sambunigrin to the Caprifoliaceæ and dhurrin to the Graminaceæ, but linamarin has been found in several families which are widely separated in natural systems of classification. The concentration and seasonal variation of prussic acid in the plant show considerable differences; in general, the concentration seems to be greatest in young growing organs, but there are curious anomalies and so far, the few studies of distribution and seasonal variation of cyanophoric glucosides have thrown no clear light upon their rôle in the plant.

Chloride Manuring for Tobacco. Although it is uncertain whether or not chlorine is an essential plant nutrient, W. W. Garner and others have shown (*Jour. Agric. Res.*, **40**, p. 627) that manuring with chloride has a far-reaching effect on tobacco and may alter the quality of the cured leaf considerably. Field tests were made using chloride and sulphate of potash. Although the plant absorbed potash equally well from both salts, the chlorine ions were taken up much more readily than the sulphate ions, and on light, sandy soils an average increased yield of ten per cent was obtained with applications of 20-30 lb. of chlorine per acre. The soils used were very deficient in magnesium, an element of particular importance for the tobacco crop, and since an application of potassium chloride was found to increase the magnesium content of the plants, it would seem that the stimulating action of the chlorine was probably due to an increase in the availability of the magnesium. Further, the addition of chloride resulted in an increased water content of the leaf, thus enabling the plant to resist desiccation, protecting it against the type of injury known as 'drought spot', a fact which adds materially to its commercial value. On the other hand, an excess of chlorine induces an abnormally high moisture content of the leaf and is therefore liable to injure its combustibility and keeping qualities. In addition, it interferes with normal carbohydrate metabolism, bringing about an accumulation of starch and a thickening of the leaf. These adverse effects may be caused by applications of 40-60 lb. of chlorine per acre and are most likely to occur on light soils, with limited buffering properties. From the economic point of view the chlorine nutrition of tobacco is of the greatest importance, for upon it, either directly or indirectly, the commercial value of the crop may depend.

Cosmic Dust and Meteorites.—It is usual, in considering the cosmic dust, to assume that the velocities of its particles vary in the same way as those of the molecules of a gas (Maxwell's law), but that the masses of the particles are all equal. Levi-Civita, in *Atti della Pontificia Accademia delle Scienze Nuovi Lincei* (March 1930) and *Rendiconti della R. Accademia Nazionale dei Lincei* (April 1930), considers it reasonable to suppose that the masses vary in the same way as the velocities. The results obtained are applied to estimate the effect of the impact of meteorites on a planet moving in its orbit.

Pleochroic Haloes in the Archæan of Uppsala.—The inaugural dissertation of Erik Wiman on "Studies of Some Archæan Rocks in the Neighbourhood of Upsala" (published in the *Bull. Geol. Inst., Upsala*, vol. 23, 1930) contains a series of measurements of pleochroic haloes around zircon and apatite in biotite and hornblende from the Uppsala and Arno granites. In the Uppsala granite haloes with the radius 0·038 mm., corresponding to ThC, are abundantly present. In one case a radius of 0·057 mm. was found. The Arnö granite, however, contains numerous larger haloes with radii 0·055—0·056—0·057—0·060 mm., the value 0·057 being most characteristic of this series. The author adopts this contrast as a means of distinguishing the two granites. Of greater significance is the question of the origin of the larger haloes, for such large radii have not previously been recorded. They are found both in biotite around zircon and in hornblende around apatite, and Wiman thinks that they may point the way to the discovery of a new radioactive substance. They can scarcely be ascribed to the longer α-rays from radium C (Philipp and Donat: *Zeit. f. Physik*, vol. 52, p. 759, 1928), as in that case they should have been previously observed elsewhere.

Fundamental Physical Constants.—During the past year, doubt has arisen as to the accuracy of the standard values of the electronic charge (e) and Planck's constant (h). A welcome contribution to this problem has now been made by Prof. R. A. Millikan himself, in a paper in the second issue of the *Physical Review* for May. Prof. Millikan considers that the only changes which need be made to the numbers which he gave in 1917 are the almost trivial ones which arise from new determinations of the velocity of light, and of the absolute value of the ohm; taking these into account gives, for e, $(4{\cdot}770 \pm 0{\cdot}005) \times 10^{-10}$, for h, $(6{\cdot}547 \pm 0{\cdot}010) \times 10^{-27}$, and for Avogadro's number, $(6{\cdot}064 \pm 0{\cdot}006) \times 10^{23}$. Prof. Millikan also discusses, from the experimental point of view, the most probable value of the spectroscopic fine-structure constant ($1/\alpha$ or $hc/2\pi e^2$), which quantum theory predicts to be 137, and finds that it is highly improbable that this can be a whole number—there is of course no question that its value is *approximately* 137. Using his new values for e and h, and Michelson's redetermination of the velocity of light ($2{\cdot}99796 \times 10^{10}$), Prof. Millikan finds for $1/\alpha$ the value 137·29, which is very close indeed to the quantity $8\pi(8\pi^5/15)^{1/3}$, or 137·348, predicted by Lewis and Adams in 1914 from their theory of ultimate rational units.

Magnetic Properties of Mesomorphic Substances.—Amongst the articles in the 1929 volume of Conférences of the Conservatoire National des Arts et Métiers

(Paris, Hermann et Cie, 1930; 35 francs) is one by Prof. G. Foëx, on the magnetic properties of mesomorphic materials (liquid crystals). These substances, which although fluid are optically anisotropic, are diamagnetic. Those which belong to the nematic class have, however they are formed, a susceptibility definitely less than that of either the related solid or true liquid phase; the smectic class, on the contrary, has a definite lower susceptibility only if formed by cooling the isotropic parent liquid in a magnetic field. The variation with temperature of the susceptibility of a nematic liquid is large, and somewhat similar to that of a ferromagnetic body near its Curie point; Prof. Foëx indeed defines the nematic phase as "a liquid with a molecular field". One curious property of the nematic liquids is that they solidify in a magnetic field to a crystalline mass in which the molecules have one axis orientated. Prof. Foëx's reference to the similarity between nematic liquids and ferromagnetic solids is perhaps of special significance in view of Heisenberg's theory of the latter, which correlates their magnetism with the exchange properties of electrons on quantum theory.

Theory of Magnetism in Iron. If a telephone receiver is connected with the output circuit of an amplifier and an electromagnet is in series with the amplifier, then if a magnet is brought gradually up to the electromagnet and the amplifier is very sensitive, a crackling noise is heard in the telephone. The German physicist Barkhausen, who first noticed the effect about ten years ago, attributed the noises to sudden changes in the magnetisation of the iron. If this is true, it seems to prove that sudden changes in the magnetisation of the iron occur not by single atoms but by much larger groups of atoms. A paper giving the results of research in this subject by R. M. Bozorth is published in the April number of the *Bell Laboratories Record*. He verifies Barkhausen's results and concludes that the ordinary theory of magnetisation must be modified. Instead of accounting for a steady change in magnetic state proceeding atom by atom, the theory must be based on very large groups of atoms making sudden changes simultaneously. For different kinds of magnetic material the sizes of these groups are not radically different, but they seem to vary in size at different points on the magnetisation curve. At saturation on either end of the hysteresis loop, the groups are small, but they increase in size with decreasing magnetisation. A maximum is reached near the steepest part of the curve, where the total magnetisation is about zero. An oscillogram is shown verifying an amplified Barkhausen effect with a 1000 cycle per second timing wave for comparison.

Ionisation of Electrolytes.—Although the hypothesis of the complete ionisation of strong electrolytes is widely accepted, the assumption in some cases is invalid. In the May number of the *Journal of the Chemical Society*, H. E. Blayden and C. W. Davies examine the experimental data for the solubilities and conductivities of thallous chloride. They find that (as in other known cases) the numerical value of the constant in the Debye and Hückel formula is not the theoretical value 0·505. In the present case it is 0·38. The irregularities in the solubility curves found on the assumption of complete ionisation disappear when allowance is made for incomplete ionisation, and the activity coefficient then becomes independent of the nature of the other ions present up to concentrations of decinormal.

Reaction between Hydrogen Sulphide and Silver.—The blackening of silver by exposure to air containing hydrogen sulphide is well known, but the exact nature of the reaction has not been completely elucidated. In the March number of the *Journal of the American Chemical Society*, S. Lilienfeld and C. E. White describe some experiments on the subject. It had previously been shown that the reaction does not occur with dry gas. It was found that phosphorus pentoxide is not suitable for drying hydrogen sulphide, as it oxidises the gas to sulphur dioxide. Silica gel and aluminium oxide prepared by heating the gel at 180° for a week were found to be satisfactory, the latter removing practically every trace of water. It was found that, in presence of air, no hydrogen was evolved in the reaction between silver and hydrogen sulphide, and that no reaction occurred between silver and pure hydrogen sulphide. The presence of oxygen is necessary for the reaction, and attention is directed to the fact that ordinary silver may contain dissolved oxygen. An oxidation of hydrogen sulphide in presence of oxygen, with liberation of sulphur, is suggested.

Hydrogen Chloride in different Solvents.—The original assumption of Arrhenius that the properties of an acid are due to the dissociation of hydrogen ions: $HCl = H^{\cdot} + Cl'$, was modified many years ago by Lapworth and others so as to take account of the undoubted influence of the basic character of the solvent, and Hantzsch had suggested that in aqueous solution the hydrogen ion is really $H_3O^{\cdot}$: $HCl + H_2O = H_3O^{\cdot} + Cl'$. The effect of a solvent in promoting ionisation was also supposed by J. J. Thomson and Nernst to increase with its dielectric constant. In the May number of the *Journal of the Chemical Society*, Wynne-Jones describes some experiments on hydrochloric acid in nitrobenzene, a solvent of high dielectric constant but no marked basic character. If the dissociation is primarily determined by the dielectric constant, nitrobenzene would be a good ionising solvent for hydrochloric acid. This was not found to be the case, the acid behaving as a normal undissociated substance. These results support the view (originally due to H. E. Armstrong and to Lapworth, but attributed in the paper to Brönsted) that the behaviour of an acid is largely determined by the basic character, not by the dielectric constant, of the solvent. In the case of salts, the dielectric constant is the important factor.

Cytochrome as a Biological Oxidation Mechanism.—An interesting paper upon this subject, by Keita Shibata and Hiroshi Tamiya, is published in the *Acta Phytochimica*, vol. 5, No. 1, April 1930. They find that the oxygen-carrying properties of the pigment can function without dependence upon special oxidase or reductase systems that may form part of the respiratory mechanism of the cell. The linkage of cytochrome with oxygen is a ferro-linkage taking up molecular oxygen; naturally, therefore, the presence of potassium cyanide strongly inhibits the oxygen-carrying properties of cytochrome. By various treatments, such as boiling, drying, addition of oxidising agents, etc., the oxygen-carrying properties of cytochrome can be destroyed by a 'denaturing' of the iron to hæmochromogen (Fe'') or hæmatin (Fe''') derivatives. Cytochrome, it is suggested, is very essential to plants living naturally in air, but not to plants which are normally submerged. Owing to the striking capacity cytochrome shows for taking up oxygen, the respiration of cytochrome-containing plasma is, within wide limits, independent of the oxygen tension in the atmosphere surrounding it, whilst, on the other hand, organisms poor in cytochrome show a striking sensitiveness to variations in the oxygen content of the medium. Cytochrome, hæmochromogen, and hæmatin are found to be present in many of the lower animals.

Laboratory Induction Furnaces.

THE Metropolitan-Vickers Electrical Co., Ltd., has developed small induction furnace equipments which are particularly suited for laboratory work. They were originally designed for the Company's own research laboratories, but they are now made commercially. The Imperial Chemical Industries, Ltd., has ordered one which will melt a charge of twenty pounds of metal and is rated at 20 kilowatts. The equipment supplied to the University of Manchester is designed for charges varying from a half to two pounds of metal and is rated at five kilowatts. Two equipments supplied to the University of Sheffield are of rather smaller size, and are used for melting charges of only a few hundred grams of metal *in vacuo*.

The high frequency current required to operate these furnaces is obtained by means of a water-cooled oscillator valve. As the frequency is 500,000, the furnaces can melt very small charges. Whilst a quarter of a ton of steel could be melted with current at a frequency of 500, for small charges much higher frequency is essential. To melt the full charge requires from twenty to thirty minutes, but small charges can be melted in two minutes. So great is the rate at which heat energy is generated that half a pound of steel will evaporate if left in the furnace field for five minutes.

In Fig. 1 a ten-pound ingot of steel is shown being poured from a furnace in the Research Department of the Metropolitan-Vickers Electrical Co., Ltd. The tilting gear shown in the figure is used with the larger furnaces. The three-phase valve rectifier unit is supplied at 10,000 volts by a suitable transformer. It is controlled either by a contactor or by push buttons on the furnace table.

At the back of the furnace table are the tuning condensers and a panel on which is mounted a neon lamp to indicate when the set is oscillating and an ammeter to read the current in the oscillatory circuit. The rectifying valves are protected by a filament voltage relay which prevents the high pressure being applied before the filament voltage has the correct value. A relay is also provided in the water circulation system which trips the contactors of both the main and filament circuits in the event of a failure of the water supply.

Even with charges so small as 20 gm., the weights of the alloys agree to within 0·3 per cent with the weight of the constituent metals. Valuable work on the alloys of zirconium was carried out, using one of these furnaces. It is described in a paper read recently to the Institute of Metals by T. E. Allibone and C. Sykes.

FIG. 1.

Astronomy and Physiology in the "Encyclopædia Britannica".

ASTRONOMY.

THE treatment of a particular department of knowledge in a comprehensive work is less illuminating than might at first be imagined. One's first idea is that one might learn from it the conspicuousness of that department in the whole field of thought. Actually, all that it can reveal on that matter is the editor's opinion. As a text-book, a popular handbook, or a source of inspiration, it is equally unsatisfactory. Disconnected, heterogeneous in diction, style, and direction of approach, abounding in repetitions, it has all the potential faults and few of the virtues of those mediums of expression. The value and significance of the treatment are to be found in the individual article rather than the *ensemble*.

Nevertheless, few additions to popular astronomical literature would be more welcome than a volume containing the collected articles on astronomy in the "Encyclopædia Britannica". It would be infinitely more valuable than current productions of writers with no first-hand knowledge of astronomy who claim a faculty of exposition which they imply has been denied to the working astronomer. Such a volume would be an excellent example of the most neglected branch of scientific literature, the anthology. But if it is to be issued, it should be issued quickly, and the authors should have an opportunity of revising their work.

The task of the departmental editor, though sufficiently exacting, gives little scope for originality. The subject-matter must be distributed under the titles most likely to be looked for, not those of a technical classification. Relative lengths must be assigned to the several articles, and suitable authors must be chosen. The subjects must be treated clearly, concisely, and from the point of view of the general scientific world rather than that of the individual writer. These requirements are in the main excellently fulfilled in "Astronomy", although the last might perhaps have been met a little more strictly. An unsophisticated reader of the articles "Cosmogony" and "Star", for example, would scarcely suspect that there were ideas afloat of the genesis of the solar system and the constitution of the stars other than those so admirably presented there. The initials at the end of an article, for the key to which the reader has to turn elsewhere, are intended as a guarantee of authority rather than a license to express personal predilections, and it would have been better if the universal survey had been maintained throughout.

One excellent innovation is a separate 'article' consisting of a list of the astronomical articles in the

"Encyclopædia". Let no one imagine, however, that astronomy is confined within the boundaries there represented. Besides permeating a few articles, such as "Astrophysics" and "Celestial Mechanics", which might fairly have appeared in the list, the breath of astronomy penetrates more or less deeply the domains of physics, geology, history, philosophy, biography, and indeed almost every realm of thought. He who would gauge the influence of astronomy in human affairs must take the whole encyclopædia for his province.

The specifically astronomical articles are naturally of unequal merit, but they are almost, if not quite, all worthy of the traditions of the "Encyclopædia Britannica"—more than worthy in one respect, for we cannot applaud too heartily their newly-acquired intelligibility to the layman. It has at last been realised that an encyclopædia is a work for the intelligent non-specialist, and with all due respect (and very great respect is due) to some of the classical articles of the past, it must be admitted that they were ugly ducklings in a company where all but the scientific stock were of familiar breed. At the same time, it is pleasing to note that two of the least recondite of former articles have been reproduced: namely, those of Miss Clerke and Sir David Gill on "History of Astronomy" and "Telescope", respectively. These well-known articles could scarcely have been improved upon as a whole, though it seems to us that in two respects they might have been made more suitable for their present purpose. If their date of origin had been given, it would have explained the intangible but very real archaism of the point of view of the writers, which it is impossible altogether to remove by definite alteration of the text; and secondly, amendments might have been made a little more freely without disrespect to the memories of the authors. For example, we feel that it is scarcely fair to repeat that Galileo failed to identify Saturn's rings through lack of "sagacity", and it is unfortunate also that in a historical article the dates of Hipparchus, Ptolemy, Tycho, Kepler, and Galileo should be omitted when those of a host of lesser men are given.

On the other articles, only the most general comments can be made. The definition of the field of astronomy as "the world beyond the earth" seems inconsistent with the inclusion of "Earth" in the list of astronomical articles. The clear description of astronomical photometers in the article, "Photometry" would have been much more easily followed if diagrams had been provided such as those of physical photometers and chronographs. In the matter of technique of exposition, we would direct particular attention to the paragraph "The Demand for Data" in the article, "Astronomy," which comes as near as is humanly possible to our conception of the ideal—a clear statement of a general principle, with vivid examples (*not* illustrations). If every expositor were compelled never to generalise without providing at least one example of the particular, he would not only clear his own mind of much cant, but also would enlighten readers whom otherwise he would only mystify.

Another well-conceived innovation is a list of astronomical societies, though it would have been more dignified generally, and in the case of foreign titles more useful, if abbreviations had not been introduced. The British Astronomical Association appears as the "British Astronomical Society"—a curious blunder which can scarcely have been the unaided work of an astronomer. Indeed, there are other defects which suggest the operation of influences not scientific. It is improbable that the author of the article "Chromosphere" would confuse another astronomer's initials with his own, and the inscriptions under some of the illustrations show a decided laxity of expression when compared with the corresponding articles. The unsigned article "Planet" suffers in a different sense, for its illustrations, which are referred to in various places throughout the "Encyclopædia", are non-existent. Author's proof-corrections appear to have been treated with scant courtesy; to mention one of the least serious examples, the name "Rutherfurd" appears in two articles as "Rutherford," although, in one of them at least, the error was twice corrected in proof.

Such blemishes go beyond the limit of excusable fallibility, but perhaps the most astonishing feat of the publishers—or whoever is responsible—is the 'cutting' of certain articles, without intimation to the authors before publication, because of "congestion in the later letters". It is apparently this procedure that has led, in at least one instance, to the alteration of a true statement into a false one. Cutting admittedly is a necessary process if it is done for an intelligible reason and by a competent agent, but what are we to make of the reason assigned here? If the language is such that the later letters require even a hundred times as much space as the earlier ones, why in the name of all that is rational should they not have it? "The Democracy of Letters" is certainly a familiar phrase, but surely it has never before received such a literal interpretation.

The "Encyclopædia Britannica" remains the leading work of its kind, but it does so in spite, not because, of the arrangements made for its production.

H. D.

PHYSIOLOGY.

IN the selection and presentation of the physiological subjects dealt with in the new edition of this monumental work, the perfection attained proves that the publishers could not have made a happier choice of associate-editor for the physiology section. The enormous development of the science of physiology since the appearance of the thirteenth edition has necessitated the inclusion of matter which is entirely new, and no pains have been spared in bringing the subject right up-to-date. Many of the new articles introduced deal with those branches of the science which have undergone advancement at the hands of Anglo-American workers who have themselves written the articles. As a consequence, two happy results accrue to the reader: he is assured of a much considered and authoritative statement on the subject and of reading of a refreshing nature imbued with the enthusiasm of the research worker.

The contributors, in nearly all cases highly specialised in their respective fields, are to be congratulated on rendering their subjects intelligible to the general reader by expressing themselves in the universal language of science. Remarkably few printers' errors have crept in and none which lead to confusion; the abbreviation error $1\mu\mu$ for $1m\mu$ which appears so commonly in medical writings has unfortunately been adopted for expressing wave-lengths of light in one of the articles.

Articles of a general character, formerly a characteristic feature of the 'Encyclopædia', have been advisedly curtailed, since in a scientific subject they may either suffer from being too vague for the general reader or lack the precision expected by the scientific inquirer. The article on physiology by Prof. J. Barcroft is, however, valuable for its orderly statement of some of the main principles governing the bodily functions, while Prof. J. C. Drummond presents in historical form the development of the comparatively new subject of biochemistry.

The special articles introduce a novel feature of

high educational value and will be greeted with pleasure by workers in the ancillary sciences, since they present a wealth of information presented in a language shorn, so far as accuracy of expression permits, of many of the technicalities inherent to high specialisation. Main headings are, as is usual, arranged in alphabetic order; no better start can be made than by looking up the master organ—the brain—the article on which begins a new volume and is written by the leading authority on the physiology of the nervous system. The account given by Sir Charles Sherrington is so fascinating that the reader is impelled to look up the subsequent articles on the spinal cord and the sympathetic system from the same pen; they may be read with equal delight by the general, the scientific, the psychological, and the physiological inquirer; the evolution of a superman is considered in retrospect under the sub-heading of "Had man had wings".

Prof. Barcroft, in his interesting and inimitable style, outlines the present position of the physiology of the blood, of respiration, and of excretion, and gives the most orderly exposition of the subject of anoxaemia yet published; this should not be missed by any aviator, mountaineer, or medical man. Subjects of interest more limited to physiology and medicine deal with the heart, vascular system, hormones, etc., and these articles give excellent summaries of knowledge to date. Articles of wider general interest, in particular to psychologists and physicists, will be found: hearing by Dr. Wilkinson, vision by Sir Herbert Parsons, light and radiation by Sir Leonard Hill, animal equilibrium by Dr. E. D. Adrian, sleep by Dr. G. Anrep. Not only physiologists and biochemists but also industrial psychologists, athletes, and gymnasts will profit from the article by Prof. A. V. Hill on muscle and muscular exercise. Amongst other articles possessing a wide appeal there may be mentioned hunger and thirst by Dr. W. B. Cannon, tissue culture by Dr. A. Carrel, and insulin by Prof. J. J. R. Macleod: all are distinguished by the stamp of authority and are presented in an interesting manner.

The publishers have not stunted the work in any particular. The text is supplemented by clearly annotated diagrams, and plates are beautifully reproduced on art paper, some in colour. Indeed, all concerned in the production of the physiology section of this gigantic work are deserving of high praise.

Recent Work on Vitamin D.

I.

SINCE the discovery three years ago that ergosterol is converted into vitamin D on exposure to a source of ultra-violet light, to which reference has already been made in these columns (see NATURE, vol. 120, p. 955; Dec. 31, 1927), a considerable amount of work has been carried out on the chemistry of the changes undergone by this compound under various conditions. Although the details of the process of its conversion to vitamin D have attracted most attention, it is only recently that the isolation of the vitamin in a pure state has been reported. Coincident with these investigations, opportunity has been taken to study the effects upon the animal economy of administering very large doses of the vitamin, since even 'impure' preparations of vitamin D are much more potent than its richest natural source, cod-liver oil, and can be given without the complicating effect of accompanying substances, although it may be necessary to distinguish between the actions of vitamin D, other products of the irradiation, and unchanged ergosterol together present in the preparation used.

BIOLOGICAL ASSAY.

In the absence of a simple chemical test for vitamin D or the isolation of the vitamin as a pure chemical compound, recourse must be had in all experiments to the animal test. The animal commonly used is the rat; the diet, one which will in the course of a few weeks produce rickets, and the criterion of cure or healing the change brought about in the calcification at the growing ends of the bones on administration of vitamin D: a modification of this test is to give the vitamin prophylactically instead of curatively. The degree of calcification is estimated chemically, by the ash or calcium content of the bone, histologically, by splitting the end longitudinally and staining with silver nitrate, when the newly deposited calcium salts appear as a line in the metaphyseal cartilage (hence the term 'line test'), or by means of X-ray photographs. It is possible, however, to use other tests: thus under certain conditions vitamin D can be shown to produce an increase in the growth rate, or to bring about a change in the pH of the fæces.

K. M. Soames and J. C. Leigh-Clare (*Biochem. J.*, vol. 22, p. 522; 1928) point out that the common diets used to produce rickets in rats are not only free from vitamin D, but are also deficient in salts, vitamin A, and sometimes protein and vitamin B: they consider that the diet should contain all known requirements except the constituent under test. On a complete synthetic diet free from vitamin D, rickets cannot be produced in the rat, but that calcification is defective is shown by the low ratio of ash to organic residue in the fat-extracted bone, for example 0·9 instead of 1·5 (on the diet plus vitamin D); on a diet low in phosphorus in addition to vitamin D this ratio is 0·5 or less. Vitamin D was given in the form of cod-liver oil and irradiated cotton-seed oil, and besides bringing about normal calcification it also increased the growth rate: under these conditions, therefore, growth can be used as a criterion for the presence of vitamin D. The diets used were of the common synthetic type, vitamin A being given as wheat embryo or hog millet, sources free from vitamin D.

H. N. Green and E. Mellanby (*ibid.*, p. 102) have found that, as in dogs, the degree of rickets developed by rats depends also upon the nature and amount of the cereal in the diet. For testing this point they gave the animals a diet containing 75 per cent of the cereal with caseinogen, sodium chloride, marmite, lemon-juice, and dried cabbage. Oatmeal and whole meal flour are more rachitogenic than barley meal or white flour, with maize meal intermediate. The effect can be antagonised by an adequate supply of vitamin D and also to a great extent by increasing the calcium, though not the phosphorus, intake. The nature of the interfering substance in cereals and the mechanism of its action are not definitely known, but L. Mirvisch (NATURE, vol. 124, p. 410; Sept. 14, 1929) has recently shown that a factor can be extracted from oatmeal with weak hydrochloric acid which lowers the blood calcium of rabbits to the extent of 35 per cent in twenty-four hours.

The usual method of comparing the activity of different samples is to find the amount which will produce a definite degree of healing of rickets or the amount which will just prevent its onset. The drawback of this method is that it presupposes that every animal or a certain number of a group will always respond in precisely the same way to the same dose; but it is notorious that animals vary considerably

among themselves, even when all conditions of diet, maintenance, etc., are kept as constant as possible and an inbred stock is employed. It is for this reason that standards for biological remedies have been set up, the potency of the unknown preparation being determined in terms of this standard; in this way, variations due to the animals are to a large extent eliminated, since the response of a group to the standard and to the unknown varies usually in the same direction; comparable results can therefore be obtained with the same preparations at different times and in different laboratories. K. H. Coward (*Quart. J. Pharmacy*, vol. 1, p. 27; 1928) has adopted as standard of reference a preparation of irradiated ergosterol, of which 0·0001 mgm. is defined as containing one antirachitic or vitamin D unit; the comparison is made by means of the 'line' test and the test doses are fed for 10 days after 3-4 weeks on a preparatory rachitogenic diet. In her animals, this dose of the standard preparation brings about complete healing, whilst $\frac{1}{20}$ of it may produce early definite signs of calcification in the metaphysis.

The sensitiveness of the test is also indicated by some results obtained by Fosbinder, Daniels, and Steenbock, which were confirmed by Coward (see *Biochem. J.*, vol. 22, p. 1221; 1928). The former authors found that $3{\cdot}2 \times 10^{13}$ molecules of vitamin D were formed when 'impure cholesterol' was exposed to radiation of 2650 A. for 22·5 sec., by calculation from the energy absorbed; this corresponds to 2×10^{-8} gm. vitamin D on the assumption that the molecular weight of the vitamin approximates to that of cholesterol. This amount fed over ten days produced a positive 'line' test. Coward found that 2×10^{-7} gm. of a sample of irradiated ergosterol fed over ten days also gave a positive test: if it may be assumed that only 10 per cent of the preparation consisted of vitamin D, Coward's result agrees with that of Steenbock.

E. Poulsson and H. Lövenskiold (*Biochem. J.*, vol. 22, p. 135; 1928) point out that methods using chemical or histological criteria do not take account of the degree of rickets present when the test doses are first administered, except in so far as certain animals of the litter may be killed and examined at the end of the preparatory period, but this procedure does not guarantee that the others are suffering from the same degree of rickets, since variation is found even amongst the animals of the same litter. By taking X-ray photographs of living rats, however, it is possible to follow the healing or not of rickets when a dose of the substance under test is fed, the base line, so to say, for each animal being its own condition at the end of the preparatory period. In practice, the latter lasts twenty-five days and the test doses are given for six days. The unit is defined as that amount which will bring about a marked degree of healing of rickets.

H. Jephcott and A. L. Bacharach (*ibid.*, vol. 20, p. 1351; 1926; vol. 22, p. 60; 1928) found that on Zucker's 'patent flour' diet the *p*H of the fæces of rats becomes alkaline and that with the administration of a source of vitamin D the reaction shifts back to the acid side of neutrality again: the estimations must be made by the electrometric method. After 10-21 days on the diet, the fæcal *p*H is 7·3 or higher: within a few days of giving an adequate amount of vitamin D the *p*H has fallen to 6·7. The amount necessary to bring about this change is taken to be 10 *p*H units.

A number of authors have examined the *p*H of the intestinal contents or fæces under various conditions and in different animals and have not always succeeded in demonstrating the alkaline change in rickets or the acid change with its healing. Thus T. Redman (*ibid.*, vol. 22, p. 15; 1928; vol. 23, p. 256; 1929) using the quinhydrone electrode, found no relationship between the *p*H of the fæces and the condition of rickets in children, although there was a tendency for the *p*H (and calcium output) to fall with treatment. Working with S. G. Willimott and F. Wokes (*ibid.*, vol. 21, p. 589; 1927), however, it was found that the changes could be demonstrated in rats maintained on rachitogenic diets. Bacharach and Jephcott, in a recent paper, reply to certain criticisms of their method, and point out that it is a means of measuring vitamin D, and that the changes in *p*H do not indicate either the development or cure of rickets (*J. Biol. Chem.*, vol. 82, p. 751; 1929). In performing the test, it is essential to give only vitamin D (in solution in an oil), and not a preparation which may alter the ratio of the constituents of the diet, more especially its salt content. The test is specific for the vitamin only under well-defined conditions: its advantage is that the preparatory and test periods are of shorter duration than is necessary when the degree of calcification is taken as the criterion.

Congress of Experimental Phonetics.

THE first Congress of the International Society of Experimental Phonetics was held at Bonn on June 10-14. It was specially characterised by the variety of the addresses and demonstrations from all parts of the science of speech.

Particularly striking was the demonstration of a Röntgen speech film by Dr. Gutzmann, Berlin, in which the movements of the larynx, hyoid bone, and tongue appeared with great clearness. W. Lenk, Vienna, demonstrated a speech film apparatus suitable for laboratory use. Dr. Moses, Cologne, presented the results of the application of the science of experimental phonetics to character. Prof. Scripture, Vienna, presented his theory of the nature of the vowels. The vowels were also discussed by Dr. Van der Elst, Utrecht, and Dr. J. Schmidt, Bonn. Miss Janvrin, London, presented the results of an experimental analysis of a record of verse spoken by John Galsworthy himself.

The pathology of speech was treated in three addresses, namely: Prof. M. Isserlin, Munich, problems of the pathological physiology of speech (aphasia); Dr. Berger, Münster, phonetic investigations of the genuine and simulated results of the Lombard test; Dr. L. Kaiser, Amsterdam, registration of pathologically altered voices.

Linguistic phonetics was represented by the following: Prof. E. Blancquaert, Ghent, comparative investigations of Nederland dialects; Dr. L. Hegedüs, Gödöllö, experimental phonetic investigations on the melody of Hungarian; Prof. J. Feltes, Luxemburg, concerning the characteristic phenomena of assimilation in Luxemburg speech; Dr. E. W. Peters, Tartu, experimental investigations of the Esthonian language.

In an address entitled "What is Experimental Phonetics?" Prof. Scripture showed that experimental phonetics is approaching the ideal established by the exact methods of chemistry, psychology, and biology.

The exhibition included various oscillographs, film apparatus, graphic registration apparatus, harmonic analysers, and numerous other devices.

The Congress was attended by more than a hundred

people. An account of the proceedings will be published as a separate volume at the price of 10 shillings.

At a meeting of the Council, the secretarial bureau was definitely located at 73 Welbeck Street, London, W.1, and arrangements were made to send the following publications free of charge to the members: *Zeitschrift für Experimentalphonetik*, *Bulletin of the International Society of Experimental Phonetics*, *Bulletin de la Société Internationale de Phonétique Expérimentale* and *Sprachneurologische Mitteilungen*. The membership fee was fixed at 10 shillings per annum.

Prof. Hugo Pipping, Helsingfors, has been made an honorary member of the Society.

University and Educational Intelligence.

A VACANCY having arisen for the Busk studentship in aeronautics for 1930–31, the trustees hope to make an appointment shortly. The studentship is of the value of about £150, tenable for one year from Oct. 1, and is open to any British subject of British descent who has not attained the age of twenty-five years on Oct. 1 next. The object of the studentship is to enable the holder to engage in research or preparation for research in aeronautics, and specially in those subjects, such as stability problems, meteorological questions bearing on flight, or the investigation of gusts, treated either experimentally or mathematically, in which Edward Busk was specially interested. Forms of application, to be returned not later than July 26, can be obtained from Prof. B. Melvill Jones, Engineering Laboratory, Cambridge.

THE Air Ministry announces that five hundred aircraft apprentices, between the ages of fifteen and seventeen years, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Cranwell, near Sleaford, Lincs. They will be enlisted as the result of an open competition and of a limited competition which will be held shortly by the Civil Service Commissioners and the Air Ministry respectively. Boys in possession of an approved first school certificate may be admitted without other educational examinations. The scheme offers a good opportunity to well-educated boys of obtaining a three-years' apprentice course of a high standard and of following an interesting technical career. Particulars can be obtained upon application to the Royal Air Force (Aircraft Apprentices' Dept.), Gwydyr House, Whitehall, London, S.W.1. The sons of officers, warrant officers, and senior N.C.O.'s of the three services will receive special consideration.

THE Teachers Registration Council, which came into existence in 1912 and now functions as the executive of the Royal Society of Teachers, views with concern the slowing down during the past five years in the flow of applications for membership. In 1914 there were 5150 applications. During the three succeeding periods of five years the applications numbered, respectively, 25,780, 44,470, and 4680. In a communication addressed to members in May last, Lord Gorell, president of the Society, observes that up to the present the Council's work has not received that measure of official recognition which is necessary to make a register of teachers effectual as a means of protecting the public from unqualified practitioners, and "the time has come when a serious effort should be made to induce the Board of Education and local authorities to attach due weight to registration in the appointment of teachers to posts of responsibility". It is the Council's aim to secure in the first instance that no one save registered teachers shall exercise professional supervision over the work of other teachers, but the Board of Education can scarcely be expected to adopt this policy while a large proportion of those qualified for registration remain outside the Society. The president therefore suggests that every member should secure at least one recruit during the next three months. The registration fee is to be increased to £3 on July 1, 1931. It appears that the revenue of the Council from all sources from 1912 to 1929 was £123,293 and the expenditure £98,566. Twenty-one cases of registered teachers accused of conduct likely to bring discredit upon the teaching profession have been investigated and nineteen names have been removed from the register.

ON June 7 the inauguration of the new president, Dr. Karl Taylor Compton, of the Massachusetts Institute of Technology, took place in the presence of a large gathering of delegates from educational institutions in the United States and abroad. Sir William Bragg represented the Royal Institution. Addresses were delivered by the retiring president, Dr. S. W. Stratton, who now becomes chairman of the corporation of the Institute, and by the new president, Dr. Compton. At a subsequent dinner, at which many of the *alumni* of the Institute were present, Mr. Gerard Swope, president of the General Electric Co., and a graduate of the Institute, announced the formation of a fund for the purpose of helping needy students of promise to obtain their education at the Institute. In his speech he said, *inter alia*, that they were embarking upon a new plan of organisation in dividing the administration between a chairman and president. For some time the question of increased pay for the teaching staff has been under consideration and also further facilities for research, and it has been decided to increase the tuition fees next September from 400 to 500 dollars, but as the cost of educating a student is between 700 and 800 dollars a year this would mean that, unless more money was forthcoming, the intention of raising stipends could not materialise. He announced that, though only a few had been approached, the fund has already exceeded the sum of 4,200,000 dollars, which will be paid over a ten-year period. The instalment payments will keep it going until the loans made to students have been repaid after graduation. The subscriptions are in the form of donations, and include 500,000 dollars from Mr. George Eastman, who has previously been a generous benefactor, a like sum from C. Hayden, A. P. Sloan, and E. S. Webster, and also large sums from others, among whom was Mr. Swope. Among the announcements made by the new president was the proposal to construct a new chemical and physical laboratory to provide for the increased numbers taking these subjects.

Historic Natural Events.

July 20, 1723. Storm.—The "Journal of Étienne Azambourg", a farmer of Enfournet, Dépt. du Cher, records a "flood of water from a storm and frightful thunder" which ravaged the whole district about 2 to 3 P.M. Vines were stripped and uprooted, and the wind and rain destroyed the grapes, causing enormous loss.

July 20, 1921. Whirlwind in Ceylon.—About 7.30 A.M. a tornado passed directly across the school at Veyangoda, Ceylon, which collapsed with 70 or 80 boys in it. One was killed and another seriously injured. Neighbouring houses were also damaged. The whole track was only about three miles long, and very narrow.

July 22, 1801. Hurricane at the Bahamas.—A terrible hurricane devastated the Bahamas. At Nassau, although the ships in the harbour had their masts struck and anchors down, they all broke loose and were driven on shore, and of the ships at sea, apart from those which were sunk, 120 were counted at one time lying as wrecks on the coast. The sea broke through the sand hills south of Fort Montague, flooding the land, and enormous damage was done.

July 22, 1907. Thunderstorms over the British Isles.—In North London a certain amount of damage was done by heavy rain, but in South Wales and the west of Ireland the storms appear to have been really exceptional. In Wales heavy rain and hail fell on the Black Mountains; the hailstones varied in size from a walnut to a hen's egg. On the Llanthony Road they were five feet deep, and near Tredrenow they completely blocked the river, turning it from its course across the road and the adjoining land, so that trout and other fish were left on the fields. In south-east Clare, Ireland, there were extensive floods, which washed away roads, carried off sheep and pigs, and destroyed whole fields of crops. Five large stone bridges were carried away, and in one place a dead ass was left in a tree, fifteen feet above the ground, by the flood.

July 22, 1925. Thunderstorm over England.—Violent thunderstorms occurred at many places, including London, on the night of July 22–23. Hail occurred in places, especially in eastern London, where the hailstones were reported to be as large as a man's fist. Very many windows were broken, and corrugated iron was cut through by the hail. The amounts of rain and hail were very heavy.

July 24, 1818. Hailstorm in Orkneys.—A great storm of hail traversed a path 20 miles long and 1½ miles broad, at the rate of 4 miles an hour. At each place it lasted 9 minutes, during which time 9 inches of hail fell. During the passage of the storm the barometer fell 1·15 in.

July 25, 1743. Great Heat in Pekin.—Between July 14 and 25 Pekin suffered from glowing heat. Temperature rose to 121° F. and 11,000 men suffered from sunstroke.

July 25, 1910. Eruption of Usu-san (Japan).—An interesting, though by no means violent, eruption began in the small volcano of Usu-san in Hokkaido, the northern island of Japan. It was preceded by frequent earthquakes, 638 being recorded between July 22 and 25, in consequence of which all the inhabitants were removed from the district and there was no loss of life. The eruption consisted of small outbursts of ashes, without any lava, from a number of craterlets along a curved band north of the volcano. On Aug. 6 it was found that the land on the northern flank of the volcano was rising, and a portion 3000 yards long and 625 yards wide was uplifted until it became a new mountain. By the beginning of November, the elevation amounted to 510 feet, but, about this time, a reverse movement set in, and in April 1911 the height was 120 feet less than in the previous November.

July 26, 1798. Atmospheric Refraction.—At about 5 P.M. the coast of France became clearly visible from the shore at Hastings, Winchelsea, and neighbouring parts of the south coast of England, and appeared to be only a few miles away, although the distance is actually 40 to 50 miles. The various features of the French coast were easily recognised, and with a telescope even the buildings on shore. This phenomenon continued fully developed until after 8 P.M., when it gradually faded away.

Societies and Academies.

LONDON.

Physical Society, June 26.—**M. C. Johnson**: The effect of photosensitised mercury vapour on the walls of silica vacuum tubes. An investigation is made into some phenomena occurring at the gas-solid interface in the well-known experiments in which mercury atoms absorb energy from the radiation λ 2537 and then transfer that energy to other gas molecules at collision. It is shown that a combination of both condensation and liberation of gas at the surface of the apparatus must be taken into account, if the effects of irradiation of a gas mixture are to be traced by any of the usual methods of observing pressure changes.—**H. R. Nettleton** and **F. H. Llewellyn**: A sensitive rotating-coil magnetometer. This paper describes a sensitive rotating-coil magnetometer in which the flux due to the earth's field or to a magnet is neutralised by that due to a current passing through a fixed concentric compensating coil which forms with the rotating coil a variable mutual inductance. It shows how the first-order correcting term due to the length of the magnet may be made to vanish if the angle of contact be suitably chosen, and that the second-order correction may be eliminated by a correct choice of the dimensions of the coil.—**L. Hartshorn**: The frequency errors of rectifier instruments of the copper oxide type for alternating current measurement. Alternating current milliammeters containing copper oxide rectifiers possess frequency errors of an unusual type. The errors are almost independent of the instrument reading, and thus the percentage errors are inversely proportional to the current to be measured, and may be very large for small currents. It is shown that the errors are due to the capacities of the rectifiers, which, in milliammeters, are of the order $0{\cdot}09\mu F$.—**D. S. Perfect**: A method of eliminating the effects of magnetic disturbance in highly sensitive galvanometers. The paper describes a method of making correction for the chaotic fluctuations, of magnetic origin, to which the zero of a highly sensitive moving-magnet galvanometer is susceptible. The method consists in the employment of a second galvanometer with properties adjusted as nearly as possible to identity with, and placed as close as possible to, the first. No current is passed through the second galvanometer, which acts in this respect as a dummy the sole function of which is to record the zero changes.—**M. C. Marsh**: The thermal insulating properties of fabrics. One of the chief properties of a fabric is its thermal insulation, which prevents excessive heat-loss from the body. The paper gives a critical review of methods used in the past for measuring the thermal insulating properties. These are discussed with the view of making a new apparatus for the study of the subject.—**Wm. Band**: Classical quantum theory and X-ray excitation by canal-rays and alpha-particles. This paper shows, by application of the classical quantum theory and simple equations of energy, that it is not possible for canal-rays of normal experimental energy to remove K-electrons from the atoms of a metal target either by capture or by simple removal into free space.—**A. T. Mackay**: Diffusion from an infinite plane sheet subject to a surface condition; with a method of application to experimental data. The solution of the partial-differential diffusion equation for the infinite plane sheet is found by operational methods subject to a surface condition analogous to Newton's law of cooling.—**S. Tolansky**: Intensity modifications in the spectrum of mercury. The modifications produced in the spectrum of mercury

by the use of high-frequency discharges have been studied from λ7000 to λ2400, and the lines λ4916 and λ5461 have been examined with high resolving power for fine structure.

DUBLIN.

Royal Dublin Society, May 27.—**W. R. G. Atkins** and **E. Wyllie Fenton**: The distribution of pasture plants in relation to soil acidity and other factors. *Cynosurus cristatus*, *Lolium perenne*, and *Dactylis glomerata* are unimportant in soils of greater acidity than *p*H 5·5. Wild white clover is the main leguminous constituent of acid pastures, not more acid than *p*H 5, above which acidity *Ulex spp.* only occur. In dry soil at *p*H 8 in Cornwall *Medicago sativa* persisted well for six years, also *M. lupulina*. When allowed to roam freely, sheep and cows were found to graze only slightly on pastures with soil acidity exceeding *p*H 5. Extraction with dilute potassium chloride leads to large errors in determining soil *p*H values. **W. R. G. Atkins** and Miss **F. A. Stanbury.** Photo-electric measurements of illumination in relation to plant distribution. Pt. 3. Certain spruce, larch, oak, and holm oak woods. Simultaneous measurements were made of the illumination in and outside the woods, the ratio of total vertical to diffuse vertical illumination being also determined. From these the daylight factors were calculated. Under *Ilex aquifolium* the daylight factor was only 0·6 per cent and nothing grew. In the spruce and holm oak woods values such as 1-3 per cent were common, with 3-16 per cent in the larch wood and 2-11 in the oak wood. **C. P. Martin**: The raised beaches of the east coast of Ireland. The pre-glacial raised beach described by Wright and Maufe on the south coast of Ireland extends round on to the east coast and as far north as Co. Down. The Neolithic raised beach extends as far south as Co. Wexford. The dating of the Neolithic raised beach by human implements found in association with it is unreliable.

June 26. Report of the Irish Radium Committee for the year 1929. 14,730 mc. of radon were issued for therapeutic purposes. Reports from medical users give particulars of treatment of some 370 cases. **M. Grimes**, Miss **V. C. E. Kennelly**, and **H. A. Cummins**: A study of fungi found in butter.—Miss **V. C. E. Kennelly** and **M. Grimes**: *Paecilomyces hibernicum*; new species.

PARIS.

Academy of Sciences, May 19.—**M. D'Ocagne**: Pascal's arithmetical machine. This old machine has been put into working order, by simple replacement of worn or corroded parts. It is noteworthy that in Dr. Roth's machine (1841), one of the improvements claimed as new was realised in Pascal's machine.—**V. Grignard** and **J. Dœuvre**: The transformation of *l*-isopulegol into *d*-citronnellal. The isopulegol was passed over 50 cm. of glass wool, at 500° C., under a pressure of 25 mm. The β form of citronnellal was obtained with a good yield.—**Jean Baptiste Senderens**: The catalytic dehydration, in the gas phase, of the fatty alcohols in the presence of alkaline bisulphates. Fused sodium bisulphate acts on *n*-propyl alcohol vapour at 125°-140° C., giving water and propylene. Isopropyl alcohol reacts in the same way at 105°-110° C. The results obtained with methyl, ethyl, and isobutyl alcohols are also described.—**Jean Effront**: The chemical nature of amylose. Amylose is not a homogeneous product. At the temperature of the formation of starch paste, the starch undergoes a profound depolymerisation. During the ageing of starch solution, a molecular polymerisation is produced, giving rise to different hexosanes.—**W. Vernadsky**: Natural waters rich in radium. An account of the various amounts of radium found in various natural waters. The highest proportion found hitherto is in the subterranean waters accompanying a petroleum deposit at Novyj Groznyj in the Caucasus, amounting to more than 1×10^{-8} Ra per cent.—**Marcel Vasseur**: The equations of Laplace.—**A. Lokchine**: The influence of an elliptical hole in a beam which undergoes bending.—**G. Maneff**: The electromagnetic energy in the field of gravitation.—**Henry Favre**: An optical method for determining the internal tensions in solids of three dimensions.—**A. Bogros**: The structure of the lithium line 6708.—Mlle. **C. Chamie** and **Marcel Guillot**: The centrifugation of hydrochloric acid solutions of polonium. Photographic impressions of groupings of polonium atoms can be obtained with sufficiently active solutions of normal hydrochloric acid strength; and these give no precipitate on centrifugation. It has still to be proved whether these groups pre-exist in the solution or whether they are formed in contact with the surface on which they are photographed.—**E. Herzog** and **G. Chaudron**: Study of the mechanism of the corrosion of the duralmins by sea water. Under oxygen pressures up to 90 atmospheres the losses of weight of the alloys in salt solution are proportional to the pressure. The corrosion is very rapid and the corrosion requiring five or six months at the ordinary pressure can be obtained in 24 hours under high pressures of oxygen.—**P. Cordier**: A new diaryl-alkyloxysuccinic anhydride.—**Fr. de Rudder** and **H. Biedermann**: The pyrogenation of methane. The effects of the variables temperature (900 C. to 1500 C.), pressure (20 mm. to 760 m.) and time of contact with hot tube (15 sec. to 0·01 sec.) have been studied independently. The temperature appears to be the most important factor. The presence of catalysts does not affect the reaction.—Mme. **Ramart-Lucas**, Mlle. **Biquard** and **Grunfeldt**: The configuration of molecules in space. The absorption in the ultra-violet of the groups CH_3 and CH_2. The saturated normal fatty acids, $C_nH_{2n+1}CO_2H$, possess for ultra-violet light an absorption coefficient which is practically independent of n. In the region 2500–2200 A. the groups CH_3 and CH_2 cannot be regarded as chromophores.—**A. Wahl** and **Jonica**: The influence of substitutions on the colour shades of the sulphonated derivatives of stilbene.—**A. Duparque**: The causes of the differentiation of coals.—**Jean Lombard**: The Cretaceous of the Gabon coast line.—**Marcel Mascré** and **Maurice Herbain**: New experiments on the precipitation of nitrogenous substances in serums in the presence of formaldehyde.—**Henri Jean Frossard**: Arterial pressure and its measurement by the pulse method.

VIENNA.

Academy of Sciences, Mar. 20.—**J. Pollak**, **M. Heimberg-Kraus**, **E. Katscher**, and **O. Lustig**: The action of chloro-sulphonic acids on cyclic hydrocarbons. Sulpho-chlorides and other products were obtained from benzol, toluol, xylol, di-phenyl, and naphthalene.—**M. Holly**: Synopsis of the fresh-water fishes of the Cameroon.—**M. Beier**: Zoological expedition to the Ionian Isles and the Peloponnesus, 9th part, Crustacea. Amphipoda by **S. Karaman** and Decapoda by **O. Pesta**.—**A. Tornquist**: Perimagmatic types of east alpine ore deposits.—**B. Knaster**: One-dimensional non-comparable continua.—**K. Menger**: On laminable tri-graphs and powers of non-laminable graphs.—**K. Menger** and **G. Nöbeling**: The *n*-leg theorem in locally connected continua.—**G. Nöbeling**: A refinement of the *n*-leg theorem.—**G. Nöbeling**: *N*-dimensional universal spaces (2).

Official Publications Received.

BRITISH.

Transactions of the Edinburgh Geological Society. Vol. 12, Part 2. Pp. 189-288+plates 27-48. (Edinburgh.) 7s. 6d.

The Tea Research Institute of Ceylon. Bulletin No. 4: Annual Report for the Year 1929. Pp. 32. (Kandy.)

Rubber Research Institute of Malaya. Annual Report, 1929. Pp. 99. (Kuala Lumpur.) 1 dollar.

Natal University College. Magazine Commemoration Number, 1909-1930. Vol. 22, June. Pp. 108. (Pietermaritzburg.)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1929. Pp. 8. (Cape Town.)

The Proceedings of the Physical Society. Vol. 42, Part 4, No. 234, June 15. Pp. viii+293-354. (London.) 7s. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, June. Pp. 295-390+xxxvi. (London.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 11. Pp. 55+2 plates. (Hertford: Stephen Austin and Sons, Ltd.) 1s. 6d.

Journal of the Chemical Society. June. Pp. iii+1277-1511+x. (London.)

Canada. Department of Mines: Geological Survey. Memoir 160: The Disappearance of the Huronian. By T. T. Quirke and W. H. Collins. (No. 2207.) Pp. iv+129. 20 cents. Memoir 161: Lardeau Map-area, British Columbia. General Geology, by J. F. Walker and M. F. Bancroft; Mineral Deposits, by H. C. Gunning. (No. 2209.) Pp. iv+142. Memoir 162: Peat Bogs in Southeastern Canada. By Vaino Auer. (No. 2230.) Pp. ii+32. Economic Geology Series, No. 6: Fluorspar Deposits of Canada. By M. E. Wilson. (No. 2210.) Pp. vii+97. 20 cents. (Ottawa: F. A. Acland.)

Transactions and Proceedings of the Royal Society of South Australia (Incorporated). Vol. 53. Edited by Prof. Walter Howchin, assisted by Arthur M. Lea. Pp. iv+414+11 plates. (Adelaide.) 23s.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 20: The Genus Dictyoconus and its Allies; a Review of the Group, together with a Description of three new Species from the Lower Eocene Beds of Northern Baluchistan. By Lieut.-Col. L. M. Davies. Pp. 485-505+2 plates. 8s. 6d. Vol. 56, Part 2, No. 21: A Study of Apothecial Development in the Leaf-spot Disease of Red Clover. By Dr. S. G. Jones. Pp. 507-519. 1s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge for the Academical Year 1928-29. Published by Authority. Pp. 96. (Cambridge: At the University Press.)

FOREIGN.

Memoirs of the Geological Survey of China. Series A, No. 6: The Geology of the Kalgan Area. By Prof. George B. Barbour. Pp. xi+148+14 plates. (Peking.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 22: On the Distribution of Earthquakes in the Netherlands East Indian Archipelago. 2: 1920-1926, with a Discussion of Time Tables. By Dr. S. W. Visser. Pp. 116. (Weltevreden: Albrecht and Co.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 7: The Atmosphere and the Sun. By H. Helm Clayton. (Publication 3062.) Pp. 49. (Washington, D.C.: Smithsonian Institution.)

Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse. Nr. 9: Moskusokset i Øst-Grønland. Av B. Lynge. Pp. 19. Nr. 10: Dagbok ført av Adolf Brandal under en overvintring på Østgrønland 1908-1909. Pp. 73. Skrifter om Svalbard og Ishavet. Nr. 29: Franz Josef Land, Natural History, Discovery, Exploration and Hunting. By Gunnar Horn. Pp. 54. 5.00 kr. Nr. 30: Beiträge zur Kenntnis des Oberdevons Ost-Grönlands, von Anders K. Orvin; Oberdevonische Fischreste aus Ost-Grönland, von Anatol Heintz. Pp. 46+4 Tafeln. 4.00 kr. (Oslo: Jacob Dybwad.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 2: Report on the Diptera collected at the Station for the Study of Insects, Harriman Interstate Park, N.Y. By C. H. Curran. Appendix: Tipulidae and Ptychopteridae, by Charles P. Alexander. Pp. 21-115. (New York City.)

Japanese Journal of Geology and Geography: Transactions and Abstracts. Vol. 7, Nos. 3-4. Pp. iii+73-113+15. (Tokyo: National Research Council of Japan.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 5: Fauna Buruana; Aves. Von H. C. Siebers. Pp. 165-303. 2.50 f. Vol. 11, Livraison 4. Pp. 373-507 2.50 f. Vol. 12, Livraison 1. Pp. 119. 2.50 f. (Buitenzorg: Archipel Drukkerij.)

Publications de l'Observatoire de Genève. Rapport sur les concours de réglage de chronomètres de l'annee 1929. Par Georges Tiercy. Pp. 82. (Geneve.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. On the Genus Nyctiperdix; Relationships and Distribution of the Bare-throated Francolins; Geographical Variation in Cinnyricinclus Leucogaster. (Fifth, Sixth and Seventh Preliminary Papers on Birds collected during the Gray African Expedition, 1929.) By W. Wedgwood Bowen. Pp. 145-167. (Philadelphia.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 162: Tides and Currents in Chesapeake Bay and Tributaries. By F. J. Wright and H. E. Finnegan and G. L. Anderson. Pp. vi+145. 65 cents. Special Publication No. 165: Slope Corrections for Echo Soundings. By A. L. Shalowitz. Pp. 24. 10 cents. (Washington, D.C.: Government Printing Office.)

National Research Council. Transactions of the American Geophysical Union, Tenth Annual Meeting, April 25 and 26, 1929, Eleventh Annual Meeting, May 1 and 2, 1930, Washington, D.C. Pp. 314. (Washington, D.C.: National Academy of Sciences.)

Department of the Interior: U.S. Geological Survey. Bulletin 788: Topographic Instructions of the United States Geological Survey. Index. Pp. v+421-432. Bulletin 811-A: The New World or Cooke City Mining District, Park County, Montana. By T. S. Lovering. (Contributions to Economic Geology, 1929, Part 1.) Pp. vi+87+25 plates. 50 cents. Bulletin 812-C: Geology and Coal Resources of the Meeker Quadrangle, Moffat and Rio Blanco Counties, Colorado. By E. T. Hancock and J. B. Eby. (Contributions to Economic Geology, 1929, Part 2). Pp. iv+191-242+plates 19-30. 30 cents. Bulletin 812-D: Geology and Oil Resources along the Southern Border of San Joaquin Valley, California. By H. W. Hoots. (Contributions to Economic Geology, 1929, Part 2.) Pp. vi+243-338+vi+plates 31-48. 50 cents. Bulletin 813-C: Mining in the Fortymile District, Alaska. By J. B. Mertie, Jr. (Mineral Resources of Alaska, 1928.) Pp. ii+125-142. 5 cents. Bulletin 816: Geology of the Eagle-Circle District, Alaska. By J. B. Mertie, Jr. Pp. v+168+12 plates. 50 cents. Professional Paper 158-I: Borate Minerals from the Kramer District, Mohave Desert, California. By Waldemar T. Schaller. (Shorter Contributions to General Geology, 1929.) Pp. ii+137-173+plates 22-27. 20 cents. Professional Paper 165-A: Lithologic Studies of Fine-grained Upper Cretaceous Sedimentary Rocks of the Black Hills Region. By William H. Rubey. (Shorter Contributions to General Geology, 1930.) Pp. iv+54+5 plates. 25 cents. Professional Paper 165-B: A Flora of Green River Age in the Wind River Basin of Wyoming. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1930.) Pp. ii+55-81+plates 6-15. 20 cents. Water-Supply Paper 606: Surface Water Supply of the United States, 1925. Part 6: Missouri River Basin. Pp. vi+252. 30 cents. Water-Supply Paper 619: Geology and Water Resources of the Mokelumne Area, California. By H. T. Stearns, T. W. Robinson and G. H. Taylor. Pp. xii+402+21 plates. 1.25 dollars. Water-Supply Paper 624: Surface Water Supply of the United States, 1926. Part 4: St. Lawrence River Basin. Pp. v+163. 20 cents. Water-Supply Paper 625: Surface Water Supply of the United States, 1926. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+170. 20 cents. Water-Supply Paper 626: Surface Water Supply of the United States, 1926. Part 6: Missouri River Basin. Pp. vi+228. 25 cents. Water-Supply Paper 627: Surface Water Supply of the United States, 1926. Part 7: Lower Mississippi River Basin. Pp. iv+98. 15 cents. Water-Supply Paper 636-F: Water-Power Resources of the Umpqua River and its Tributaries, Oregon. By Benjamin E. Jones and Harold T. Stearns. (Contributions to the Hydrology of the United States, 1929.) Pp. vi+221-320+plates 15-25. 40 cents. Water-Supply Paper 637-A: Surface Water Supply of Minor San Francisco Bay, Northern Pacific and Great Basins in California, 1895-1927. By H. D. McGlashan. (Contributions to the Hydrology of the United States, 1930.) Pp. vi+68. 10 cents. (Washington, D.C.: Government Printing Office.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 2. Pp. 155-261. (Tokyo and Sendai: Maruzen Co., Ltd.)

CATALOGUE.

Ephedrine B.D.H. Pp. 10. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, JULY 18.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women), at 5.30.—Mrs. Ursula Roberts (Susan Miles): The Nature of Prose.

FRIDAY, JULY 25, TO *THURSDAY*, AUGUST 7.

GEOLOGISTS' ASSOCIATION.—Summer Field Meeting in the St. David's District, Pembrokeshire.

COLLOQUIUM.

JULY 19 TO 30.

ST. ANDREWS MATHEMATICAL COLLOQUIUM (in University Hall, St. Andrews).

Prof. H. F. Baker: Rational Curves and Surfaces.
Dr. H. W. Richmond: Arithmetical Properties of Curves and Surfaces.
Prof. C. G. Darwin: The Wave Mechanics.
Prof. H. W. Turnbull: Elementary Mathematics from the Higher Standpoint.
Dr. A. C. Aitken: Recent Developments in Symmetric Functions, Determinants, and Algebraic Equations.
Theory of Functions.
Prof. E. T. Whittaker and others: Informal Talks.

CONFERENCES.

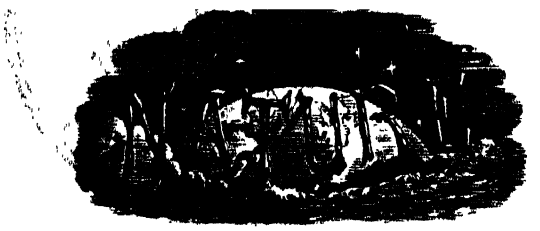
JULY 20 TO 25.

INTERNATIONAL CONGRESS OF MICROBIOLOGY (at Institut Pasteur, Paris).—In three sections, devoted respectively to Medical and Veterinary Microbiology, Ecology and Immunology, and Botany and Parasitology.

JULY 21 TO 24.

BRITISH PHARMACEUTICAL CONFERENCE (at Cardiff).

Monday, July 21, at 8 P.M. (in City Hall).—Civic Reception.
Tuesday, July 22, at 10 A.M. (in Technical College).—J. T. Humphrey: Chairman's Address.
Science Meeting.
At 4.30.—Education Meeting.
Wednesday, July 23, at 10 A.M. (in Technical College).—Science Meeting.
At 2 (in Technical College).—Science Meeting.
Thursday, July 24, at 10 A.M. (in Technical College).—Closing Session.



SATURDAY, JULY 26, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Rationalisation of Research.

FOR the plain man and, even more, for the scientific worker and many Empire industries, it is extremely desirable that some authoritative pronouncement should be issued detailing the *raison d'être* and the lines of work of the several institutions and research centres in Great Britain which are endowed or supported by Government grants. Even the scientific worker of the present day may be pardoned if he finds it difficult, amongst an apparently bewildering number of institutes and research centres, to pick out the one at which he can obtain the most authoritative information upon the work in which he is interested; for the industrial inquirer the position is even more difficult; whilst the farmer is often hopelessly lost, when all he requires to know is the reason why a portion of his crop is failing. The farmer wants the answer at once: he has lost all interest (having lost that part of his crop) six months later, when an answer may arrive, after he has been sent from pillar to post.

The last few years have witnessed the advent of the Imperial Economic Committee, the Empire Marketing Board, the Government research laboratories connected with the Army, Navy, and Air Force, the several agricultural research and experimental stations now in existence in the country, increased by special lines of research undertaken at the Universities of Cambridge, Edinburgh, and so forth; the Forest Products Research Laboratory at Princes Risborough, the Imperial Forestry Institute at Oxford, etc. Among these centres are some which are not directly endowed with Government grants. The rest, under the supervision of the first or second body above mentioned, are, it is believed, influenced or stimulated to carry on work and to build up collections; the latter being either on a local or home standard, or on the far larger and more costly Empire one—these collections requiring buildings for housing and staff to look after them. In other words, the pendulum has swung with a vengeance and the pre-War apathy appears now to be leading the country into unnecessary (because unorganised) duplication of centres, buildings, exhibits, and so forth.

Before the War the scientific inquirer had a few well-known centres to which he resorted for information. To take two examples: Kew, with

its unrivalled collections of plants, timbers, and so forth—a collection of such excellence that it would take years to reproduce anything similar; and anything of less value would still necessitate the inquirer or student, having access to it, visiting Kew to complete his studies and investigations. Another centre designed for answering economic inquiries and for housing collections of economic products was the Imperial Institute—starved of funds for many years, it is true, but still inaugurated with a definite economic aim.

What is the position of the Imperial Institute to-day? From the annual report for 1929, written by the director, Lieut.-General Sir William Furse, and recently issued, it would not be easy for any but the highly technical expert to frame an answer: and the ordinary scientific worker and specialist inquirer would perhaps find it extremely difficult. For the report furnishes plentiful evidence that the Institute is engaged upon a wide series of economic inquiries and investigations involving elaborate research work. How is this co-ordinated with other research centres receiving Government grants?

It may be assumed that both the home government and all the dominion governments have a full belief in the importance and value of the work of the Institute. The high commissioners of all the latter are members of the board of governors; the trustees include several cabinet ministers; government departments are represented on its managing committee, as also are well-known men of science and others representing commercial interests. The Institute consists of several departments: for example, plant and animal products department, of which Sir David Prain is chairman of the advisory council; mineral resources department, of which Sir Richard Redmayne is chairman of the advisory council; Ceylon rubber research scheme; sericulture research. Investigations into vegetable fibres, timbers, crops for Kenya Colony, improvement of Burma rice, and many other important investigations are dealt with in the annual report.

The work carried out by the Institute with the approbation of the Government, and more important still, the Treasury, is of the greatest value, and its inception, although for so long cold-shouldered, may be regarded as an inspiration. The Institute is a centre to which all can resort, the serious investigator and the citizen who wishes to understand something of the great Empire of which he is privileged to be a member. The educational value of the Institute has been increased by the addition of a cinema, and the provisions made for the visits of parties of school children; and no finer educational centre for the youth of Great Britain could be found.

This being the present position, has not the time arrived when it becomes the duty of Government, in the interest both of the taxpayer and to prevent the wasteful and unnecessary duplication of work, buildings, and exhibits, to have a list drawn up of all institutions existing in Great Britain which are maintained either wholly or in part from Government funds or grants? This list should give details as to the exact nature of the work carried out by each; the reason or necessity for acceding to the demands for extra buildings to accommodate exhibits, perhaps already existing in other institutions in the country, extra staff, and so forth. With such a list available it might be found that Government was making grants to institutions for the purpose of carrying out work which was already being undertaken efficiently by existing institutions.

There would appear to be little doubt that such an inquiry is needed to avoid further waste of money both on the part of the home government and on those of dominions and colonial governments. The latter, as is well known, have received many calls of recent years to collect and forward specimens of a varying nature, many of these requirements being duplications of previous ones already furnished to other institutions. Further, in certain cases these governments are being invited to make grants of money to specialised educational or research centres in Great Britain. It would seem a duty imposed on the home government to be in a position to place before them a list of all centres engaged in the particular line of education or research.

It is known that duplication of the kind to which attention is here directed does exist. It is also known that the average scientific investigator and the commercial man, unless in close touch with the centre of affairs, is bewildered by the apparent multiplicity of institutes and research centres some of which are apparently undertaking work, or competing with each other (in some instances unknowingly), in the same field. A list of Government aided research institutions such as we have suggested above would largely prevent this duplication of effort and, what is perhaps indirectly even more important, would lead to wider use and fuller appreciation of the services which they can render to both science and industry.

The Compleat Anthropologist.

Notes and Queries on Anthropology. Fifth edition. Edited for the British Association for the Advancement of Science by a Committee of Section H. Pp. xvi+404. (London: Royal Anthropological Institute, 1929.) 6s.

THE first edition of this indispensable guide to field anthropology was published in 1874 "to promote accurate anthropological observation on the part of travellers, and to enable those who are not anthropologists themselves to supply the information which is wanted for the scientific study of anthropology at home". This was a counsel of perfection; but there were no schools of anthropology in Britain then, and very few elsewhere, and the risks of mistakes of observation were not fully appreciated, as a glance at the first edition shows. Successive editions, and especially the fourth, in 1912, substituted for many of the original lists of direct questions a short outline of the kind of information already acquired, with hints as to topics most worth elaborating. It was realised that the whole subject of physical anthropology was best left to medically trained observers, and psychology to psychologists; and the general advance in method was held to necessitate careful definition of many of the commoner phrases and terms, especially for those complex social systems which were now attracting the special attention of home-workers, and eliciting some valuable observations in the field.

In the present fifth edition, the 'notes' have still further been expanded at the expense of the 'queries', and the whole work has grown almost beyond pocket-book size: the fourth edition runs to 288 pages, the fifth to 404. The increase is mainly in the section for "sociology", which has been more than doubled in length; "marriage and sexual relations" alone being allowed seventeen pages instead of three, and the "regulation of public life" twenty instead of about six differently grouped. The economic sections also have been very much remodelled. All this reflects current tendencies in "anthropology at home", and the realisation that customs are much more difficult to collect than war-clubs. The numerous definitions which have been thought necessary are very carefully done; but some of them may have to be undone before this edition is exhausted. Too often one has seen the definition of an anthropological word in an earlier edition of "Notes and Queries" used as a starting-point for a systematic restatement of a whole problem. The new section on "Law and Justice" is admirably planned, and should be of the greatest use to administrators of native communities: it puts the old sections on "property", "land tenure", and "inheritance" into a coherent setting, and it is a question whether "slavery" should not be grouped with them. The old section on "morals" seems to have vanished; but "psychology" has come back, with sections on "primitive mentality" and on "dreams". It is always difficult to draw the line between pure and applied science, and usually the compilers of this edition have been discreet; but there is a lapse on p. 171 where, in a matter of child-psychology, "this point has been brought forward not so much for its anthropological as for its administrative value": followed by remarks about depopulation, its causes, and a "better position to deal with the problem", which are not anthropology at all.

When the fourth edition was published, the study of magic and of religion was in a chaotic and transitional phase, which gave popularity to the comfortable term 'magico-religious' to describe this whole group of facts. This usage apparently persists but it is qualified by quite wholesome attempts to define both 'religion' and 'magic' before going on to discuss what may turn out to be either; and the suggestions supplementary to the general requirement of "sympathy and gentlemanly behaviour" in an anthropologist are excellent. It is a much-needed caution (pp. 177-178) that while very few occurrences in the life of uncivilised peoples are without their religious aspect and ingredient, quite as few religious beliefs or observances are unrelated to some occurrence or need in daily life: "pure religion and undefiled", in the philosophical and personal sense, is one of the more ethereal distillates of advanced cultures; and the occasions for religious acts are rightly noted as being no less social than economic. The importance of native accounts of what happens, and of the native terminology for 'gods', 'devils', and other 'magico-religious' paraphernalia, is also very properly emphasised. The short section (p. 184) on "hero-cult" would have afforded almost no help at all to a field worker in ancient Greece, and would be little more useful anywhere else. Of how many known 'heroes' is it true that "when a hero is associated with war a cult begins to appear"? and when heroes are "associated with death", what does this mean?

Under "Arts and Sciences" the section on "decorative art" has been remodelled, and occasion should have been taken to bring its terminology up-to-date, and emphasise the import-

ance of descriptions to supplement sketches. An unusually detailed specification of 'musical' instruments reflects the current interest in jazz; there are apparently about fifty ways of making a noise by hitting something, and for sheer self-expression give me the "open tubes which are stamped on a man's thigh" (p. 298). The directions for recording native languages are entirely re-written; much doubtless good advice is given; the "wise observer will resist the temptation to invent an alphabet of his own": but the Royal Geographical Society's excellent rules for transliterating place-names (and they can be used for much besides) have been cut out. The alphabet of the International Phonetic Association is recommended instead, but not supplied.

The valuable sections at the end, on photography and the collection of specimens, have been brought up-to-date; and there is a fresh note on the kinematograph, in which the sole omission is advice on the difficult art of bringing scientific films into Great Britain.

For the very moderate price of six shillings, this is a very handsome outfit of instruction, and suggestion also: and the convenient arrangement is continued whereby the book, though prepared for the British Association, is published and distributed by the Royal Anthropological Institute from its library at 52 Upper Bedford Place, W.C.1.

J. L. M.

Early Literature of Acarology.

Tijdschrift voor Entomologie. Uitgegeven door de Nederlandsche Entomologische Vereeniging onder redactie van Dr. J. Th. Oudemans, Prof. Dr. J. C. H. De Meijere en Dr. A. C. Oudemans. Deel 69, Jaargang 1926. Supplement: *Kritisch historisch overzicht der Acarologie.* Eerste Gedeelte, *850 v.C. tot 1758.* Pp. viii + 500. Deel 72, Jaargang 1929. Supplement: *Kritisch historisch overzicht der Acarologie.* Tweede Gedeelte, *1759–1804.* Pp. xvii + 1097. ('s-Gravenhage: Martinus Nijhoff, 1926–1929.)

AMONG the Arthropoda, the Acarina, or mites and ticks, would not generally be considered the most attractive group. It is, therefore, somewhat surprising to find that they have received a large amount of attention from the earliest times. This is no doubt due to the fact that to their presence is attributable a long series of highly disagreeable consequences; and that man himself, his food materials and his domestic animals, have suffered conspicuously from their depredations.

The two parts now published of Dr. Oudemans' historical review contain an exhaustive account of everything that has been written on the subject down to the year 1804; a forthcoming part will carry the story on to the year 1850. The scope of the work being mainly historical, we do not find much space devoted to classification or to minute structural detail; the wealth of information, however, on such points as the external characters, habitat, life-history, and distribution of the various species is amazing, and gives evidence of extraordinary labour on the part of the author. As an encyclopædia of the knowledge of the subject up to the beginning of the last century, these volumes will have a permanent value.

Whether the opprobrious terms addressed in the Iliad by Ares to Athene, and applied by Hera to Aphrodite, can be held to refer to any member of the Acarina may be thought doubtful, but that Dr. Oudemans is right in identifying the tormentors of Argus, the faithful dog of Odysseus, with a well-known species of the Ixodidæ need not be questioned. Other references in the classics that may apply to mites or ticks are numerous, but in many cases there is an evident confusion between the Acarine pest and the true louse, which was naturally not recognised as belonging to another class of the Arthropoda. Aristotle, however, distinguishes clearly between the louse and the tick: the ass, he says, is not infested by either; oxen, on the other hand, suffer from both. Ticks, but not lice, are found on sheep and goats. The name that he gives to the external parasite of the dog is the same as Homer's in the Odyssey; and also in a fable which he attributes to Æsop the same word is used of vermin that were draining the blood of an unfortunate fox.

The uncertainty that besets all attempts at identification of the forms mentioned by ancient authors becomes gradually cleared away as we approach our own times. It is not, however, until the introduction of the binomial system of nomenclature by Linnæus in the tenth edition (1758) of his "Systema Naturæ", that the determination of species becomes to any large extent possible. Some descriptions of an earlier date are, however, sufficiently exact to enable us to be reasonably sure that we know the species referred to. The *Araneus indicus coccineus major*, for example, brought from the coast of Coromandel, and described by Petiver in 1701, is without doubt the mite now known as *Trombidium gigas*. There are, moreover, many records of observations made in the seventeenth and eighteenth centuries which anticipate in a remark-

able manner the results obtained by work conducted on the lines of modern systematics. Among those dealt with by Dr. Oudemans are the discovery by Leeuwenhoek (1694) of the six-legged larva of the mites; the description of the mouth parts of ticks in a letter by an anonymous contributor to the *Philosophical Transactions* of the Royal Society (1703); the observation by Linnæus that *Tetranychus telarius*, commonly known as the 'red-spider', spins threads with which it covers the stems and leaves of trees. A graphic account of the habits of the larval *Thrombidium pusillum* (the too-well-known 'harvest bug'), with some mention of structural details, was given by Baker in 1753. Some years before this the earliest description of the larva of a Hydrachnid, or water-mite, was published by Joblot, who adds to his account a figure, obviously exaggerated, of the dorsal sculpture of this creature, showing a grotesque resemblance to a human face.

In his second volume Dr. Oudemans treats of the further information gained on the whole assemblage since the year 1759; ending his survey with the year 1804. A brief summary is given of the earlier attempts made at a classification of the group, a problem which even at the present day is far from having received a satisfactory solution, Trouessart's scheme, adopted in the main by Warburton in the "Cambridge Natural History", being probably at present the most convenient in practice. By the naturalists of the seventeenth century the term *Acarus* was used in a very wide sense, including, according to Dr. Oudemans, larvæ of Coleoptera, Lepidoptera, and Diptera. Successive approximations to a reasonable restriction of the term were made by O. F. Muller (1769), Fabricius (1775), and Latreille (1795). Dr. Oudemans, being an advocate of strict adherence to the rule of priority in nomenclature, has thought it his duty to revive several of the older names in place of those now commonly used. Thus in the subgenus *Platyseius* he sinks his own specific name *subglabra* in favour of *tendens* Schrank, which dates from 1803. The well-known pigeon-tick, hitherto generally spoken of as *Argas reflexus* Fabr., reverts to its original designation of *Argas columbarum* Shaw. So, too, Latreille's *Caris vespertilionis* (1802) becomes *Acarus testudo* Risso (1790). The author is no lenient critic of mistakes in nomenclature; he does not spare what he considers to be the mistaken following of Neumann in the Cambridge "Monograph of the Ixodoidea".

The numerous illustrations, reproduced from the figures in the original works of authors up to the beginning of the nineteenth century, serve to justify Dr. Oudemans' contention that many Acari were well described and figured in quite early times. There is, nevertheless, much evidence that the producers of these descriptions and figures, careful observers as they were, did not always succeed in appreciating fully the significance of what they saw. Through the maze of conflicting records and determinations, Dr. Oudemans' important work is a safe and sufficient guide.

Apart from a few trifling printers' errors, the only serious misprint that we have noticed occurs in a passage cited from Aristotle on p. 51 of Part 1. Here, though all the words are good Greek, the opening sentence of the speech is unintelligible as it stands. Fortunately the necessary emendation is quite obvious. F. A. D.

Modern Volumetric Analysis.

Volumetric Analysis. By Prof. Dr. I. M. Kolthoff, with the collaboration of Dr. H. Menzel. An authorised translation based on the German Text by Prof. N. Howell Furman Revised and enlarged by the Author Vol. 2: *Practical Volumetric Analysis.* Pp. xiv + 552. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1929.) 25*s*. net.

FOLLOWING on Vol. 1 dealing with the general theory of volumetric analysis, Dr. Kolthoff has produced a work on practical methods which in its way is different from the well-known standard works dealing with the subject. The author does not claim to deal particularly with special methods of applied chemistry, but, as a matter of fact, the general considerations and the exhaustive discussion of general methods suffice to give the reader the necessary indications for accurate procedure. As an example of this, we have in Chap. xiii. what appears at first sight to constitute a general discussion of certain methods. Actually the chapter is a very full description of iodometric processes for both inorganic and organic compounds. The limitations of the methods and the author's experience are given, the discussion of the errors and details being full enough for most purposes: for example, the discussion of the hydroquinone titration on p. 453. A short chapter is devoted to the useful iodate method developed by Andrews, and the use of bromate is likewise properly stressed.

The greatest interest of the book lies in its development of the fundamentals of volumetric analysis. The chapter on calibration of measuring vessels, for example, puts the subject as succinctly

as can be desired from a general point of view. There are some considerations, however, on this matter which might have been further emphasised. It should be pointed out even more strongly than is done in this work that for the highest accuracy in volumetric analysis, the weight burette is essential if drainage and wetting errors are to be avoided. For micro-work these errors are even more important. We are furnished with tables of ' tolerances ' for measuring vessels as laid down by various standardising institutions, but it is not clearly indicated that an error of nearly 0·5 per cent in a volumetric determination of a constituent is possible, even when the highest grade of volumetric apparatus (with the usual tolerances) is used. This is apart from errors due to purity of the standard reagents (see Stott, *J. Soc. Chem. Ind.*, **40**, 64 T ; 1921).

Chap. ii. deals with a most important—and perhaps the most important—requirement of accurate volumetric analysis, namely, the selection of a true standard substance and the specification of such a standard. Wagner, Kühling, Sörensen, and others have advocated rightly the selection of the least number of ' standard ' substances and have laid down certain principles for testing the standard. Various suggestions to this end receive consideration and the arguments advanced by different authorities are considered, with the result that rules are laid down (p. 47) for the requirements of a standard substance, particularly the all-important question of stability and keeping properties. There is one point in this connexion that we do not think receives adequate recognition. It is not difficult to apply certain tests for purity to a standard substance, but an important matter is to determine as accurately as possible the actual content of the standard substance, for example, sodium chloride, by an accepted gravimetric method of high accuracy. Such a test settles the adequacy of the standard, particularly of a stable standard.

In the section dealing with standardisation of acids, a number of primary standards is given, and it is satisfactory to note that the potassium iodate method receives proper consideration. The methods of ' argentometry ' are described in great detail in Chap. viii., which likewise contains a full account of Fajan's adsorption indicators. This section makes pleasant reading, inasmuch as it indicates very clearly indeed that the subject is really a branch of physical chemistry. The last two chapters deal shortly with some of the more recent oxidising agents such as ceric sulphate, and with the general applications of titanous solutions. The work is very fully indexed.

Two points of criticism need to be made, namely, the continued use of the atomic weights of 1925, which includes titanium as 48·1, and the use of c.c. instead of ml. It is difficult to understand the latter feature in a book of this character, so philosophical in other respects. Dr. Kolthoff's two books on " Volumetric Analysis " occupy a position by themselves, inasmuch as they deal with the subject from the point of view of modern theoretical chemistry. The reader cannot fail to perceive a new presentation of old subjects, for example, pp. 279-284 on permanganate oxidations. The whole work is to be commended, alike for the use of students and for general reference.

J. J. F.

A Directory of the Learned World.

Index Generalis : Annuaire Général des Universités, Grandes Écoles, Académies, Archives, Bibliothèques, Instituts scientifiques, Jardins botaniques et zoologiques, Musées, Observatoires, Stés Savantes. Publié sous la direction de Dr. R. de Montessus de Ballore. Pp vi + F170 + BE228 + US213 + E39 + 2322. (Paris : Éditions Spes, 1929-30.) n.p.

IN scope, as indicated by the sub-title, this annual is akin to the well-known " Minerva Jahrbuch der gelehrten Welt ". It is, however, very much less exhaustive, and the two publications differ in the methods of arrangement of their material. " Minerva " presents, gazetteer-fashion, a single series of sections arranged in the alphabetical order of the names of towns. The " Index Generalis " provides a catalogue *raisonné* under the following group headings : Universities and " grandes écoles " (1147 pages), astronomical observatories (95 pages), libraries and archives (270 pages), scientific institutes (118 pages), learned societies and academies (190 pages). Within each of the first four groups the arrangement is by countries ; the last group is subdivided according to subject and, within each subject, by towns, irrespective of country. There is, of course, an alphabetical index of names of persons—65,000 references—and, finally, there are geographical tables enabling one to find one's way to the whole of the information given regarding any particular place.

Many of the notices of the various institutions, etc., some 6500 in number, are in their native languages, where these are French, English, German, Spanish, or Italian. The date (year) up to which the information has been corrected is in most cases

given. Prefixed to the sections relating to the universities of France, the United States of America, Spain, and Italy, are short accounts of the organisation of higher education in those countries. An account is also given of the organisation of studies in the University of London, as being typical of British universities in general. In the index of persons' names references are not merely to pages but also to subdivisions of pages. The pages being small and the names being printed in bold type, this makes the tracing of references an easy matter. Provision is made for enabling authors who wish to exchange original memoirs with others to advertise the fact.

In the preface, contributed by M. Appell, the well-known Rector of the University of Paris, it is claimed as a merit of the method of arrangement adopted that it shows "avec une clarté toute française le rang de chaque pays au point de vue intellectuel": a thankless service, of dubious value, more likely to attenuate than to strengthen those relations on the intellectual plane between the peoples of the world which are to pave the way, according to M. Appell, for the advent of the veritable League of Nations. It would be easy but profitless to compare and comment on the allocations of space in the "Index" to the various countries, but there is one country the almost total exclusion of which compels remark, the more so in that its cultural relations with France were once very close—Russia. The only references under the heading U.S.S.R. are to two astronomical observatories, and the same remark applies to the Ukraine and Turkestan. It would seem that the editor holds the conditions of a socialist State to be such as to vitiate the pursuit of all branches of knowledge, except knowledge of the celestial bodies! Minerva (1930) devotes 59 pages to Moscow alone and gives information about universities at fourteen places in Russia which are not even mentioned in the "Index Generalis".

The preparation of the chapter relating to universities in the British Empire was, or could have been, made comparatively easy by using the "Universities Yearbook of the British Empire". Recourse to this could have prevented such mistakes as omitting the University College of Swansea and London Day Training College, and the teaching staff of the largest English university college for women (Bedford).

Although still marred by deficiencies in regard to balance and too many inaccuracies in detail, the "Index Generalis" has greatly improved since its first appearance in 1919.

Our Bookshelf.

Hyde Park: its History and Romance. By Mrs. Alec. Tweedie (*née* Harley). Abridged revised edition. Pp. vii + 239 + 29 plates. (London: Besant and Co., Ltd., 1930.) 3*s.* 6*d.* net.

THIS is an abridged and revised edition of a book published in 1908, which in many parts has been largely rewritten. For Mrs. Tweedie's point is that of to-day. She brings the story of Hyde Park down to its mobilisation in 1926 during the great strike, and refers to the danger of Socialist proposals to-day for its popularisation as a sports ground. She follows the Park through its many vicissitudes from the grants of land east of Tyburn from the King to St. Dunstan in 960 and of Geoffrey de Mandeville, who fought at Hastings, of the Manor of Hyde to the abbey at Westminster. Under the Tudors after the suppression of the monasteries it became a Royal hunting-ground; but it was not until the return of Charles II. that it really entered upon its function as a centre of social gathering, primarily for the Court and its hangers-on. For long the people were not admitted. Nevertheless, Hyde Park serves as focus for more than one side of our earlier social history. Its neighbourhood was infested with footpads and highwaymen, and Tyburn, with its sinister associations of the hangman and the 'Triple Tree', was within its purlieus.

Mrs. Tweedie's book is an entertaining and gossipy narrative, instructive in its glimpses of English life and history; but she is a mistress of irrelevance. This is not entirely a fault, as it usually permits her to introduce matter which adds colour to her background. Little asides of social incidents and changes to-day, perhaps not even remotely connected with the Park, will have a value for the historian of the future. Their place and meaning become clearer when it is understood that the pageant "Heart of Empire" to be held at the Albert Hall in October next while the Imperial Conference is sitting is based upon the book. No doubt Mrs. Tweedie had in mind the public before whom the book will be brought in this way. They will treasure it in the future when overseas, perhaps most of all for these same little touches from the London of to-day.

L' atomistica moderna e la chimica. Per Dott. M. Haissinsky. Pp. xiv + 315. (Milano: Ulrico Hoepli, 1930.) 35 lire.

THE enormous strides made during the past few years in the knowledge of the inner structure of the atom, developed principally by physicists making use of physical and physico-mathematical methods, have led to the publication of numerous works dealing with this branch of modern physics. The author considered, however, that a need existed for a book dealing with such subjects more from the chemical point of view. In the preparation of the present volume, the requirements of the chemist in particular have, therefore, been borne

in mind, and the treatment adopted should present little difficulty to any reader conversant with the ordinary fundamental conceptions of physical chemistry.

The first two chapters are devoted to elementary notions concerning molecules, atoms, electrons, thermodynamics, and the quantum theory. The third treats of the Bohr atom as the basis of modern atomistics, emphasis being laid on points of immediate importance in the study of chemical problems. The remainder of the book is concerned with atomic chemistry proper, and is dominated by the fundamental idea that chemical phenomena are due to the laws governing physical phenomena in general, namely, the laws of energetics and probability. The extent of the ground covered may be judged from a brief summary of the contents of the book, these including: Electronic theory of valency; Bohr's theory and its applications; electronic structure and ionic radii; deformation of electronic orbits; photochemistry; radiochemical hypothesis; catalysis and adsorption; wave mechanics, and Fermi's statistics.

Each chapter is followed by a useful bibliography, and an author index and a list of the tables included in the text are given at the end of the book. The print is good, the proofs have been carefully revised, and the whole is well up to the Hoepli standard of production. The price is commendably moderate.

Mechanism of Enzyme Action and Associated Cell Phenomena. By F. F. Nord. Pp. ix + 78. (London: Baillière, Tindall and Cox, 1929.) 9s. net.

WITH our present knowledge of enzyme processes any conception of their mechanism must be essentially highly speculative. In the work under notice the author makes no claim to deal comprehensively with the subject of enzyme chemistry, but confines himself to a limited aspect of this wide field. The book deals almost exclusively with the subject of yeast fermentations, while the probably related subject of muscle chemistry and the various other enzyme processes of animal physiology receive little or no attention.

The work of Harden and Young on alcoholic fermentation is summarised and discussed in conjunction with the findings and views of other workers in this field. Evidence for the presence and rôle of intermediate compounds in yeast fermentations is examined, and a short account is given of the information obtained as to the course of fermentation reactions by the use of alkaline sulphite as a means of influencing the part played by acetaldehyde as an intermediary. A whole chapter is devoted to the discussion of the problem of 'activation' of enzymes, and particular attention is directed to the part played by simultaneous reduction and oxidation in fermentation processes.

In its literary style the work is somewhat laboured and occasionally obscure, while the execution of the diagrams also leaves much to be desired in the way of clarity. The information presented has obviously been carefully collated; nevertheless, the reviewer has been unable to find authority for the statement, on p. 10, that the gamma fructose present in cane sugar is partially enolised.

A good bibliography greatly increases the value of the book as a concise presentation of the chemistry of yeast fermentations.

Histoire des sciences mathématiques dans l'antiquité hellénique. Par Prof. Gino Loria. (Science et civilisation: Collection d'exposés synthétiques du savoir humain.) Pp. vi + 215. (Paris: Gauthier-Villars et Cie, 1929.) n.p.

THIS is probably the best short history of Greek mathematics which has yet been published. It has all the clearness and charm of a French popular exposition of a difficult subject; it also gives, unfortunately (in the copy submitted for review), a striking proof of the carelessness of French book-production, fourteen pages being entirely blank!

Prof. Loria gives a brief general sketch of the earliest steps, with the presumed debt to Egypt and Babylonia, takes a conservative view as to Thales and Pythagoras, and reserves most of his space for the later mathematicians whose works are extant. He is particularly good on Euclid, Archimedes, and Apollonius, and enlivens the end of his little book by several examples of the amusing concrete problems in which the Greeks delighted and which were sometimes engraven on the tombs of their ancestors.

There is a very useful short chapter at the end, giving the applications of Greek mathematics to their astronomy and views of the universe. This supplies the link needed in many accounts of early Greek science. The bibliography is well chosen and up-to-date, giving both the latest editions of the texts and the best books discussing the results.

F. S. M.

List of the Vertebrated Animals exhibited in the Gardens of the Zoological Society of London, 1828–1927. Centenary edition in 3 volumes. Vol. 2: *Birds.* By Dr. G. Carmichael Low. Pp. viii + 832. (London: Zoological Society, 1929.) 25s.

A COMPANION volume to that on "Mammals", already noticed in NATURE, and like it a most useful work of reference. It includes the names of 2330 birds which have appeared in the London Zoo, and in addition gives the geographical races of many of the forms. All the essential catalogue information accompanies each scientific name—the most important synonyms, the geographical distribution, references to a good description and to a coloured figure where such exists. The English name or names of each species is given—an important item for the museum official who has to label birds, and, since each name is indexed, for the reader who wishes to know the exact significance of colloquial names used in books of travel and the like. So authoritative a list should help to stereotype the popular names of foreign birds, which are sometimes in danger of having as many popular as scientific synonyms.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A New Theory of Magnetic Storms.

AN attempt to infer the course of events when a neutral ionised stream of particles from the sun is directed towards the earth has now led to results which we believe indicate how magnetic storms are produced. A full discussion of the phenomena involves the solution of numerous intricate mathematical problems, many of which have not yet been attacked in detail; but it seems possible to outline the main sequence of events.

The motion of a neutral ionised stream in the earth's magnetic field was investigated by one of us in 1923,[1] and it was concluded that the stream would be scarcely deflected by the field, though some slight convergence would occur within about one earth-diameter from the earth's centre O (Fig. 1).

No indication as to how such a stream could produce magnetic storms and auroræ was obtained. It would seem that this failure was due to the assumption there made that the stream had enveloped the earth for a time long enough to enable a steady state to be set up, whereas it now appears that magnetic storms are essentially connected with the *approach* of the stream towards the earth. The important changes in the stream occur within a few earth radii from O, and beyond this distance the former conclusion that the stream travels almost without deflection remains valid.

The stream is in effect a highly conducting body, and as it enters the earth's field electric currents flowing parallel to its surface are induced in the surface layers, so that the interior of the stream is nearly shielded from the earth's field. Outside the stream the magnetic effect of the currents is roughly equivalent to that of an 'image' magnetic doublet at a certain point inside the stream; in the equatorial plane the field between the earth and the stream is increased in intensity. It is as if the current layer, as it advances towards the earth, pushes forward and crowds together the earth's lines of force.

We identify this change with the observed increase in the earth's horizontal force during the first stage of a magnetic storm. Detailed examination shows that the magnitude of the effect, and its time scale, depend almost entirely on the kinetic energy of the stream per unit volume; if the velocity of the stream is of the order 1000 km./sec., the density requisite to explain the first phase of an average magnetic storm (taking account of the shielding effect of the Heaviside layer) is roughly of the order 10^{-22} gm./c.c.; this might be provided by about 1·5 calcium ions or 60 hydrogen ions per c.c.

The magnetic energy of the field is increased during this phase at the expense of the kinetic energy of the stream; the retardation of the particles occurs in the current layer, which is continually increased in mass-density by the oncoming of particles from behind. The retardation is greatest at that part of the front of the stream (A in Fig. 1) which is moving along the direct line from the sun to the earth's centre O; on either side of A the stream will advance relatively to A, and the earth will become partly enclosed by the stream; the surface $B'BACC'$ will continually close in, at a diminishing rate, upon the earth; whether it actually reaches the earth's atmosphere, in the equatorial plane, will depend on the density of the stream, and the length of time during which it is directed towards the earth (this is determined by the angular breadth of the stream viewed from the sun).

In the second (which is the main) phase of a magnetic storm the earth's horizontal force is decreased. We attribute this to the formation of a westerly current round the earth, due primarily to the flow of charges across the space 'behind' the earth (viewed from the sun). Along the sides BB', CC' of the enclosure there will be charged layers, BB' positive and CC' negative, due to the polarisation of the stream by the magnetic field. The charges in these layers will be subject to an outward electrostatic force, and the positive ions along BB' will cross over to CC', partly guided by the earth's field. The electrons along CC' cannot flow along the reverse path because of the greater deflecting influence of the field upon them, but negative charges from 'above' and 'below' the equatorial plane will travel along the earth's lines of force to neutralise the charge of the ions moving from BB' across the gap. The details

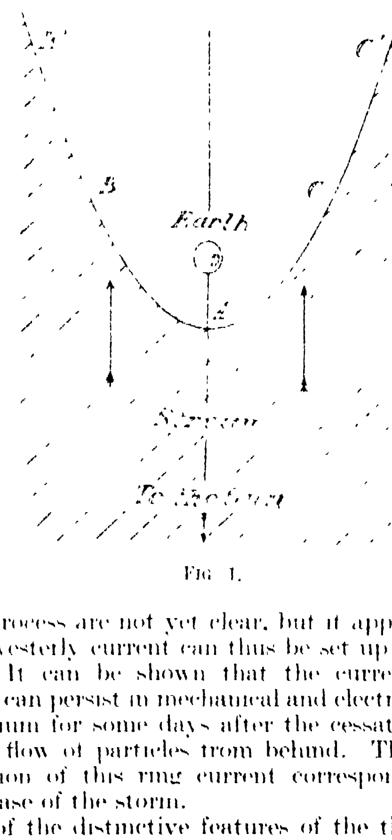


FIG. 1.

of the process are not yet clear, but it appears likely that a westerly current can thus be set up round the earth. It can be shown that the current-ring, if formed, can persist in mechanical and electromagnetic equilibrium for some days after the cessation of the onward flow of particles from behind. The gradual dissipation of this ring current corresponds to the final phase of the storm.

One of the distinctive features of the theory here outlined is the distance from the earth within which the main electric currents flow, namely, a few earth radii: they are outside the earth's atmosphere (though secondary currents are induced therein), but they are much nearer the earth than the currents (in the equatorial plane) discussed by Birkeland, or the equatorial current proposed by Prof. Stormer and associated by him with the decrease of latitude of auroræ during magnetic storms.

We have not examined closely the extent to which the stream will cause inflow of ions and electrons into the earth's atmosphere in the polar regions, or how this inflow will give rise to the observed currents along the auroral zones; but it seems likely that present theories of the auroræ will need to be modified, because the particles of a neutral stream can approach much closer to the earth, in the equatorial

plane, than the single charged particles hitherto considered. This must also have an important bearing on the theory of radio echoes, should it be proved that these are produced outside the earth's atmosphere.

S. CHAPMAN.
V. C. A. FERRARO.

Imperial College of Science,
South Kensington,
London, S.W.7,
June 26.

[1] *Proc. Camb. Phil. Soc.*, 21, 577; 1923.

Method of obtaining a Visible Spectrum of Waves of Radio Frequency.

IN the course of a research on the heating effects of radiation of wave-lengths 10 to 200 metres, it was found that for a given wave-length there is a maximum heating effect produced in a medium the specific conductivity and dielectric constant of which are connected with the frequency by a simple law. This law, proved theoretically as well as shown experimentally to hold for dilute solutions, is

$$\frac{2c}{nD}=1,$$

where c = specific conductivity in absolute units, D = dielectric constant, and n = frequency of wave. This law accounts for the curious selective heating effects observed in such high frequency fields, which give promise of great application in medical science.

The above relation suggested that it might be possible to produce a spectrum of a radio-field, where

FIG. 1.

a line would by its position in the spectrum indicate the wave-length emitted by a valve oscillator. A jelly of about four per cent agar-agar in distilled water was impregnated with finely powered tetriodomercurate of silver. This substance is orange-red when hot and canary-yellow when cold, the change being quite sharp at about 35° C. (It is used and described by Pariseau, *Can. Med. Assoc. Jour.*, 20, 146; 1929.) A glass tube was filled with the jelly, a small section at a time, a few drops of an electrolyte being added to the hot jelly before each addition, so that the conductivity increased as we passed along the tube. When the completed tube was placed in the field of radiation of an oscillator, it was found that if there was sufficient intensity, a red patch appeared in the jelly in a position where the conductivity was that determined by the relation given above. The accompanying photograph (Fig. 1) shows how the device acts as a crude spectrograph. The colour change is quite marked but is difficult to record photographically.

Neither the dispersion nor the resolving power are at present great, but an attempt is being made to prepare a film of the substance in which the conductivity will vary continuously. Interesting results might be found with ultra-short waves, as any changes in the dielectric constant would show themselves as anomalous dispersion, as do changes in the refractive index with light.

J. C. MCLENNAN.
A. C. BURTON.

The Physical Laboratory,
University of Toronto,
June 28.

Isolation of the Film Responsible for the Passivity of an Iron Anode in Acid Solution.

A RECENT paper (*J. Chem. Soc.*, 1930, p. 478) showed that the *direct* solvent action of dilute sulphuric acid on ferric oxide films is very slow. The *rapid* removal of a ferric oxide film from iron by acid is due to the formation of the local cell iron/acid/ferric oxide, which produces cathodic reduction of the ferric oxide to the rapidly soluble ferrous oxide. If the whole surface receives anodic treatment, this cathodic reduction is prevented, and hence an iron anode may remain passive in acid solution.

Further work has now shown that it is possible to isolate the film responsible for this type of passivity. The electrodes used consist of cold-rolled electrolytic iron abraded with No. 1 emery and degreased in carbon tetrachloride. The anode, fixed at 70° to the horizontal at a distance of 4·5 cm. from a vertical cathode, is viewed continuously through a binocular microscope. The electrolyte is normal sulphuric acid, and time is allowed for the dissolution of any 'air-formed' films. An e.m.f. of 6 volts is then applied to the cell; the anode at first is active, suffering corrosion, but soon passivity sets in, and evolution of oxygen commences. If the circuit is now broken for a short time, and restored, the anode is found once more to be active, and iron passes into solution; in due course, passivity returns, and in this way the iron can be made active and passive alternately.

Microscopic observation shows that during the passive periods, the anode is quite bright; but when, after the 'off' period, the current is again turned on, a series of horizontal shadow-fringes pass upwards over the surface, due to the wrinkling of a surface film. This film must have been present in optical contact with the metal during the passive stage; but it only becomes visible when the metal immediately below it is dissolved away. By alternately making and breaking the circuit (with variation of the e.m.f. between 4 and 6 volts, if required), it is possible to separate the transparent film intact from the electrode over quite large areas. Success depends on making and breaking the circuit at the right moments, chosen by watching the appearance of the skin through the microscope. The current is employed to undermine the skin, and prevent its destruction, whilst the 'off' periods serve to produce the local failure of the skin required for the commencement of undermining, and at later stages may be used to destroy the film at any points where it adheres too obstinately to the metal (this destruction is caused by the formation of the local cell iron/acid/oxide).

The film is less easy to preserve than that obtained from iron rendered passive in potassium chromate solution (*J. Chem. Soc.*, 1927, p. 1020); the fragments readily twist themselves into masses recalling 'cobwebs', whilst in some cases the film, as it peels from the anode, rolls up 'like a carpet' into long tight rolls, which under low magnification may be mistaken for fibres. But although mechanically flimsy, the films are stable chemically and can survive an hour in normal sulphuric acid, provided they are free from

metallic iron. Some specimens of iron have yielded a skin containing opaque inclusions—no doubt a further example of the 'interlocking' of oxide and metal studied in earlier work (Evans and J. Stockdale, *J. Chem. Soc.*, 1929, p. 2651).

The results confirm the views of Hedges (*J. Chem. Soc.*, 1928, p. 976), that anodic passivity—like other types—is due to a protective film. Since Benedicks and Sederholm (*Z. Phys. Chem.*, **138**, 123; 1928) have photographed the film which causes passivity in nitric acid, it may now be claimed that, for each important type of passivity, the film responsible has been rendered visible.

The removal of oxide-films by the cell iron/liquid/ferric oxide, which takes place so rapidly in acid, occurs slowly in neutral solutions. Mr. S. C. Britton, working in this laboratory, has found that heat-tinted iron kept in oxygen-free $N/10$ potassium chloride for two weeks loses its colour; a similar treatment appears to be capable of removing much thicker films, such as mill-scale, and also films too thin to be visible: the removal proceeds at least in part by undermining. These facts may explain the important discovery of McAulay and Bastow (*J. Chem. Soc.*, 1929, p. 85), who found that mere immersion in oxygen-free potassium sulphate brought iron specimens to a 'standard state', in which subsequent movements of the electrode potential were reproducible and independent of the previous history.

ULICK R. EVANS.

University Chemical Laboratory,
Cambridge, July 1.

Nutritional Status and Sex Determination.

RECENT correspondence in NATURE (R. R. Gates and D. V. Daran, Mar. 1, p. 309, and D. M. Cayley, April 5, p. 527) indicates that diversity of opinion still exists in regard to the question of 'multiple sexes' or 'nutritive heterothallism' in the fungi. The lower plants have yielded a great deal of information of a fundamental nature on sex, and the outcome of such correspondence must certainly be a further advance of knowledge with its applications not restricted to the fungi.

Nutritional status was long ago considered to play a part in sex determination in animals, but, largely through lack of well-controlled experiments, the idea lost favour. Nevertheless, evidence from a variety of sources is redirecting attention to the question. That nutritional state, without any relation to such phenomena as parasitism, may affect the ultimate sex expression in insects is the conclusion I have reached as a result of studies on the 'flour beetle' *Tribolium confusum* Duval. The evidence will be published in greater detail in the near future, but a summary at the present time may be of interest.

The sex ratio of newly hatched unfed larvæ, under controlled conditions of temperature, humidity, light, nutrition of the parents, and subsequent nutrition of the larvæ, has been altered by starvation. The alteration in sex ratio was not due to differential mortality of the sexes, since the change was considerably larger than the total mortality up to pupation, when it was possible to determine the sexes by genitalia characters. (The mortality ranged from 0 to 2 per cent, with an average of 1·2 per cent.) However, the change in sex ratio is not a simple relation between starvation and the production of a preponderance of one sex, or between time of starvation and resultant sex ratio, for with one day's starvation there is an increase in the preponderance of males, while with two and three days' starvation the number of males decreases and there is a preponderance of females. The net result is that while life lasts there is an oscillation of the sex ratio. Graphically, the curve representing this oscillation has an axis which slopes somewhat from a slight excess of males to a lower proportion of males with increase in starvation period.

The oscillating nature of the change in sex ratio indicates that either some forms change from one sex and back again, or that certain forms of both sexes change to the other sex after different periods of starvation. The conclusions reached are that either:

1. A proportion of the population is stable as regards its expression of sexuality, while a proportion is more easily converted to the opposite sex one way or the other; or

2. That forms of either sex may be changed to the opposite sex but that there are gradations of sexual stability only upset after varying periods of time.

The effect of nutrition on sex determination undoubtedly takes place *per medium* of its effect on the biochemical and biophysical state of the body fluids, and through them also on the germ cells. In insects one does not consider that more than two sexes occur, but the results briefly quoted above indicate that there are at least gradations in constitution which show a relation between nutritional status, dependent on time of starvation, and the ultimate sex expression.

F. G. HOLDAWAY.

Australia House,
London, W.C.2, June 25.

A New Band System probably due to a Molecule CP.

WHEN investigating the band spectra of phosphorus I tried a discharge in a mixture of argon and phosphorus vapour. This discharge, with suitable arrangements of the concentrations of the two gases, shows an intense and extended band system in the wave-length region λ4000-λ2900 A, which does not occur in pure phosphorus vapour. So far as I am aware it has not hitherto been recorded. At the same time the Swan bands of the C_2 molecule are very intense in the visible region, obviously due to tap grease and sealing wax. As in a mixture of argon and a small trace of nitrogen, under the same conditions of discharge, the CN bands are specially strong (the C_2 bands of course also being present), it seems very probable that the new band system is due to a molecule CP which would be the analogue of CN. So far as I know, such a molecule, or a molecule $(CP)_2$ which would be analogous to $(CN)_2$, has not been found chemically. If the above conclusion that the new band system is due to CP is correct, it might be possible also to get chemical evidence of some simple CP compound. In order to obtain a further test of the above conclusion, an attempt is being made to get exposures strong enough to show the bands due to the isotope molecule $C^{13}P$ which would make possible a definite identification of the emitter of the bands in question.

The structure of the band system and the single bands is very simple and in agreement with the assumption that they are the analogue to the $^2\Sigma$-$^2\Sigma$-CN bands. The fine structure is clearly resolved except near the heads. Only one R- and one P-branch seem to be present. The distance between head and origin of the bands is very small, corresponding to a large alteration of nuclear distance. A preliminary vibrational analysis yields the following formula for the heads:

$$\nu = 29103{\cdot}6 + [832{\cdot}4(v' + \tfrac{1}{2}) - 5{\cdot}44(v' + \tfrac{1}{2})^2] - [1239{\cdot}0(v'' + \tfrac{1}{2}) - 6{\cdot}75(v'' + \tfrac{1}{2})^2].$$

The above formula does not represent all the bands which have been found, because there are certain striking perturbations in the vibrational levels of the upper state involved. The 3rd, 4th, and 5th vibrational levels of this state are shifted in the direction of higher energy by an approximately constant amount of about 4·5 cm.$^{-1}$ (the measurements being accurate to within 1 cm.$^{-1}$ or probably less). This is seen especially well in the ω-curve for the upper state, which is approximately linear, only the 2nd and 5th points lying far off it by about the same amount but in opposite directions. Similar perturbations have been found in an extended band system of P_2 (λ3500-2000 A.) which is also under investigation.[1] In this case these perturbations make the vibrational analysis very difficult because they occur both in the upper and in the lower state.

G. HERZBERG.

H. H. Wills Physical Laboratory,
University of Bristol,
July 3.

[1] Part of this band system was discovered twenty-three years ago by Geuter (*Zeit. f. wiss. Phot.*, 5, 1, 1907).

Differentiation in the Dartmoor Granite.

IN his presidential address to the Devonshire Association on June 24, Mr. R. Hansford Worth devotes a section to a brief survey of Dartmoor geology and states, *inter alia*, that he cannot accept the idea of differentiated types of varied age for this granite mass.

As Mr. Worth points out, the granite as a whole is remarkably uniform in type, despite textural contrasts. But variants from the standard type are numerous, and their time-relationship to this type is often demonstrable.

Classified according to the C.I.P.W. system (based on detailed chemical analyses), these variants range from "II. 4. (2)3 . 3(4) to I . 4 . 1 . 2", with extreme types represented on one hand by highly biotitic vein-occurrences and, on the other, by considerable masses of quartz-felspar eutectic and pegmatite. The great bulk of the granite varies little from the type I . 4 . 2 . 3 which may be conveniently adopted as the standard. But the symbols for a suite of thirty granites representative of East Dartmoor, for example, reveal a graded and significant variation, which is more clearly shown in the following table:

	SiO_2. Per cent.	K_2O. Per cent.	Na_2O. Per cent.	Total Alkalies. Per cent.	CaO Per cent.	MgO Per cent	Total Iron Oxides Per cent.
Coarse granitoid inclusion in tor-granite "II . 4 . (2)3 . 3(4). . .	57·4	3·98	1·89	5·87	3·68	3·63	9·23
Tor-granite (Saddle Tor) I . (3)4 . "2 . 3.	71·69	4·59	3·03	7·62	1·49	0·66	2·50
A quarry-granite intrusive into tor-granite (Haytor) I . 3(4) . 1 . 3.	73·66	5·02	2·89	7·91	0·67	0·45	1·72
A typical aplite (Jordan) I . (3)4 . 1 . 2".	76·32	7·51	2·00	9·51	0·40	0·02	0·11

(Analyses by H. F. Harwood.)

In West Dartmoor, variation is still more striking.

Notwithstanding this wide range of mass-composition, biotites separated and analysed prove to be varietally identical, and are associated with the same characteristic accessory minerals.

Essentially the same variation-trend is displayed by many granite complexes, both British and foreign, in which the mass-relation between differentiates and standard types also varies. As applied to such composite granite masses, 'stages of intrusion' imply nothing more than brief local pauses in the intrusion process.

The variation briefly indicated above is closely concerned with the tectonic history of the Dartmoor granite, its anatomy, and its space-form in relation to the country rocks and to the granites farther west. These problems are complex indeed, and admit of amicable and stimulating exchanges of opinion.

A. BRAMMALL.

Geology Department,
Royal School of Mines, S.W.7,
July 2.

Influence of Nitrogen Dioxide upon the Ignition Temperature of Hydrogen-Oxygen Mixtures.

H. B. DIXON has observed that the ignition temperature of hydrogen-oxygen mixtures may be lowered so much as 200° C. by small quantities of nitrogen dioxide. Hinshelwood[1,2] and his co-workers, who investigated this reaction afresh, found that the nitrogen dioxide concentration must lie between two definite limits to give the observed effect, and when the nitrogen dioxide concentration is above or below these limits, only a slow combination of hydrogen and oxygen ensues. Up to the present, it has not been possible to give a satisfactory explanation of the phenomenon.

Now, according to Mecke,[3,4] one of the oxygen atoms in nitrogen dioxide is relatively weakly bound (77 Cal.). On the other hand, in the chain mechanism proposed by Bonhoeffer[5] and Haber[6] for the hydrogen-oxygen combination, reactions are involved which are considerably more exothermic than 77 Cal.

It is legitimate to assume that the nitrogen dioxide is especially fitted to take up the energy of the 'hot' molecules produced in these reactions and then dissociates thus: $NO_2 \rightarrow NO + O$. The oxygen atom formed in this manner can then cause further reaction to take place. When the nitrogen dioxide concentration is great enough to form sufficient oxygen atoms, explosion takes place at a lower temperature.[7] (This is the lower limit of nitrogen dioxide concentration.)

Again, it has been shown[8] that the reaction I.,

$$O + NO_2 \rightarrow NO + O_2$$

takes place more frequently than the reaction II.,

$$O + H_2 \rightarrow OH + H,$$

when it is assumed that the oxygen atom is not very strongly excited, which is, however, scarcely the case in these examples. The three body collision reaction, $O + H_2 \rightarrow H_2O$, which yields very 'hot' molecules, is likewise slower than reaction I.

Hence it follows that when the nitrogen dioxide concentration rises, the probability of the oxygen atom disappearing through reaction I. becomes greater and greater, until eventually the nitrogen dioxide concentration reaches a point where no explosion due to oxygen atoms develops. (This is the upper limit.) Taking suitable values for the velocity and the mechanism of an individual reaction, it is possible to derive the sharp limiting values of the nitrogen dioxide concentration observed by Hinshelwood (loc. cit.). The influence of nitrogen dioxide upon the ignition temperature of $CO + O_2$ mixtures found by

Sagulin and Semenoff[9] likewise finds a similar explanation.

HANS JOACHIM SCHUMACHER
(International Research Fellow).

Princeton University,
Princeton, May 16.

[1] Gibson and Hinshelwood: *Trans. Faraday Soc.*, **24**, 559; 1928.
[2] Thompson and Hinshelwood: *Proc. Roy. Soc.*, A **124**, 219; 1929.
[3] R. Mecke: *Z. phys. Chem.*, B **7**, 108; 1930.
[4] *Die Naturwiss.*, Dec. 20, 1929.
[5] Bonhoeffer and Haber: *Z. phys. Chem.*, **137**, 263; 1928.
[6] Haber: *Z. angew. Chem.*, 745, 1929.
[7] Farkas, Goldfinger, and Haber: *Die Naturwiss.*, **34**, 671; 1929.
[8] H. J. Schumacher: *J. Am. C. S.*, in press, 1930. G. B. Kistiakowky: *J. Am. C. S.*, **52**, 1868; 1930.
[9] Semenoff: *Chem. Rev.*, 350, September 1929.

Photography on Copper.

DURING a metallographic examination of some copper alloys it was observed that certain etching reagents produced a surface which was light sensitive to such a degree that the illuminated area of the specimen turned black during a few seconds' examination under the microscope. The phenomenon has been investigated, and found to depend upon the well-known light-sensitivity of cuprous chloride. The process affords a simple and rapid method of obtaining a sharp photographic image on the surface of plates of copper and copper alloys, including white alloys like German silver. It appears, however, to have escaped observation, and a brief description may therefore be of interest. It seems possible that the process may have some technical application, although I do not know of any, and I should be glad to give further information to anyone interested.

The copper or brass surface is polished and cleaned as for engraving, and dipped for ten seconds into a ten per cent solution of cupric chloride or copper ammonium chloride. A very thin white film, which X-ray examination shows to be cuprous chloride, forms on the surface of the plate. The plate is washed in running water, rinsed in methylated spirit, and dried in the air. The methylated spirit not only accelerates drying, but also makes the film much more adherent, and the wet plate can be wiped with a cloth without the film being destroyed. The plate is now light sensitive. On exposure for a few seconds to the direct light from an arc lamp the surface turns black, owing to the conversion of cuprous chloride into cuprous oxide. For contact prints from ordinary negatives an exposure of about one minute to the light of an arc lamp is required. The image (positive) so obtained is about equal in definition and contrast to that obtained in the ordinary three-colour and photogravure processes. The image can be 'fixed' by washing in dilute hypo or salt solution, but since this also reduces the intensity of the image the plate should be over-exposed during printing. For many purposes, such as engraving, fogging by diffuse daylight is so slow that fixing is unnecessary.

C. J. SMITHELLS.

Research Laboratories of the
General Electric Company,
Wembley, July 2.

Absorption Band Spectrum of Chlorine.

As a mistake which I made in a paper under the above title appearing in the June issue of the *Proceedings of the Royal Society* has been repeated on p. 989 of NATURE of June 28, I should like to direct attention to it and to correct it. In the publication first referred to, I refer to "Aston's figure for the relative abundance of Cl_{35} and Cl_{37}". Dr. Aston informs me that he has never made a direct measurement of the isotope ratio of chlorine, or published a value for it calculated from his work.

The value 1·67 which I gave as the calculated ratio of $Cl^{35}Cl^{35}$ to $Cl^{35}Cl^{37}$ was derived by using the figure 3·35 : 1 for the ratio Cl^{35} to Cl^{37} calculated by F. W. Loomis (*Astrophysical Journal*, 52, 248; 1920), and quoted on p. 156 of "Isotopes" (F. W. Aston, second edition). Dr. Aston has kindly pointed out to me that the masses of the chlorine atoms (correcting for O^{17} and O^{18}) are 34·980 and 36·976 ± 0·006 for Cl^{35} and Cl^{37} respectively. Using the atomic weight 35·457 and these figures, the ratio Cl^{35} : Cl^{37} becomes 3·185 : 1, giving the calculated ratio $Cl^{35}Cl^{35}$: $Cl^{35}Cl^{37}$ = 1·59 : 1. This value agrees slightly better with that found from the band spectrum intensities, namely 1·35 : 1 (this is incorrectly given on the first line of p. 656 of the publication first referred to as 1·45 : 1; Table VII. of the same paper gives the correct value).

A. ELLIOTT.

Physical Laboratory,
University of Utrecht.

Effect of Magnetic Fields on Dielectrics.

PROF. BURNS in his letter in NATURE of July 12, p. 59, observes that he has found a decrease of power factor when a magnetic field is superimposed on a dielectric, normal to the alternating electric field, and refers to my paper on dipoles (*Phil. Mag.*, May 1930). The view that such effects may arise from the existence of a magnetic as well as a dipolar moment is tempting, although cursory consideration of magnitudes suggests that such an effect is likely to be small.

Smouroff, however, has investigated the effect of magnetic fields upon dielectrics from atomic and ionic considerations ("Int. Congress of Math." (Bologna), Sept. 1928, *Arch. El.* p. 31, 1929). On his theory a decrease of power factor appears possible in some cases, but it would seem more usual to expect an increase in power factor. Monkhouse (*Proc. Phys. Soc.*, vol. 31, p. 83) has made experiments upon the electrical breakdown of dielectrics in magnetic fields and also mentions that large increases of power factor have been observed in agreement with Smouroff's theories.

With solids a longitudinal field appeared to have much more effect than a transverse field. In absence of experimental details it cannot be concluded that these results are contradictory, but a further examination might give interesting information upon the limitations of Smouroff's theory and the applicability of an extension of the dipole theory.

S. WHITEHEAD.

The British Electrical and Allied Industries
Research Association,
36 and 38 Kingsway, London, W.C.2,
July 15.

Palæolithic Man in North-East Ireland.

DURING our present survey, unavoidably postponed last year, of existing exposures of the glacial series in Northern Ireland, we have found a palæolithic flake industry in flint, *in situ*, within undisturbed gravel beneath 21 feet of what appear to be fluvio-glacial deposits. We make this preliminary record in view of the significance of the discovery, which will form the subject of the presidential address to the Prehistoric Society of East Anglia in 1931.

J. P. T. BURCHELL.
C. BLAKE WHELAN.

July 12.

A Study of the Phenomenon of Spin in Airplanes.*

By H. E. WIMPERIS, C.B.E.

THE spin is a mode of motion of which we know very little. The general public are inclined to look upon it as necessarily dangerous, but this we do know it is not. It is only in rare circumstances and under fortunately rare conditions that danger arises. Nevertheless there is ample warrant for its study and for that study to be treated as one of high importance. New conditions of airplane operation are continually arising; the very increase of speed itself would ensure an entry into regions never before penetrated. Hence it is ever necessary to seek for remedies even before serious difficulty has arisen. This anticipating action always seems to me to be absolutely essential, and I am comforted by support in this view from no less an authority than Francis Bacon, who, in his essay "On Innovations", wrote: "Time is the greatest innovator; and if time in course alters things to the worse, and wisdom and counsel shall not alter them to the better, what shall be the end"?

So we have ahead of us the difficult task of diagnosing not so much actual diseases as mere symptoms, and of devising in anticipation suitable remedies. Spins from which recovery is difficult may be rare, but since from time to time they are reported, a vigorous investigation becomes necessary. Though that investigation is far from having been completed —indeed in some ways it is little more than begun — the interest taken by everyone in flying makes some account of our present efforts worth attempting, whilst the very complexity of the phenomenon is in itself a challenge.

THE SPIN.

The first step will be to describe what constitutes a spin, why certain forms of spin present difficulty, why the obvious remedies fail, and the form which the studies now in hand have taken.

Almost all airplanes are built nowadays to be stable in flight; if any small disturbance to their normal attitude occurs the craft tends by its own virtue to return to its previous attitude. The naval architect has always aimed so to design ships that they have this great quality. Indeed, a ship the stability of which depended upon the clever balancing action of its steersman would be decidedly unpopular.

Now, how does an airplane achieve stability? If one suspends a model airplane from a point above its centre of gravity it hangs in stable equilibrium. If slightly displaced it returns. When gliding in flight the upward pull of the string has to be replaced by the resultant of all the upward air forces on the wings and tail plane. If stability is to be obtained, this vertical resultant must pass through the centre of gravity of the craft. The usual way of ensuring this is to give an upward tilt to each wing (the dihedral angle), so that the air forces on the two sides are inclined and meet at a point in the vertical plane of symmetry. The relative inclinations of wing and tail plane can be adjusted in just the same way, and thus the resultant of all the vertical air forces is made to pass through the centre of gravity so that the airplane behaves as though suspended at an imaginary point above the airplane.

This is the condition of ordinary straight flight: centrifugal force does not come into the picture. With circular motion, however, it does. The airplane banks as it turns, the air forces bank with it, and their resultant force balances gravity by its vertical component and the centrifugal force due to the turn by its horizontal one. Hence motion in circles can be just as steady and just as normal as in straight flight. Inconvenient and even dangerous as the actual spin may sometimes be, the spinning airplane is not, so to speak, conscious of doing anything wrong. Its behaviour is purely normal and quite virtuous. There is nothing in it to suggest the vicious circle. When the radius of the turn is made gradually less and less, the angle of bank grows greater and greater until the vertical component of the air forces can no longer balance gravity and the nose drops; the motion then becomes a kind of tight corkscrew. The motion is still steady and is quite safe. It is safe because the pilot can convert the motion into ordinary straight level flight whenever he wishes to do so. If, however, the corkscrew is made tighter and tighter the motion of the airplane may suddenly change to one in which the air forces on the machine will automatically tend to make it tighter still. This is the spin.

Before the essential features of the phenomenon of spin can be grasped, it is necessary to consider in slightly more detail the nature of the forces which act on the wings of an airplane.

AUTOROTATION.

Airplane wings are of various shapes—some have concave undersurfaces and some convex—but all alike when inclined at an angle to the wind (the angle of incidence) give rise to an upward lift force and a small rearward drag. It is important to notice the manner in which the lift force changes as the angle of incidence increases. To begin with, the lift force doubles for each doubling of this angle, but once the latter has reached a certain amount, the lift force increases less rapidly until at a particular angle (known as the angle of stall and usually about 20°) the lift force ceases to increase at all, and instead falls off rapidly as the angle is still further increased. When this happens there is produced a new phenomenon altogether. For if any sudden 'bump' in the atmosphere causes the right wing (let us say) to drop and therefore to meet the air at a steeper angle, the lift force on that wing will *ipso facto* become less and the wing will tend to drop still further. In fact, the whole wing will tend to go on turning. This is the phenomenon of autorotation. It can easily be exhibited in a wind

* Discourse delivered at the Royal Institution on Friday, May 2.

tunnel by so mounting an aerofoil about a suitable axis as to give it a large angle of incidence ; once the air stream is turned on the aerofoil will be found to be quite ready to rotate in either direction once some external cause has given it an initial push in that direction. (An experimental demonstration of autorotation was given at this point.)

The speed of autorotation depends upon the aerofoil section and the angle of incidence. In the case of a complete airplane it depends also on the disposition of the wings particularly in relation to each other and upon the arrangement of parts in the tail of the machine. It is the existence of the many factors which govern the occurrence and speed of autorotation which makes the study of the spin so complicated, that unless the problem is reducible to a few bare essentials a purely theoretical solution is scarcely to be anticipated.

When describing the tight corkscrew as a mode of motion I mentioned that this motion might suddenly change to the spin. This will happen if the angle of incidence should rise to the value at which for that particular wing section, and aerodynamic arrangement, autorotation sets in. Thereupon the forces acting on the airplane speed up the rotation and tend generally to take charge. Sometimes the machine is said to be 'locked into' the spin, but this language though understandable is really over strong, since the pilot by putting down the nose of the craft can bring the angle of incidence below that of autorotation ; at once the autorotation couple dies away and the spin ceases.

How is a true mental picture of this complicated motion to be made? There are the resultant air force, the centrifugal force, and the gravitational attraction all acting on the airplane. We know that the last-named always acts vertically downwards, whilst the centrifugal force acts at right angles to the axis of spin. For equilibrium these forces must be balanced by the air forces, hence the resultant of these latter must have a vertical component equal to the weight, a horizontal and radial component equal to the centrifugal force, and a horizontal and tangential component of zero. This last has to be zero, since in steady motion there can be no acceleration in that direction, and any force necessary to drag the tail round must be supplied by a suitable component of the air forces which act on the aerodynamic surfaces. The resulting motions are known, but no disentanglement of the various air forces due to lift, drag, and sideslip has yet been made.

It was Bairstow who first suggested that the phenomenon of spinning could be imitated in a wind channel by setting an aerofoil at such an angle that self-rotation must occur. This is made clear in an Aeronautical Research Committee report dated October 1918. In this report Relf and Lavender showed not only why autorotation took place, but also how to calculate the rate of spin. Model tests showed excellent agreement with their prediction. The rate of spin was found to increase with the angle of incidence, and in a chosen example the rotational speed rose from about $1\frac{1}{2}$ spins per second to 2 spins per second when the incidence was increased from 20° to 30°.

It is clear from what has already been said, that a lift curve which did not drop after the stalling point would be much less likely to lead to autorotation, or would in any case delay it to so large an angle of incidence that it would be very rare for an airplane to be in the attitude at which spinning could occur. The so-called 'flat-topped lift curve' has this virtue in varying measure, as also have airplanes with slotted wings, for then the stalling angle is very large and could usually only be reached, if at all, by a deliberate jerk to the whole machine. Getting into a spin would then be a piece of voluntary aerobatics and not a pitfall awaiting the unwary. 'Pitfall' may seem a strong word, especially as the phrase of 'locking into' a spin has been deprecated on the ground that, after all, the pilot holds the key of the motion in the right use of his control levers. It seems, however, that certain forms of airplane have so high an autorotation couple that, given time to attain the full corresponding rate of spin, the centrifugal forces due to the unsymmetrical distribution of mass in the airplane may oppose and overcome the control force exerted by the pilot's actions, and this may happen the more readily on account of the spin having become so flat (the airplane being less inclined to the horizontal plane than the vertical) that the control organs in the tail, in the fin, and rudder, are shielded from effective action by the tail plane. At the same time the physiological action of the rotational forces on the pilot may hinder his actions. If one casts a kind of airstream 'shadow' at 45° behind the tail plane, it will be seen that but little of the fin and rudder area can be effective in slowing up the undesired rotation or indeed in affecting it in any way.

The most elementary way of preventing this rapid spin from developing is to increase the size of the vertical tail surfaces, the fin and rudder, and to lengthen the fuselage so that a greater leverage is available. This leads to an increase of weight in the tail, and puts the centre of that weight still farther aft; both these actions lead to an increase in what are called the inertia couples due to the centrifugal force. The effect of these inertia couples is, as I will describe in a moment, to oppose the pilot's control of the machine, and so neutralise wholly or partly the good effect, from another point of view, of the larger tail surfaces and greater leverage. Nevertheless, there is sometimes an advantage on balance to be gained in this way, and for some time a ready criterion of spinning tendencies was used in America which depended principally upon whether or not the tail organs were inside a semicircle based on the wing span.

INERTIA COUPLES.

The effect of an inertia couple can be illustrated by taking the simple case of a rod having equal heavy masses at each end and pivoted at its centre of gravity. If one holds such a system at arm's length and turns round rapidly the rod takes up a horizontal position. This happens because the

centrifugal force on each mass is proportional to its radius of rotation, hence the mass which starts farthest out tends to go still farther out, and stability is only reached when the rod is at right angles to the axis of rotation. If a second similar rod were fastened at right angles, the forces upon it would balance those on the first rod. The combination would be neutral and would take up a neutral position. Hence an airplane with its masses symmetrically disposed would be free from such couples and free therefore from the peculiar difficulties of a flat spin. In practice, however, airplanes cannot be so made, and as a fair example of what occurs in practice the case of the well-known Bristol Fighter airplane may be cited. Here the moments of inertia about the longitudinal axis and the transverse axis are found to be about equal, whilst that about a vertical axis is half as much again.

A simple calculation shows that for any given rate of rotation this disturbing couple reaches a maximum when the fore and aft line of the airplane is inclined downwards at 45°. Once that angle is exceeded the couple grows less. When, therefore, an airplane is being brought out of a very flat spin the pilot has to exert a control not merely large enough to balance the inertia couple at the moment, but also large enough to overbalance this growing couple as the barrier angle is reached. The barrier angle will come at exactly 45° if the rate of spin remains constant, if it does not it may be somewhat above or below this angle. But a barrier there will in general always be, and recovery from any flat spin must depend on its being satisfactorily surmounted. (An experimental demonstration was given to show the effect of the inertia couple in raising the nose of the fuselage.)

A typical pilot's impression of the change from the ordinary spin to the flat spin appeared in one report as follows: "After the first two or three turns, which were relatively steep, the nose came up and the machine settled down to an exceptionally steady spin at moderately large incidence and a quick rate of rotation. There was no noticeable jerkiness during the turn."

(*To be continued.*)

The Bristol Meeting of the British Association.

PROGRAMMES OF SECTIONS.

MATHEMATICAL AND PHYSICAL SCIENCES.

THE presidential address of Section A (Mathematical and Physical Sciences) will be delivered on Monday, Sept. 8, by Dr. F. E. Smith, who has chosen as his subject "The Theories of Terrestrial Magnetism." On each of the other days a considerable portion of the available time will be taken up by a series of related papers. Thus on Thursday, Sept. 4, there will be a discussion on "The Meteorological Relations of Atmospherics," in which Dr. R. A. Watson Watt, Prof. E. V. Appleton, M. R. Bureau, Dr. F. Schindlehauer, and Mr. M. A. Giblett will participate. On the following day there will be a series of papers dealing with aspects of the solid state, the contributors being Prof. J. E. Lennard-Jones, Prof. W. L. Bragg, Dr. J. D. Bernal, and Dr. F. Bloch. These will be followed by a brief discussion, opened by Prof. Heisenberg. On Tuesday, Sept. 9, there will be a discussion on flow in gases, and the aerodynamical and meteorological aspects of this subject will be dealt with by Mr. E. Ower, Mr. F. C. Johannsen, Mr. G. Bilham, and Mr. M. A. Giblett. The programme contains also the usual papers on particular investigations.

Many distinguished foreign visitors are contributing to the proceedings. In addition to those mentioned above, Prof. M. Siegbahn will present a paper on "The Highly Ionised Spectra in the Extreme Ultra-Violet," and the section will probably listen to other eminent visitors.

There will be a strong Sub-Section of Mathematics, and twenty papers appear on its programme. Several of these will be of interest to physicists and others. Thus Prof. S. Brodetsky will read a paper on "The Einstein Field-Theory," and Prof. A. C. Dixon will discuss integral equations, a subject which is rapidly becoming important in physical investigations. There will also be a paper on modern Babbage calculating machines by Dr. L. J. Comrie.

CHEMISTRY.

For his presidential address to Section B (Chemistry) Prof. G. T. Morgan, director of chemical research in the Department of Scientific and Industrial Research, has chosen the title "A State Experiment in Chemical Research." He will discuss the development of the Chemical Research Laboratory at Teddington since its beginning five years ago. His account of the investigations now in progress at that institution will be illustrated by an exhibit of preparations, apparatus, and models of chemical plant.

On Friday, Sept. 5, a discussion will be held on the present position of the British dyestuff industry—a topic which is particularly opportune in view of the impending lapse of the Dyestuffs (Import Regulations) Act in January 1931. In opening the discussion, Prof. A. G. Green will review the development of the British industry since 1901, when he gave an account of the position at the Glasgow meeting of the Association. Subsequent speakers will be Prof. J. F. Thorpe, president of the Chemical Society and a member of the Dyestuffs Industry Development Committee, Sir William Pope, and the following members of the Dyestuffs Industry Development Committee: Messrs. C. J. T. Cronshaw, G. Holden, J. Morton, and Major L. B. Holliday. Mr. W. J. U. Woolcock will sum up the debate.

Another important discussion will be opened on Monday, Sept. 8, by Dr. F. L. Pyman, on "Chemo-

therapy". This is the first time that this important subject has been discussed, and those taking part include Prof. G. Barger, Prof. R. Robinson, Dr. A. J. Ewins, Dr. T. A. Henry, Dr. H. King, Prof. G. T. Morgan, and Prof. C. S. Gibson (Recorder).

Amongst other important individual communications are those by Prof. M. W. Travers, and Prof. N. Semenoff, of Leningrad. Prof. Travers will give an account of "New Experimental Methods for the Study of Gas Reactions". Although Prof. Semenoff is unable to attend the meeting, his paper on "The Initiation of Combustion" will be summarised by Prof. W. E. Garner, and it is hoped that this will lead to a discussion in which Prof. Garner and Mr. A. C. G. Egerton will take part.

GEOLOGY.

Prof. O. T. Jones's presidential address to Section C (Geology) will deal with "Some Episodes in the Geological History of the Bristol Channel Region", a subject that seems particularly appropriate to the place of meeting. Two of the items on the agenda arise out of the meeting in South Africa last year. Dr. G. Slater spent the greater part of his stay there in studying the earlier glacial deposits and will read a paper entitled "The Dwyka Tillite of Griqualand West". The question of the correlation of past pluvial and glacial periods is to be discussed jointly by Sections C, E, and H (geology, geography, and anthropology). It is perhaps doubtful if any geologist thinks this is possible at present, but a summation of the present position and a consideration of the difficulties in view may indicate lines for future work.

Perhaps of greater interest will be the sectional discussion on "The Validity of the Permian as a System". Since Murchison in 1841 divided the New Red Rocks into two systems, the Permian and the Trias, the status of the former division has been the subject of much controversy. Whilst abroad much greater thicknesses of rocks have been placed in that division, in England the system has been whittled down by the placing of the lower beds in the Carboniferous System. No doubt the exceptional British position will be thoroughly explored, and it is hoped that the wider aspects of the problem will receive due attention.

Both Upper and Lower Carboniferous Rocks come under review, for Prof. G. Delépine (of Lille) will describe "The Dinantian Zones of Goniatites in North France and Belgium", and Dr. D. A. Wray will discuss the sequence of non-marine lamellibranchs in the Upper Carboniferous of Yorkshire. Two papers on classification by Dr. A. E. Trueman and W. S. Bisat may prove somewhat controversial.

Of wide general interest should be Prof. J. W. Gregory's account of the recent cable fractures due to an earthquake in the Western Atlantic. The first description of a liverwort-like plant from the Lower Downtonian of the Llandovery District will be made by Dr. A. Heard and Mr. J. F. Jones.

GEOGRAPHY.

The president of Section E (Geography) will be Prof. P. M. Roxby, of the University of Liverpool, whose address will be devoted to a review of "The Scope and Aims of Human Geography". Since one of the most fruitful local applications of the work of modern human geographers has been in connexion with the development of regional survey and regional planning, it is opportune that this aspect should receive particular attention at this meeting. Thus the main principles of the South-West Lancashire regional plan are to be analysed by Mr. Peirson Frank, while Prof. P. Abercrombie will deal with the problems of satellite towns. A discussion on these papers will be opened by Dr. Vaughan Cornish.

Various aspects of the Bristol region will be dealt with by Mr. W. W. Jervis and others, while the contribution made by Bristol to English exploration will be reviewed by Col. E. W. Lennard.

Problems concerning past changes in climate will occupy an important place in the work of the Section at the Bristol meeting, since in addition to the joint discussion with Sections C and H on the relations between past pluvial and glacial periods, the Section of Geography is to have papers dealing with climatic changes in historic times in parts of both the Old World and the New. The former will be dealt with by Dr. C. E. P. Brooks and the latter by Prof. A. E. Douglass (of the University of Arizona), who will be the foreign guest of the Section.

One morning is being devoted to papers dealing with various parts of Africa, and another will be occupied by a series of detailed physical and economic studies of parts of Great Britain.

ENGINEERING.

The subjects to be dealt with by Section G (Engineering) are somewhat broad in their scope. The president, Sir Ernest Moir, Bt., an authority on tunnelling and other operations at great depth, will speak on that subject in his address. Section G will afterwards join with Section I (Physiology) to discuss the physiological effects of the high pressures to which those working in these operations are subjected. This discussion is important, since these effects set a limit to what may be undertaken.

Of more general interest, perhaps, are three papers on "The Trend of Airship Development" to be given respectively by Col. V. C. Richmond, the designer of *R101*; Mr. B. N. Wallis, of *R100*; and Herr Direktor Doerr, of the Zeppelin Company. These papers will be followed by films illustrating the construction and operation of the British and German airships.

The question of the economical production of power, so important to us as a nation, is to be considered from various points of view. Mr. George A. Orrok, of New York, on "High Pressure and Temperature Steam"; Sir Henry Fowler, on "Fuel Consumption in Locomotive Practice";

and Messrs. A. L. Stanton and T. Stevens, on the "Distribution of Electrical Power", will lead the discussion.

The importance of Bristol as a centre of the aircraft industry is reflected in the paper on "Recent Developments in Air-cooled Aero-engines" by Mr. C. F. Abell, of the Bristol Aeroplane Co. Messrs. T. F. Hurley and R. Cook, of H.M. Fuel Research Station, Greenwich, will describe some of their researches on petrol engines; while Dr. S. J. Davies and Mr. Edmund Giffen will review the present position of the high-speed heavy-oil engine.

Section G will conclude the meeting with a discussion on steel for structural purposes and its standardisation. The degree of standardisation of steel sections can naturally exert a great influence upon costs of production, and the subject is to be treated from the points of view of the consulting engineer, the manufacturer, and the technician by Mr. J. S. Wilson, Mr. J. S. Lewis, and Prof. C. Bath respectively. Reports of the special research committees will also be presented.

ANTHROPOLOGY.

Anthropology (Section H) at the Bristol meeting will be under the chairmanship of Dr. H. S. Harrison, whose work has made the Horniman Museum a centre of study of the evolution of the arts and crafts. His address will appropriately be followed by a discussion of the project of a National Folk Museum, in which Dr. R. E. Mortimer Wheeler and Prof. J. L. Myres will take part, while the officers of the interesting museum of the City of Norwich will give an account of their valuable work. On Tuesday, Sept. 9, geologists, meteorologists, archæologists, and geographers will gather to discuss the sequence of phases of the Pleistocene ice age. Agassiz gave an early account of views on this subject at the British Association in 1840, while, about the end of that century, James Geikie in Britain and Penck and Brückner in Central Europe were trying to correlate phases in different regions. This difficult task is entering on a new phase in which study of maritime and river terraces is being brought into the question and dynamic considerations concerning growth and decline of ice sheets are playing an increasing part. The field work of Misses Caton-Thompson and Gardner in the Faiyum, of Messrs. Sandford and Arkell in Egypt, Leakey and Solomon in Kenya, Cammiade in South India, and Armstrong at Bambata in Rhodesia, will be brought into the scheme, and the discussion is likely to make a definite advance.

The University and city of Bristol have played a great part in anthropological studies, and a memorial lecture by Sir Arthur Keith will offer a tribute to the pioneer, Dr. John Beddoe, the chair being taken by Sir Evan Jones, an old student of Bristol and of Dr. Beddoe. The memory of Dr. Czaplička, at one time lecturer at Bristol, is cherished in anthropological circles, and the Spelæological Society of the University has made itself a place in the history of the science. It is, therefore, specially interesting that an unusual number of papers on local archæology and anthropology are being presented to the section after an introductory study of the area by Mrs. D. P. Dobson. The interesting discussion of the ruins at Zimbabwe in Rhodesia, which was a main feature of last year's meeting, will be continued by Miss Caton-Thompson, with Dr. Randall MacIver in the chair, an appropriate choice, as his book on medieval Rhodesia twenty years ago first made a serious attempt to combat fanciful speculations on this subject.

PHYSIOLOGY.

In Section I (Physiology) the work of the meeting will open with the presidential address by Prof. H. S. Raper on "The Synthetic Activities of the Cell". It is expected that this address will be characterised by vigorous thought and that it will provide material for lively expressions of opinion in the discussion to which the president has consented. Among the remaining items, in all probability the foremost in the breadth of its appeal is the joint discussion with Section G (Engineering), somewhat heavily entitled "Air Pressure Variations encountered in Engineering Works, and their Physiological Effects". The speakers from Section I will be (1) Capt. G. C. C. Damant, R.N., qualified not only by reason of his work with J. S. Haldane and Boycott, and his share in the preparation of the Admiralty tables regulating the decompression of deep-sea divers, but also by a personal experience of such work lasting over twenty years and including the recovery of £5,000,000 of bullion sunk in the *Laurentic*, and (2) Sir Leonard Hill, whose experience of air pressure and movement effects on the physiological side is well known and whose katathermometers (and their modifications) have proved of enormous value in the accurate recording of conditions calculated to promote the comfort of workers in unusual surroundings.

The remainder of the programme includes papers covering a very wide range. On one side, the section has a contribution from Dr. F. W. Edridge-Green of the Board of Trade, on the detection of certain forms of colour-blindness especially important in the mercantile marine and a discussion with Section J (Psychology) on primary colours which, one fears, is likely to prove interesting rather than conclusive. On another part of the wide field over which this section extends, Prof. Ruggles Gates is speaking on "The Blood Groups and their Inheritance". Again, Prof. A. Stanley Kent, well known for his discovery of the auriculo-ventricular bundle, is returning to the laboratory which he designed to communicate some of his hitherto unpublished work.

PSYCHOLOGY.

Section J (Psychology) this year meets under the presidency of Prof. C. W. Valentine, who in his presidential address will review the present position of child psychology. The proceedings will open with an intra-sectional discussion on "The Psychology of Adolescence". A joint discussion

has also been arranged with Section I (Physiology) on the question, "In what Sense can we Speak of Primary Colours?" The various branches of psychology are well represented, experimental perhaps more strongly than usual. A visit has been arranged to Stoke Park Colony, where the director of medical services, Dr. R. J. A. Berry, will give a demonstration of scientific and clinical methods of diagnosis of mental deficiency and will discuss their applicability to child guidance and normal children.

BOTANY.

Dr. A. W. Hill, of the Royal Botanic Gardens, Kew, is president of Section K (Botany) of the Association for the Bristol meeting. The emphasis at present being laid upon original investigation in mycology and plant physiology is reflected in Section K by the preponderance of papers dealing with these aspects of botany, Monday morning being devoted to the former and Tuesday morning to the latter.

A joint discussion (with Section M) on "Mineral Nutrition in Plants" will occupy the major portion of Friday morning. The various aspects of the subject dealt with during the discussion will be summarised by Sir John Russell. An excursion to Long Ashton to study material illustrating some features of the problem will be made during the afternoon.

Among the distinguished foreign botanists proposing to attend are Prof. F. A. F. C. Went, of Utrecht, who is to read a paper on "Wegener's Theory and the Distribution of the Podostemaceae"; Dr. W. V. J. Osterhout, of the Rockefeller Institute, who is to contribute to the discussion on mineral nutrition; and Prof. W. Goodspeed, of Berkeley, Cal., who is outlining the results of his experiments with X-rays and radium on the species of the genus *Nicotiana*—a choice of subject which should have a particular appeal to the citizens of Bristol.

A number of attractive excursions have been arranged by local botanists, these including a visit to Mr. C. Hiatt Baker's garden at Almondesbury, and to the Somerset peat moors.

EDUCATIONAL SCIENCE.

The president of Section L (Educational Science) is the Right Hon. Lord Eustace Percy, whose presidential address will be entitled "A Policy of Higher Education". At the opening session of the section on Thursday, Sept. 4, papers will be given on "The Pre-School Child", by Miss Margaret Drummond (representing the Nursery School Association), Dr. J. A. Hadfield, and Dr. W. E. Blatz (Director of St. George's School of Child Study, Toronto).

Almost all one session will be devoted to "The Curricula of Central Modern and Senior Schools". Mr. W. A. Brockington will open with a general survey; Mr. J. A. White, Mr. H. T. Morgan, and Miss V. E. Carr Gordon will follow with papers dealing with the subject from the selective central school, the non-selective schools, and the modern girls' school points of view respectively. An interesting discussion will no doubt follow. The session will conclude with reports from sub-committees of the section dealing with training for overseas, the production and distribution of educational and documentary films, and the teaching of general science in schools, with special reference to the teaching of biology.

Another session will deal with formal training and disciplinary values in education. Dr. C. W. Kimmins will present the report of a sub-committee on formal training, and Sir Percy Nunn will read the first paper on "Disciplinary Value in Education", and will speak particularly with reference to "The Conception of Mental Discipline". Miss H. M. Wodehouse and Prof. F. A. Cavanagh will follow with papers on "Discernment of Disciplinary Values apart from Experiment" and "Some Further Practical Considerations". A final paper will be read by Dr. W. G. Sleight, and the discussion will be opened by Sir Richard Gregory.

For the final session the subject will be English and foreign ideas on method of education in relation to industry and commerce. Mr. Henderson Pringle and Sir Francis Goodenough are to deal with the subject mainly with reference to commerce; Dr. A. W. Richardson and Miss E. Webb Samuel will give papers dealing with the industrial aspect, and Mr. A. Abbott will conclude with a general paper on the whole question.

Afternoon visits to the local schools and the new Hospital School for Cripples at Winford are being arranged, and also a full day motor trip for the Saturday, during which Dauntsey School will be visited.

News and Views.

VERY hearty congratulations are extended to Sir Howard Grubb, who celebrates his eighty-sixth birthday on Monday next, having been born on July 28, 1844. Sir Howard was educated privately and at Trinity College, Dublin. In most parts of the world where observatories exist one may be sure that he has had a leading and expert part in the preparation of their equipment of mirrors, objectives, and all the varied apparatus and machinery of the modern astronomical observatory. Particularly is this the case as regards many of the great astronomical observatories of America; here his resourceful ingenuity has long been acclaimed. He has published many memoirs, chiefly through the medium of the Royal Dublin Society—among the earliest, "The Great Melbourne Telescope" (1870) and "On Clocks for Equatorial Telescopes" (1875). In 1896 he read a paper at the Royal Institution on "The Development of the Astronomical Telescope". In 1881 Sir Howard was the recipient of the Cunningham gold medal of the Royal Irish Academy, in recognition of work in the service of astronomers; in 1912 he received the Boyle medal of the Royal Dublin Society, awarded for scientific labours of outstanding merit carried out by Irishmen or in Ireland. Holding the honorary degree of master of engineering in the University of Dublin,

Sir Howard is also an honorary member of the Institution of Civil Engineers of Ireland. He was elected into the fellowship of the Royal Society of London so long ago as 1883.

DR. HERBERT LEVINSTEIN went fairly to the root of things in his presidential address to the Society of Chemical Industry delivered at Birmingham on July 15. "How we govern ourselves," he said, "how we arrange the exchange of our labour for goods or services, how we arrange our quarrels and our hates, social, racial, or international, all are merging into or depend on the greater problem of how we shall make the earth supply us with what we must have; how we can make the sun and the air do the maximum for us. This we may regard as one of the two great tasks of science. . . . The other problem of science is how to decrease human suffering by the conquest of disease." Hence the title of his address, "But an Apprentice in Nature's Workshop", and his remark that Aristotle's elements—earth, air, fire, and water are the real raw materials of our organic chemical industries; hence also his statement that a striking weakness of Great Britain to-day as a manufacturing country is its dependence on coal as a source of power. We reckon wealth in terms of our store of fossils, but the age of coal is passing, and Dr. Levinstein suspects that the age of coal will take up but little space when the history of the world is written a few generations hence. "It will have lasted, when it is over, for a shorter period than the Moorish occupation of Spain." Other countries are developing the use of water power; we have little, but the problem of finding sources of energy alternative to a diminishing store of fossilised energy is none the less, rather the more, urgent.

AN industrial nation must have cheap power; although the exhaustion of our coal supplies will concern our descendants more acutely than ourselves, we of the present generation are faced with the alarming fact that coal is now no longer the cheapest source of power, and consequently it is no longer suitable for the new and large, cheap power industries. One such industry, that which produces aluminium, possesses the only outstanding hydro-electric installation in Great Britain; this will eventually represent about 840,000 tons of coal annually. We must therefore look for some other source of power. Politics must of necessity enter into the examination of such questions as are discussed by Dr. Levinstein. They can scarcely be considered along traditional lines, for tradition is a poor weapon with which to slay new and unmistakably fiery dragons. Familiar points of view may indeed prove sufficiently well placed to envisage the new domain of industry, but probably they will not, and the whole political side of the matter will have to be examined anew and 'without prejudice'. It is therefore only just that we should refer briefly to some considerations which Dr. Levinstein lays before our legislators.

THE business of Great Britain, as seen by the 'Manchester school' of economists, is to import raw material and food and to export manufactures; the main principle is to buy in the cheapest and sell in the dearest market. This, said Dr. Levinstein, is the "principle of the cheapjack"; to buy in the most trustworthy and sell in the most permanent market is a better maxim. He would therefore buy food and timber from those who buy our manufactures. There is at present a world over-production of manufactured articles which is likely to be permanent, whilst the over-production of food and wood is certainly temporary; when it passes, the opportunity for making arrangements for mutual interest between Great Britain and those sparsely populated nations which own wide areas of food and forest lands may pass with it. Further, Dr. Levinstein stresses the fundamental importance of the proper utilisation of the land in a densely populated country where land is relatively scarce. Let us decide, he urges, what proportion we should have under grass and then ensure that every acre, whether grassland or arable land, is compelled to yield the maximum of nourishment for the people. By the application to pasture of intensive methods, seventy million pounds could be added to the annual value of our milk and meat production; this is more than double the value of imported American cotton, and its magnitude indicates both that the grass-manufacturing industry is of national proportions, and that our present lack of a consistent agricultural policy demands attention.

MANUFACTURERS of chemical products in Great Britain have shown that they are able not only to produce efficiently the numerous chemical materials demanded in every avenue of modern life, but also to display their goods attractively, to stimulate interest and inquiry into their fields of activity, and to organise effective means for the interchange of opinion and the promotion of common interests. Speaking at the fourteenth annual general meeting of the Association of British Chemical Manufacturers, the chairman, Dr. G. C. Clayton, said that as regards chemical exhibitions Great Britain is far ahead of any other country. In none of the big foreign fairs is there a chemical exhibit comparable in magnitude, variety, or interest with that at the British Industries Fair. It is evident, therefore, that the principle that progress must be built on knowledge—a principle lying at the very foundation of the chemical, as of every other, industry—has been applied in the selling branch as well as in the manufacturing branch; the policy is wise and necessary, and should go far in maintaining and advancing the position which British scientific and commercial men have together won for a young, but vital, industry. At the same meeting, Dr. Clayton referred to agreements with the corresponding French and German associations to collaborate in work having in view the greater safety of workpeople. The study of risks of fire and explosion has already been completed, and the results of this inquiry will shortly be submitted to members for their information and criticism. It is satisfactory to find that it has been agreed to regard safety in industry as a matter on which there shall be the fullest and freest exchange of information, subject only to the limitations imposed by the need for safeguarding confidential details of methods of manufacture. Dr. Clayton included in his

address an expression of sympathy with the proposal for the establishment of Chemistry House; the ultimate industrial advantage is, he said, likely to be so great that everyone should do what he can to further the success of the scheme.

AT a recent meeting of the trustees of the Beit Memorial Fellowships for Medical Research, Sir James K. Fowler, trustee and honorary secretary, presented the annual report, reviewing the work of the twenty years of the existence of the fund. The Beit Fellowships were founded in 1909 by means of a gift of £230,000 by Sir Otto Beit. The total number of those who have held fellowships to date is 138, a considerable number of whom now hold or have held important posts on the scientific staffs of universities, colleges, and institutes. It is not possible to review the researches which have been carried out by Beit Memorial fellows, but those of Sir Thomas Lewis on the heart and of Prof. Edward Mellanby on rickets have been of outstanding importance. In 1927 a senior fellowship, value £1000 per annum, for research in tropical medicine was created and Dr. Edward Hindle appointed. His work on yellow fever has yielded important results. A vaccine has been prepared from the organs of certain monkeys infected with yellow fever which gives protection to other animals of the same species against a dose of virus a million times as great as that which is fatal to the unprotected. It has also been shown that Europeans may suffer from a mild disease scarcely recognisable as yellow fever, and if this is also true of natives, this may be the means by which the continued existence of the disease is maintained in endemic areas in the intervals between epidemics.

THE following elections have been made to Beit Memorial Fellowships for Medical Research, the proposed subject of the research to be undertaken by Junior Fellows and the place where it is to be carried out being given in brackets: *Senior Fellowship* (value £700 p.a.), Mr. R. J. Lythgoe. *Fourth Year Fellowships* (value £500 p.a.), Mr. P. Eggleton and Dr. F. R. Winton. *Junior Fellowships* (value £400 p.a.), Dr. F. H. Smirk (to study the functional pathology and physiology of diuresis from a biochemical point of view, and to study the functional pathology of plethoras, anæmias, and œdemas—Medical Unit of University College Hospital, London); Dr. G. R. Cameron (to complete work on the histological identification of calcium salts in pathological deposits and to commence study of inflammation in invertebrates—Graham Laboratory, Department of Pathology, University College Hospital School); Mr. J. McMichael (to continue present studies on the interrelationships of liver and splenic disease, mainly by clinical and pathological methods and animal experiments—Department of Medicine, University of Aberdeen); Dr. R. P. Cook (to study bacterial metabolism and its relation to the specific action between host and bacterial parasite—Sir William Dunn Institute of Biochemistry, Cambridge); Mr. N. U. Meldrum (to study the so-called reversible denaturation of hæmaglobin—Sir William Dunn Institute of Biochemistry, University of Cambridge); Mr. D. R. P. Murray (to make a comparison of the two types of proteolytic enzymes characteristic of the tissues and organs and of the digestive tract—Sir William Dunn Institute of Biochemistry, Cambridge); Mr. G. N. Myers (to study the curative action of digitalis, its glucosides, and allies, in general toxæmia and in conditions of shock—Pharmacological Laboratory, Cambridge); Mr. C. A. Ashford (for studies on the (*a*) metabolism of nervous tissue; and (*b*) mode of action of vitamin D with special reference to hyper-vitaminosis D—Sir William Dunn Institute of Biochemistry, Cambridge).

THE valuable work which has already been accomplished in Great Britain by the various research associations is well known to workers in pure science and technology. The wide dissemination of the results of their researches and the task of securing adequate appreciation of those results amongst the ranks of industrial workers are, however, matters of considerable difficulty. The British Cotton Industry Research Association attempted in part to meet those points some two years ago by the publication of a report on research in the cotton industry, which gave an account, as free from scientific terms as possible, of the main topics of the published research work of that Association. The British Research Association for the Woollen and Worsted Industries, in its recent publication, "Scientific Aid for the Wool Industries", has supplied a similar summary which should prove valuable to workers in the many branches of the woollen and worsted industries. Reference is made in the report to fundamental researches which are in progress, particularly on the physical, chemical, and biological sides. The textile technologist will appreciate the attempt which has been made to improve existing methods of testing. In this connexion the development of methods for the reeling of yarn, for the testing of yarn levelness, and for the autographic recording of strength and elasticity, deserve special mention. The report offers abundant evidence of the progress of the Association. Its success in its relationship with industry may be judged by the fact that a scheme for the support of the Association by means of a voluntary levy upon imported wool has recently been conditionally adopted by the industry.

WE are glad to learn that, after delay since August 1928, the Cultural Society of Peking and the Government of Nanking have jointly given permission for the renewal of Central Asiatic expeditions of the American Museum of Natural History. Dr. Roy Andrews is now in the field north-east of Kalgan, with a very strong party, including Messrs. Granger, Thomson, and Young of the American Museum staff, Père Teilhard de Chardin as associate palæontologist, two Chinese zoologists and palæontologists trained by Dr. Abel of Vienna, Dr. C. C. Young, and Dr. H. Chang. Lieut. W. G. Wyman, U.S.A., accompanies the party as topographer The present survey is to the eastward of the Kalgan-Urga Trail where important Pliocene discoveries were made during the 1928 expedition, and the season's work will be chiefly in Pliocene horizons not represented in previous explorations west of the Kalgan-Urga Trail. Dr. Andrews' volume on the

narrative of the Expedition, Vol. I of the quarto series, is nearly ready for the press; Dr. Amadeus Grabau's volume entitled "The Permian of Mongolia" is now in press.

In a recent issue we published a summary of, and commented upon, Sir Arthur Keith's lectures on recent discoveries of early man and their bearing upon our knowledge of his origin, development, and distribution (see Nature, June 21, p. 935). How these discoveries have stimulated fresh interest in the discussion of man's place of origin may be gathered from an article by Prof. Elliot Smith which appears in the June issue of *Scientia*. As is well known, Charles Darwin in 1871 suggested that the survival in Africa of the two great apes most nearly allied to man pointed to that continent as the dwelling-place of our early progenitors. Many authorities have since taken the same view. On the other hand, the discovery of fossil apes in the Himalayas and of *Pithecanthropus* in Java has been held to point to Asia as the probable home of the human family. The evidence is reviewed, and carefully weighed, by Prof. Elliot Smith in his article. Notwithstanding the occurrence of a fossil ape in southern France, and setting aside the view of Schoetensack in favour of Australia and Ameghino's claim for South America owing to the absence in each of any possible ancestor of man, he concludes that the balance of probability is in favour of Africa. In arriving at this view he attaches considerable weight to the evidence afforded by the Taungs skull, now determined to be of Lower Pliocene age. He holds that while the Taungs skull cannot be mistaken for the gorilla or chimpanzee, and in the absence of prominent eyebrow ridges and in its upright forehead it resembles the orang, it affords definite though slight indications of the beginning of the process of refinement of the features that is an essential part of the transformation of the ape into a human being.

In October next a pageant entitled "Heart of Empire" will be held at the Royal Albert Hall. The date opportunely coincides with the meeting of the Imperial Conference which is to be held in London during that month. The pageant is to be taken from the book "Hyde Park: its History and Romance" by Mrs. Alec Tweedie, of which a new and abridged edition recently published is noticed in another column. It will last from Oct. 13 to 25 inclusive, and the proceeds will be given to charities. Each evening will have a special character· Oct. 14 the Lord Mayor, Oct. 15 Canada, Oct. 16 Australia, and so forth, the last evening being given to the United Services. It is gratifying to note that what may be called the imperial function of science is not to be overlooked, and one night, that of Oct. 22, is to be devoted to learned societies. Among the list of patrons, which includes the Maharajah of Kapurthala, the Dowager Maharanee of Cooch Behar, the Maharajah of Burdwan, the Duke of Sutherland, the Marquis of Londonderry, the Marquis of Aberdeen, Lord Jellicoe, Lord Meston, Lord Irwin, Viceroy of India, and a distinguished array of ministers, ex-ministers, and administrators, are also a number of prominent men of science. Among these are Sir John Rose Bradford, president of the Royal College of Physicians; Sir William Bragg, director of the Royal Institution; Sir Charles Close, president of the Royal Geographical Society; Sir Frank Dyson, Astronomer-Royal; Sir Arthur Keith; Sir Ronald Ross; Sir Ernest Rutherford, president of the Royal Society; and Prof. J. F. Thorpe, president of the Chemical Society. The organisers of the conference are to be congratulated on their far-seeing policy, which will bring home to a wide public the vital interest of science in, and its close connexion with, the problems of a world-wide empire such as ours.

Mr. J. L. Baird has recently made further progress in perfecting the applications of television for theatrical purposes. We see from the *Times* that a demonstration of this new art will form part of the programme of the London Coliseum in the week beginning July 28 and onwards. A disadvantage of the home television sets which are now on the market and receive broadcast television at certain hours of the day is the small size of the televised images. This makes it possible for only two or three people to see the screen properly. In the new apparatus for use in a theatre, the receiving screen is divided into 2100 elements. Each element consists of a cubicle which contains a tiny metal filament lamp, the front of the cubicle being covered with ground glass. The lamps are in circuit with bars on a large commutator. As the commutator revolves, each of the lamps is switched on in succession. The whole of the 2100 lamps are switched on and off in one-twelfth of a second. When operating, the incoming television signal is first of all amplified. The amplified current then flows through the revolving commutator. The current is strong at a bright part of the picture and weak at a dark part, and the picture is built up of a mosaic of bright and dark lamps. The lamps are not instantaneous in their action, and in this respect they differ from those used in other television devices. Great brilliancy, however, is attained by this means, and the flickering is much reduced. Experiments have been made at the Baird laboratories on the transmission of images showing considerable detail. It seems quite feasible to broadcast these pictures to distant cinemas by means of land lines.

A Civic Week lecture on "Science and the Fishing Industry", delivered at the University College, Hull, on Oct. 16, 1929, by Prof. A. C. Hardy, has been recently published as a pamphlet by Messrs. A. Brown and Sons, Ltd., Hull, price 6*d*. Prof. Hardy, who was chief zoologist to the *Discovery* expedition, discusses at some length the bearing of marine biological research upon the problems which confront the fishing industry. The men of science, he points out, by patiently investigating the many factors, some known, many yet unknown, which influence marine life, are gradually piecing together the story of what is going on below the surface of the sea. The work is laborious, disappointments are many, and progress is slow. Nevertheless, much has already been done, and last year,

for the first time in history, it became possible to forecast the prospects of certain fisheries. This is a great achievement, and Prof. Hardy is confident that, with more knowledge, this work can be extended and perfected so as to be of immense practical value. To bring immediate financial benefit to the trade, however, is not the only function of marine investigation. Much of its efforts must of necessity be directed towards the accumulation of knowledge which will result in no immediate gain to the industry, but is absolutely necessary as a basis for intelligent legislation in future, should occasion demand it. A strong plea is made for more co-operation between science and the industry—between the research worker and the fisherman. Each has much to learn from the other. Stress is also laid upon the paucity of financial support for scientific research. The trade, says Prof. Hardy, pays but a few hundred pounds a year to research institutions, and that more as a kind of charity than as an economic investment. To be of real benefit, research must be carried out on a scale bearing a reasonable relation to the magnitude of the industry. For this to be done, ample funds are essential.

AT the recent World Power Conference, Dr. Oskar Oliven gave a remarkable address on a "European Grid Power System". He pointed out the gradual growth of small power plants to huge power stations, the voltages of which were ever increasing. Interconnexions were being made between these stations, resulting in important economies being effected. Exchange of energy and compensation of load were now taking place over political frontiers, and the question had now become one which had to be considered by the whole of Europe. The problem could be solved if the visible and invisible boundaries which separated nations could be freely opened to the passage of electric energy for their mutual benefit. The idea of the peaceful co-operation of nations was gaining ground. The approximate length of the European super power system he suggested was 6000 miles. It included Calais, Rome, Constantinople, and Oslo. Britain and the northern part of Russia are left out for economical reasons. He assumes that capital can be obtained at 4½ per cent interest, and that the total cost would be about £100,000,000. He calculated that the average cost per unit would be reduced to about the fifth of a penny. He proposes to use a supply pressure of 400 kilovolts. There are now no technical difficulties in the way. He considers that the utilisation and application of electricity has become one of the strongest factors in international economy. A map of the proposed European grid is published in the *Electrician* for July 4.

AT the ninth annual general meeting of the Empire Cotton Growing Corporation, held in Manchester, with Lord Derby in the chair, on May 29, his son, Lord Stanley, made some very interesting comments upon the possibilities of agricultural development in India as affected by the coming completion of the Sukkar Barrage on the River Indus. With the completion of this barrage, which is anticipated for 1932, it is estimated that the irrigated area in India will increase from 2,035,000 acres to 5,394,000 acres, and much of the new land is thought to be of very good quality, capable of producing a better class of cotton than is at present grown in any cotton district. Lord Stanley made two very important and suggestive criticisms in connexion with this vast scheme. He pointed out that if full use is to be made of this new area under irrigation, the advisory research services which must guide in technical matters should be created *now*; Lord Stanley is emphatic that progress should be speeded up in this direction. He also pointed out that it is essential that some large estates be created in the new irrigation area, with the necessary capital and equipment in men and materials to enable new methods of cultivation, adapted to the changed conditions, to receive a thorough trial. The small cultivator is too conservative and too poorly equipped to make the necessary trials of new methods, and unless some large estates are organised in good time, much time may be lost after irrigation commences in learning how to make full use of the new potential sources of agricultural fertility.

THE first report of the Museum of Science and Industry, Chicago, founded by Mr. Julius Rosenwald in 1926, covers the period July 1928 to December 1929, and is a record of very active progress which, if maintained, will place the Museum in the forefront of such institutions in the United States. The provision of a building is always a serious matter, but it appears that from the first the founder had in view the utilisation of the much-admired Fine Arts Building erected for the World's Fair in Jackson Park in 1893. It is more than doubtful whether it would not have been wiser to have had a new building. Facts go to show that the cost of reconditioning this old building is going to be as great as the cost of a new one without any corresponding advantages. The Director, Mr. Waldemar Kaempffert, was appointed in 1928, and he has studied the older institutions of the same kind in Europe, particularly the Deutsches Museum at Munich. It is evident that he has been strongly influenced by what he has seen and no radical departure from them appears to be in view. He is alive to the necessity of drawing up beforehand schemes of what ought to be shown, and he is avoiding the pitfalls of accepting objects not strictly within the scheme; he is obtaining, too, the co-operation of individuals and firms. In fact, the idea of the industrial museum at last seems to have gripped the American imagination. We wish the institution much and early success.

IN the annual report of the Geophysical Laboratory of the Carnegie Institution of Washington for 1928–29 (*Year Book* No. 28 of the Institution), the director (Dr. A. L. Day) describes two important scientific expeditions in which the laboratory has participated. The first was for the study of volcanoes in the Dutch East Indies, where many active volcanoes are found within a small area; Dr. Zies, who undertook this work, went provided with spectrographic apparatus for the investigation of volcanic flames. This part

of the programme was unsuccessful, but valuable experience was obtained which it is hoped to utilise later; and gases, incrustations, and lavas were collected which have provided interesting material for laboratory studies. The other expedition was a gravity-measuring cruise in a United States submarine, using the methods and apparatus of Dr. Vening Meinesz, who accompanied the expedition; the U.S. Navy and the National Academy of Science co-operated with the Geophysical Laboratory in this work. A cruise of 45 days was undertaken in October and November 1928, in the Gulf of Mexico and the Caribbean Sea. Measurements of gravity were made at 46 sea stations, as well as others in various harbours. It was found that isostatic compensation in the Mississipi Delta is practically complete, despite the deposition of nearly 12 billion tons of matter there each year. But anomalies indicate that the Nares Deep is a recent uncompensated geological feature in which there must be large shearing stresses (see NATURE, Mar. 23, 1929, p. 473).

THE University of Melbourne has recently issued in bound form several volumes of "Collected Papers from the Science Laboratories". Vol. 5 consists of separata that have appeared during the years 1910 1928 and come from the following departments: Anatomy, 9 papers; zoology, 19 papers; and veterinary science, 14 papers. The papers cover a wide range of subjects, and in all departments deal with matters not only of local interest or rather concerning local material, but also of a more general nature. The former group contains anatomical investigations of Tasmanian aboriginals and Melbourne criminals; a number of descriptions of new Australian invertebrates, parasitic and otherwise, and studies on the parasites and diseases of Australian cattle. The second group include anatomical studies of man and other mammals; investigations into the development of the fowl, and parasites and diseases of cattle not limited to Australia. Altogether the papers show a commendable recognition of the importance of research as an essential function of University activity. From the personal point of view we are glad to see the name of Baldwin Spencer as part author of one of the papers in the zoological section, as it is probably the last paper by one whose recent death has deprived the University of an outstanding personality.

THE Report of the Secretary of the Smithsonian Institution for 1929 records a year "gratifyingly and unexpectedly rich in progress". One of the most important ventures has been the addition to the research laboratories of a new department, the Division of Radiation and Organism, the object of which will be to investigate the relationship between radiation and the growth and health of plants and animals. During the year twenty-nine expeditions, fitted for anthropological, geological, biological, or astrophysical investigation, sought knowledge and materials in distant parts, from Alaska to China, Cuba, and Haiti. As material has flowed in publications have flowed out, including, in addition to the usual monographs and articles, four volumes of the 12-volume set entitled "Smithsonian Scientific Series". The National Zoological Park has obtained a new building for birds, believed to be the best for its purpose in the world, and provision has been made by Congress for a new reptile house equally well designed; and certainly not least, an extensive collection of paintings and art treasures, valued at several million dollars, has been given by Mr. John Gellatly to the Smithsonian for eventual exhibition in the National Gallery.

WITH reference to our remark (June 14, p. 901) on the lack of a serious policy for the encouragement of children in the national museums, Dr. G. H. Carpenter sends us an account of the school work conducted in the Manchester Museum. Five trained teachers specially appointed by the City Education Authority take five classes a day, and each class, paying a weekly visit, gets a systematic course of lessons, with the advantage of illustrative specimens and objects freely placed at the teachers' disposal. Such an arrangement is excellent; it is the best possible plan under the passive system where the museum allows the fullest use to be made of its treasures. Our notion was that, if the system of the Peabody Museum were adopted, the national museums by means of their own staffs—specially appointed for the purpose, of course, but responsible to the museum authority—would become active agents in spreading knowledge of their treasures inside and outside the museum. We look forward to a time when it will be recognised that education is as much the duty of a museum as is the care of specimens.

ETON COLLEGE has followed excellent precedents in having formed a Natural History Society, the threefold purpose of which is to observe and collect local plants and animals, to make and listen to lectures, and to keep a log-book of all observations. The first annual report (1930) records a creditable number of these original faunistic observations, which concentrate upon the stock lists of birds and Lepidoptera; but there are many little problems of local distribution and numbers, of life-habits, and seasonal changes, which the members could tackle with advantage to their own powers of observation and reasoning, and to the advance of scientific knowledge. There is evidence in the report of abundance of enthusiasm, and we wish the new Society a long life and a busy one.

IN the General Report of the Survey of India 1928–1929 one of the most notable achievements recorded is the completion of the survey of Chitral on the 1-inch and ½-inch scales. This was one of the most difficult pieces of work in the survey of India. Another achievement was the survey of about 800 miles of previously unexplored country in Bhutan by permission of the Bhutanese Durbar. A summary of topographical surveys shows that about forty-eight thousand square miles was surveyed during the year, an area rather in excess of the average of recent years. So steady is the progress of the work that rather more than half the total area of the Indian Empire has now been surveyed, mainly on a 1-inch scale, but in places

on a $\frac{1}{2}$-inch or $\frac{1}{4}$-inch scale. The report contains a key sheet to all maps of the survey of India.

THE North-West Territories Branch of Canada's Department of the Interior has issued a finely illustrated handbook entitled "The North-West Territories, 1930". This gives besides a general account of an area which embraces over a third of Canada, many valuable notes on the forests, other vegetation, and wild life. Particular attention is paid to the Eskimo, who, according to a census made in 1927, number little more than 7100. The Department of the Interior has also published a revised map of the North-West Territories on a scale of 60 miles to an inch. It has no orographical detail but there are a wealth of names and indications of all the police and trading posts and the position of the game preserves. From the Natural Resources Intelligence Service of the same department comes a finely illustrated volume on the province of New Brunswick with several maps and much statistical information. Copies can be obtained free of charge from the National Development Bureau, Ottawa.

ALTHOUGH the present buildings of the Mellon Institute of Industrial Research were completed only in 1915, for practically ten years the Institute has had a waiting list of companies with problems for investigation. A new building is therefore to be erected and work on it will start this year. In addition to providing a greatly increased number of laboratories, the new building will give more commodious quarters for the general departments. The present library contains 11,000 volumes; the new library is planned to accommodate 250,000 volumes. The present Department of Research in Pure Chemistry will be expanded and facilities for pure research in other branches of science will be provided. Much more elaborate chemical engineering laboratories are to be available, and the fellowships in each specific field of industrial research are to be grouped in suites of rooms so that they can best make use of general apparatus adapted to their needs. Certain rooms will be equipped for specialised phases of experimental technique, such as electrochemistry, spectroscopy, low-temperature studies, radiations, high-pressure experimentation, etc. Other special features to be included are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage. The new laboratory will be seven stories high, with monolithic columns along all four sides, and approximately 300 feet by 400 feet. The laboratories are to face on interior courts, and additional laboratory suites can be constructed in the interior courts without interfering with the original laboratory units.

THE Messel medal of the Society of Chemical Industry was presented to Lord Brotherton of Wakefield during the forty-ninth annual meeting of the Society, for his services to chemical industry.

THE Minister of Agriculture and Fisheries, with the approval of the Army Council, has appointed Brigadier H. St. J. L. Winterbotham to be Director-General of the Ordnance Survey, in succession to Brigadier E. M. Jack, who retires on July 31 next. Brigadier Jack was president of Section E (Geography) of the British Association for the South Africa meeting last year.

A PROGRAMME has now been issued of the Southampton meeting of the Institute of Metals, to be held on Sept. 9-12. The proceedings will be opened on Sept. 9, when the ninth autumn lecture will be given by Prof. D. Hanson, on "The Use of Non-Ferrous Metals in the Aeronautical Industry". The mornings of Sept. 10 and 11 will be devoted to the reading and discussion of metallurgical papers, several of which are being contributed by distinguished metallurgists from abroad. Some attractive visits and excursions, including a trip to Cherbourg during the following week-end, have been arranged in connexion with the meeting.

A CONFERENCE on Soil Science Problems, to be opened by the Right Hon. W. G. A. Ormsby-Gore, will be held at the Rothamsted Experimental Station on Sept. 16-18 under the auspices of the Imperial Bureau of Soil Science. The discussions will cover soil analysis, surveys, field experimentation, and similar topics. The Conference will be the occasion of the annual visit of Empire agricultural officers.

A FURTHER step to encourage co-operative marketing in Great Britain is seen in the modification of the terms under which loans to marketing enterprises are issued. The Ministry of Agriculture's Advisory Committee on Co-operation and Credit has recommended that the initial period of remission of interest on a loan may be extended from two up to five years. Full particulars are published in Marketing Leaflet No. 19, which may be obtained post free from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

A CORRESPONDENT has directed our attention to the fact that recently two tubes of anhydrous aluminium chloride supplied to a school laboratory exploded on opening. It should be kept in mind that these tubes frequently contain a considerable pressure of hydrogen chloride gas and are liable to burst if any attempt is made to open them with a file. The tubes are perhaps best opened by wrapping in a thick duster and softening the drawn out end with a blowpipe flame. When the rush of gas ceases, the tube may be cut open. We think it would be advisable for the dealers to attach some such information as a label on the tube, but in any case those teachers who are not aware of the danger would do well to take note of it and should never allow pupils to open such tubes.

AN International Illumination Congress will be held in Great Britain in 1931 under the auspices of the International Commission on Illumination (which succeeded the International Photometric Commission) and is being organised by the National Illumination Committee of Great Britain and the Illuminating Engineering Society. The first week of the Congress, Sept. 3-12, will consist of a tour starting from London and visiting Glasgow, Edinburgh, Sheffield, and Birmingham; technical sessions will be held at each city. The second part of the Congress, Sept. 13-19,

will be at Cambridge. The subjects for discussion include factory lighting, street lighting, museum lighting, laboratory technique, and so on. The countries represented by National Committees on the International Commission on Illumination include most of the European powers, Japan and the United States; the president (1927–31) is Mr. C. C. Paterson, honorary secretary Dr. J. W. T. Walsh, and central bureau the National Physical Laboratory, Teddington. The honorary general secretary of the 1931 Congress is Col. C. H. S. Evans, c/o Illuminating Engineering Society, 32 Victoria Street, London, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: Assistant entomologists under the Division of Economic Entomology of the Australian Commonwealth Council for Scientific and Industrial Research, for research work on buffalo fly and blowfly problems—F. L. McDougall, Australia House, Strand, W.C.2 (July 30). A lecturer and demonstrator in plant pathology at the Swanley Horticultural College—The Principal, Horticultural College, Swanley, Kent (July 30). An evening teacher in electrical engineering at Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14 (Aug. 2). A lecturer in charge of the mining department of the Walker Technical College, Hartshill, Wellington, Shropshire—The Principal, Walker Technical College, Hartshill, Wellington, Shropshire (Aug. 9). A curator of the natural history department of the Kelvingrove Art Galleries and Museums, Glasgow—The Town Clerk, City Chambers, Glasgow (Aug. 15). A cotton classer, a cotton entomologist, and an assistant pathologist, each under the Department of Agriculture and Stock, Brisbane—The Official Secretary, Queensland Government Offices, 409 Strand, W.C.2 (Aug. 20). A lecturer in chemistry at the Leicester College of Technology—The Registrar, Colleges of Art and Technology, Leicester (Aug. 25). A demonstrator in chemistry in the University of Aberdeen—The Secretary, The University, Aberdeen (Aug. 30). An expert hydrobiologist for fisheries investigations in Turkey—The Expert-Adviser of Fisheries—Mr. E. C. Weberman—Beyoglu, Sira Servi 4, Istanbul, Turkey (Sept. 15). A George Herdman professor of geology in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 30).

ERRATUM.—In NATURE for July 19, p. 109: Paragraph "The Planet Saturn", line 7, for 838,500 read 838,500,000.

Our Astronomical Column.

Recent Solar Activity.—During the last few months there has been a noticeable absence of large sunspots and a steady diminution each month since January in the average daily number of groups. Although the solar cycle is progressing towards minimum, the very active period (Nov. 1929–Jan. 1930) and the present one of decline (Mar.–June 1930) would seem to be merely one of the many 'ups and downs' shown by the sunspot curves of preceding cycles when plotted from means taken over periods of a month or of a solar synodic rotation. Unless the present cycle is abnormal, the minimum is to be anticipated about 1934. During the last fortnight there have been signs of a revival of activity. On July 13–14 two large prominences were seen at the sun's east limb, and they could be followed as dark absorption markings in hydrogen or calcium light as the sun's rotation brought them across the disc. The larger and more massive prominence, in latitude about 25° N., was seen with the spectroheliioscope at Greenwich on July 18 as a strongly defined marking nearly 6′ in length, although still somewhat foreshortened, and inclined about 30° to the sun's equator.

The Approaching Opposition of Eros.—Eros will be nearest to the earth at the end of January 1931, when its parallax will be 50·3″. Dr. H. Spencer Jones contributes a paper with useful hints to observers which is published in *Astr. Nach.* 5715.

The rapid motion of Eros makes short exposure times and rapid plates desirable. The relative advantages of guiding on Eros or on the stars are discussed. It is thought that a suitable plan may be to follow Eros in R.A., but allow it to trail in declination. It will be brighter than most of the comparison stars, and its light should be reduced by a rotating sector. No photographs should be used in which the conditions of seeing have not been constant, as this may involve an error in the effective mean time of mid-exposure.

The light of Eros is sometimes subject to rapid variations; this also may affect the mean time of mid-exposure. The times of beginning and end of exposure must be accurately noted, on account of the rapid motion.

One of the useful by-products of the campaign will be an improved mass of the moon. Photographs for this purpose should be taken at the times when the difference of the R.A. of Eros and the moon is near 0^h, 6^h, 12^h, 18^h. These photographs may be taken near the meridian, whereas those for parallax in R.A. are taken at large hour-angles.

It is recommended that stars of extreme colour (types *B* and *K*5 to *M*) should not be used as comparison stars. *Harvard Bulletin* No. 871 gives the spectral types of the primary reference stars that are not in the Henry Draper Catalogue.

Meteors connected with Comet 1930 *d* (Schwassmann-Wachmann).—It was noticed soon after the discovery of this comet that its orbit approached that of the earth fairly closely. A watch for possible meteors was kept at the Kwasan Observatory, Kyoto, Japan. *Bulletin* No. 172 of the Observatory reports that Mr. T. Miyasawa observed numerous meteors on May 21 and the following nights. Mr. S. Sibata has derived the following orbit for the meteors; the latest orbit for the comet, by Miss Hayford and Mr. Anderson, is given for comparison:

	Meteors.	Comet 1930 *d*.	
T	—	1930 June 14·21981 U.T.	
ω	212° 24′	192° 19′·4	1930·0
Ω	60 10	76 45·2	1930·0
i	18 50	17 17·9	1930·0
log q	9·965	0·004934	
Period	—	5·2668 years.	

Mr. H. E. Wood has pointed out that there is a general resemblance between the orbit of this comet and that of comet Pons-Winnecke, suggesting that the two comets may have had a common origin.

Research Items.

Melanesian Shell-Money.—In No. 1 of vol. 1 of the *Anthropological Series of the Publications of the Field Museum, Chicago*, Mr. Albert B. Lewis describes the Melanesian shell-money in the museum collections. Many different kinds of shell-money are in use in Melanesia, but each is confined to a small area, outside which it has little or no value. Usually it takes the form of small discs on varying lengths of string; but in some places, such as the central Solomons, large shell-rings were manufactured which had a high value. Tanga arm rings in New Zealand would each buy a wife or one or two pigs. In the Gazelle Peninsula, New Britain, the *dwarra* currency was strung on rattan which could be broken to any length to make change. The Duke of York Islands was an important centre for the manufacture of the broad-shell variety of money called *pele*. It was put up in short strings tied in bunches. Though it had a standard value it was not actually used as money, but was traded to New Ireland and New Britain. The chief centre of manufacture of shell-money was the small islands around New Ireland, and the great number of these islands must be held to account for the great number of varieties. The value depended on colour and workmanship, the most valuable being the small red discs. The most elaborate and valuable variety of New Ireland money was that known as 'pig money', which was used for the purchase of pigs for use in ceremonial. Its value was so great that only very wealthy people could acquire it. It has long disappeared from use. Shell disc money, though not so common as in New Ireland, was also in general use throughout the Solomons, Santa Cruz, Banks, Northern New Hebrides, and New Caledonia.

Urn-Burials in Alabama.—Among papers submitted to a Conference on Mid-Western Archæology held in St. Louis, U.S.A., in 1929, of which a report is issued as *Bull. No. 74* of the National Research Council, Washington, was an account of recent discoveries made along the Tallapoosa and Alabama Rivers by Mr. P. A. Brennan. Among them a large number of urn-burials were found. This custom is said to be an indication of Choctaw cultural influence. The Choctaw are said to have placed their dead on racks until the flesh had decayed before burying them. Articles associated with these burials indicate that they had a much higher cultural level than their descendants. Their pottery is of heavy earthenware, shell-tempered, glazed with charred grease, and sometimes the vessels are of a capacity of eight gallons. At Montgomery a cache of twelve urns, each covered with a bowl, all contained skeletons—adults, children, and babes. Several contained remains of more than one individual. The largest was 26 inches in diameter and the smallest 8 inches. Yet the latter contained the complete skeleton of a baby. The urns were close to the surface and the arrangement may have been intended to represent a constellation. A similar find made a few years ago consisted of nine urns arranged around a central urn. A vault-like placing had been attempted in a hole 25 feet in diameter which had been cut in red clay. Into this was poured quartzy gravel, periwinkle and mussel shells from the kitchen middens, and then ashes. After the vessels had been placed in position, they were surrounded with layers of gravel, shells and ashes, and then covered with clay. This was then hardened by fire. Interments in the earth and apparently contemporary accompanied them. Shell objects, though not numerous, are indications of a high civilisation, while the shell pictures, especially that of a figure with its protruding tongue transfixed by a sword, suggest contact with Mexico.

Economic Standing of Members of the Crow Family.—Having already discussed the food of the rook and jackdaw, Dr. Walter E. Collinge (*Jour. Ministry Agr.*, May 1930, p. 151) turns to four other members of the family, the carrion crow, the hooded crow, the magpie, and the jay, all of which have been condemned from one point of view or another. His conclusions do not support the almost universal views of game-preservers, and they are of great interest to a more important group of economic workers, the farmers. It was found that 36 per cent of the food of these birds was of direct benefit to the farmer and fruit-grower, since it consisted of injurious insects, mice and voles, slugs and snails. On the other hand, 18 per cent was injurious, but of this, half represented the destruction of the eggs and young of wood-pigeon, blackbird, gulls and ducks. Evidently any destruction of these 'crows' is prejudicial to the interests of the farming community. Even so far as game-preserving is concerned, Dr. Collinge finds that the injuries are not excessive, and thinks that they have been generally over-estimated.

Birds of Buru.—In 1921-22 L. J. Toxopeus made a collection of the birds of Buru, in the Moluccas, which has added considerably to the list of species and to our knowledge of the differentiation of races in that area. Stresemann in 1914 recorded 135 species from Buru; now H. C. Siebers brings the number to 167 (*Treubia*, vol. 7, suppl., May 1930). His work is of more than ordinary faunistic interest on account of its careful descriptions of racial characters, of the habits of some of the native birds, and of the detail with which the breeding areas have been worked out.

Coleoptera of Italy.—In *Memorie della Pont. Accademia delle Scienze Nuovi Lincei*, ser. 11, vol. 13, 1929, there is to be found an important contribution entitled "I coleotteri d' Italia", by Paolo Luigioni, S.O., which will interest coleopterists and students of insect distribution. This extensive compilation amounts to 1135 pages and consists of a catalogue of the beetles of Italy together with the literature dealing with them. The area embraced in this work includes continental Italy, and also Corsica, Sardinia, Sicily, and the Maltese Islands. Altogether 1169 genera and 9979 species of Coleoptera are enumerated as occurring in the area under consideration. In an appendix a number of additional species are listed provisionally owing to their identity being doubtful. As might be expected, the families most numerous in species are the Curculionidæ, Staphylinidæ, and Carabidæ, with 1610, 1595, and 1059 species respectively. As compared with the paucity of the British fauna, it is interesting to note that the Buprestidæ comprise 188 species, the Cerambycidæ 267 species, and the Meloidæ 57 species. The enterprise which prompted the compilation and actual publication of this bulky work deserves special commendation, and it is likely to remain the standard reference catalogue on its subject for many years to come.

Egg-killing Insecticide Washes.—During the winter, when vegetation upon the fruit tree is dormant, it is possible to use insecticide washes of considerable strength with the view of controlling insect pests then present on the bark in the form of eggs. During recent years there have been indications that the researches into the preparation of a successful egg-

killing wash, carried on at the experiment station at Long Ashton under the auspices of the Ministry of Agriculture, had met with considerable success. In a paper in the *Journal of Pomology*, vol. 8, pp. 129-152, May 1930, Messrs. Staniland, F. Tutin, and C. L. Wilson give an account of the progress of these investigations and show very clearly that the ovicidal powers of the successful tar distillate washes are due to the asphyxiating action of a uniform, oily film deposited over the eggs by the spraying operations. Direct toxic action of the active chemical constituents is relatively unimportant; experimentally, the eggs can be killed equally well by heavy medicinal paraffin. Paraffin wax and neutral tar products boiling above 360° C. were less successful ovicides, because, on drying, they did not yield a uniform film, but an irregular granular deposit. The control of capsid bug and the winter moth by the new 'high neutral' tar distillate washes, when a suitable emulsifier is used, seems to be exceedingly efficient on apple trees. On black currants capsid bugs are less easily controlled. The authors point out this may be because the egg protruded further into the air, out of the bark, and is therefore less readily covered by the drying film of oil. The destruction of *Aphis* and *Psylla* eggs by these washes, on the other hand, is not brought about by their asphyxiation, but by the directly toxic action on the eggs of certain chemical constituents in the washes. This paper, of great practical importance, is also of very considerable scientific interest, the practical results of field spraying trials being controlled by numerous laboratory experiments with the various constituents of the insecticide washes upon different types of insect eggs.

Grasses of Central America.—In his monograph of the grasses of Central America, Prof. A. S. Hitchcock (*Cont. U.S. Nat. Herb.*, Smithsonian Institution, vol. 24, part 9, 1930) brings together for the first time much scattered information relating to the grasses of the whole area between Colombia and Mexico. Native and introduced species are both included, and the paper gives descriptions of 115 genera and 460 species, including one new species, *Ichnanthus standleyi* Hitchc. from Honduras. The best represented genera are *Paspalum* and *Panicum*, each with more than 60 species. The grass flora falls into three types. In the tropical rain forests bordering the Atlantic coast the flora is similar to that of the other tropical American coastal lowlands bordering the Atlantic. The coastal region on the Pacific side is much drier and possesses a well-marked dry season, as a result of which there are extensive savannas extending from Panama to Mexico. The flora of elevated interior is high temperate rather than alpine, and the grass flora represents a southern extension of that of the Mexican plateau.

Hybrid Poplars for Pulp Production.—Throughout the world research work is now being undertaken, having for its object the increase in the production of paper, chiefly pulp, for the news sheets and cheaper forms of publications. During the past few years Dr. Ralph H. McKee and others have been carrying on research with the object of attempting to find means by which the steadily diminishing supplies of wood in the United States of America might be supplemented. Amongst other experiments entertained, attempts were made with hybrid poplars, the object aimed at being to obtain an increased rapidity of growth. Several hundred acres of waste land in the eastern parts of the United States have been planted with hybrid poplar trees (the species are not mentioned), which it is said will yield a crop of pulp wood for the paper industry comparable in value to the financial return from flaxstraw and cotton. Dr. McKee recently described this work before the Franklin Institute, a notice of which is given in *Daily Science News Bulletin*, No. 469 C (Washington, 1930). The new hybrids will produce, it is said, from 10 to 14 times as much wood per year as wild poplars growing under similar conditions. It was pointed out that in 60 years natural reforestation yields about six cords of useful wood per acre, or 125 pounds of cellulose a year from each acre. The yield per acre-year for cotton is 150 pounds of cellulose, for flaxstraw 100 pounds, and cornstalks nearly 500 pounds. "Well managed reforestation plantations of pulp wood using wild species produce about 2000 pounds of cellulose per acre-year," said Dr. McKee. "From the new hybrid poplar plantations we have every reason to expect 80 cords of pulp wood per acre in 12 years; that is, an average of about 16,000 pounds of merchantable wood per acre-year, equivalent to 8000 pounds of cellulose." The development of this interesting experiment will merit the most careful watching.

Carboniferous Fossils from Nova Scotia.—A collection of Carboniferous fossils from the Mississippian beds at Windsor, Nova Scotia, formed by the late Miss Eleanor Long in 1914, has been worked over by W. A. Bell (*Proc. Acad. Nat. Sci. Philad.*, vol. 81). The author, who has already prepared a paper on the district for the Geological Survey of Canada (*Memoir 155*), gives a summary of the general geology of the Windsor area, accompanied by a map, and enumerates the forty-six species of fossils in Miss Long's collection with special notes and figures of three. The Windsor fauna as a whole exhibits close affinity to the Viséen of western Europe, more especially the *Seminula* zone of England, and differs from the faunas of like age in the Mississippian basin of America, as early noted by Dawson and others.

Earth Pressure Experiments.—In connexion with the construction of a big retaining wall, 900 ft. long and 160 ft. high at mid-length, for a power scheme in New England, a series of large-scale experiments on earth pressure have been carried out in a laboratory especially erected for the tests, and an account of the investigation is given in *Engineering* for May 30 and June 13. The laboratory was erected on a site provided by the Massachusetts Institute of Technology, and the tests were made by Dr. C. Terzaghi, now professor in the Technical High School, Vienna. The testing machine employed consisted of a ferro-concrete bin 14 feet square, one side of which had a movable stiffened slab, the thrust against which could be measured by weighing machines. Boulder clay and till—the latter a geological term applied to a deposit of clay, sand, and gravel—were used in the experiments, the results of which are given in the articles. Experiments were also made on the internal frictions of sands and clays under different pressures, when it was found that, with identical materials and low pressures, the coefficient of friction was far greater with densely packed than with loose materials, but as the pressures increased the margin between the two values tended to disappear.

Structure of the Electron.—In a series of papers published since 1929 in the *Proceedings of the Physico-Mathematical Society of Japan*, Mr. U. Kakinuma endeavours to develop a new theory of the structure of the electron which shall combine the theory of relativity with wave mechanics. He starts by replacing the ordinary relativity electromagnetic energy-tensor by another energy-tensor which involves velocity components as well as electromagnetic terms, and is analogous to the usual energy-tensor of a perfect fluid.

From this assumption are derived the fundamental field-equations, which admit of a remarkable solution, with one factor such as appears in Einstein's cosmological theory, and a second factor which is periodic. Thus with every electron there is associated a wave of a definite frequency. Moreover, the solution leads directly to the fundamental equation of wave mechanics, connecting the mass of the electron with the frequency of the associated wave. It might be thought that Mr. Kakinuma's work is a development of Einstein's unitary field theory, but this is not so. It is more on the lines of the theory of gauges due to Weyl, of which little has been heard for several years, but it uses Riemannian geometry, which both Weyl and Einstein have now discarded.

X-Ray Crystal Analysis.—In the *Engineer* for July 4, Mr. V. E. Pullin, director of radiological research at Woolwich, in a well-illustrated article on X-ray crystal analysis in engineering gives a broad outline of the object, the methods, and the results of the application of the X-ray spectrometer to various metals and alloys used in engineering. Starting with a brief note on the discoveries of Von Laue and other investigators, he says that the important facts which render X-ray crystal analysis of use to engineers are first, that metals are crystalline, and second, that the working of metals either by tools or by heat always tends to alter or modify the crystal structure. This being so, it is the function of X-rays to show the manner in which individual atoms are normally arranged, and how they are modified by mechanical or heat treatment or by alloying with other metals. After a short explanation of the types of crystals of importance to engineers, (1) face-centred cubic crystals, (2) body-centred cubic crystals, and (3) hexagonal crystals, Mr. Pullin goes on to describe the apparatus and the technique, and then gives a series of examples of the information that can be obtained. He gives some forty or more characteristic diagrams which are published in a special supplement.

Compressibilities of Gases. The April number of the *Journal of the American Chemical Society* contains three papers dealing with the compressibility of hydrogen and nitrogen and of a 3 : 1 mixture of these gases at temperatures of 70°, −50°, −25°, and +20°, and at pressures up to 1000 atm.; of carbon monoxide at temperatures from −70° to +200°, and at pressures to 1000 atm.; and on a characteristic equation with relation to nitrogen. In the case of nitrogen, a curious phenomenon appeared at about 380 atm., when the deviation from the ideal gas was nearly constant through the temperature range −70° to +100°. Carbon monoxide was found to undergo decomposition under pressure at atmospheric temperature when stored in iron vessels. Carbon and carbon dioxide are formed, and at 100 atm. the gas contained more than 1 per cent of carbon dioxide after three weeks. Formation of iron carbonyl also occurred. The compressibility curves of carbon monoxide are similar to those of nitrogen: carbon monoxide is slightly more compressible than nitrogen in the low-pressure range and slightly less compressible in the high-pressure range, the difference becoming smaller with increasing temperature. The results are to be expected from the fact that carbon monoxide has a slightly higher critical temperature (−139·0°) than nitrogen (−147·1°). Carbon monoxide exhibits the same peculiar behaviour as nitrogen, but over an even wider range of temperature, namely, from −70° to +200° at 375 atm.

Chemistry of Coal.— A paper on the benzenoid constitution of coal (Part 6 of a series on the chemistry of this substance) has been contributed to the June number of the *Proceedings of the Royal Society* by Prof. Bone, Dr. L. Horton, and Mr. S. G. Ward. The elaborate series of experiments performed, mainly on the oxidation by permanganate of the residues from the 'benzene-pressure-extraction' of various coals, have lead to results of much importance. All the coal residues examined gave much the same weight-yields of crystalline organic acids, chiefly benzene carboxylic acids, the proportion of which did not vary materially from one coal to another, and smaller amounts of oxalic and acetic acids, indicating that "a considerable part of the organic débris originally deposited in the incipient coalfields either had or soon acquired a cyclic, and probably benzenoid, structure which has been preserved during the subsequent maturing process". Evidence has also been obtained that in the oxidation of the coal substance by alkaline permanganate, complex colloidal 'humic acids' are formed intermediately, the crystalline benzenoid acids, and probably also oxalic and acetic acids, arising simultaneously from their further oxidation. These results, and others obtained in earlier work, "revealing as they do that in great part the coal substance—no matter what its geological age or chemical maturity, or whether or not it is extractable by boiling benzene under pressure—has an essentially 'benzenoid' structure, suggest the possibility of its having arisen through condensations of phenolic- and amino- with aldehydic-bodies, much as 'bakelite' is synthesised nowadays from phenols and formaldehyde". The experimental exploration of the many questions opened up by this investigation—which have been necessarily referred to only in certain salient points in the present note—is being continued, but it is evident that the researches already performed have led to a considerable advance in knowledge of the properties of coal.

Radio Communication with Aeroplanes.—Mr. Hoover, the radio engineer of the Western Air Express, read a paper on radio communication with aeroplanes to the Society of Automotive Engineers in the United States on Feb. 20. The difficulties to be overcome are mainly due to the radio waves emitted by the engine every time a spark occurs in any of the sparking plugs—the ignition wires, magneto, and low tension wires forming an antenna system. The highly sensitive receivers on the aeroplanes have to pick up feeble signals from stations more than a hundred miles away. It will be seen, therefore, how difficult it is to shield from the receiver the waves coming from strong spark transmitters only ten feet away. The only possible solution is to put a continuous metallic shield round all the radiating apparatus. The Airways Division of the U.S. Department of Commerce has initiated the building of earth stations for aeronautical use. About forty stations have already been installed. They are spaced along the airways at distances apart of about 200 miles. They cover the whole country from New York to San Francisco and from Seattle to Key West. The stations use the voice and have a carrier output of two kilowatts. On a conservative estimate this would give a day range of about 150 miles and a night range of double as much. The 1927 international convention set aside a band of wave-lengths between 800 metres and 1200 metres exclusively for aeronautical purposes, and the Government stations work between these limits. A new branch of the U.S. Weather Bureau has been inaugurated to make hourly collections and forecasts of the weather. The reports are collected and broadcast over the airways every hour and it is hoped shortly to broadcast them every half-hour.

The Third Imperial Entomological Conference.

THE Third Imperial Entomological Conference was held in London, under the auspices of the Imperial Institute of Entomology, on June 15-27. Through the courtesy of the officers and council of the Entomological Society of London the meetings of the Conference were held at the headquarters of the Society at 41 Queen's Gate. About forty delegates, representing twenty-four different States of the British Empire, attended in an official capacity. Lord Buxton, the chairman of the managing committee of the Imperial Institute of Entomology, was unfortunately unable to be present owing to illness, and was represented at the opening meeting by Sir Sidney Harmer. The morning of the first day of the Conference was devoted to the reception of delegates and the appointment of sub-committees to deal with business matters. At this meeting it was announced that the Managing Committee had decided to alter the name of the Imperial Bureau of Entomology to the Imperial Institute of Entomology, in view of the growth and expansion of its work since it was first founded. In the afternoon the delegates were shown a very remarkable film brought from Canada by Mr. A. Gibson, Dominion Entomologist, representing the mass production of the parasites of the European corn borer, as carried on in the laboratory of the Dominion Entomological Department at Chatham, Ontario. In this film the various phases of the mass production work and the behaviour of the principal parasites of the pest studied were shown with extraordinary clearness and accuracy. The film was exhibited at the Imperial Institute through the courtesy of the Director, Lieut.-Gen. Sir W. T. Furse, and was again shown by request on Friday, June 20. The exhibition of the film was followed by a reception of the delegates at the Natural History Museum.

The meetings of June 18, under the chairmanship of Mr. F. A. Stockdale, were devoted to discussions on the organisation of entomological departments, opened by Mr. H. H. King, of the Sudan, and on entomological work among backward races, opened by Mr. A. H. Ritchie, of Tanganyika. In the evening there was a meeting of the Entomological Society of London, which was largely attended by the delegates.

On Thursday, June 19, the delegates visited the Parasite Laboratory at Farnham Royal, where they were entertained by the Imperial Institute of Entomology to luncheon and tea, and shown in detail the various methods in use in the work of the laboratory.

The morning meeting of June 20, held under the chairmanship of Dr. T. Drummond Shiels, M.P., was devoted to the extremely important subject of tsetse control. The discussion on this subject was opened by Mr. C. F. M. Swynnerton, whose excellent work in areas infested by the tsetse in Tanganyika Territory is, of course, well known. Mr. Swynnerton gave a detailed and most interesting account of the work which is now being carried on in Tanganyika, where the practice of grass burning, carried out under skilled direction and combined with the breaking up of the infested zones into areas of a size convenient for burning, has given excellent results. A very important phase of this work has consisted in the production of live fences or hedges designed to prevent the passage of game, and produced by the planting of cuttings or live poles of certain species of indigenous trees which are used by the natives to fence their villages. Another important development in this work is the use of moving baits smeared with tanglefoot for the capture of individual flies, and the introduction of the aeroplane for scouting work. The importance of aeroplane surveys in entomological work is now widely recognised, and it is to be hoped that every facility for their use will be granted by the authorities, in order that this work may be carried on in the infested areas in a thorough and satisfactory manner. Mr. Swynnerton's paper was followed by a very interesting discussion on various phases of the tsetse problem, including the important matter of game preservation. The afternoon meeting, under the chairmanship of Mr. A. Gibson, Dominion Entomologist for Canada, was devoted to the control of insects by cultural methods, and was opened by Mr. F. A. Stockdale. It gave rise to a number of very important comments in regard to the value of cultural methods, particularly against sucking insects, in various parts of the world.

Saturday, June 21, was devoted to a visit to the University of Cambridge, where the delegates were entertained by Prof. J. Stanley Gardiner, and shown the work conducted by the Department of Entomology and the important investigations in progress on virus diseases of plants. The delegates were entertained to tea at Messrs. Chivers' fruit farm.

The morning of Monday, June 23, was devoted to the meetings of committees and the afternoon meeting to the important subject of locusts, under the chairmanship of Major E. E. Austen. The discussion was opened by Mr. B. P. Uvarov, of the Imperial Institute of Entomology, one of the foremost living authorities on this subject. Unanimous agreement was expressed by all the speakers as to the necessity for further investigations on the permanent breeding-grounds of the migratory locusts and the underlying causes of the phenomenon of migration.

On the following day the meetings, which were held under the chairmanship of Sir Sidney Harmer owing to the unavoidable absence of Dr. R. Stewart MacDougall, were devoted to the subject of biological control, which is now of especial interest owing to the fact that since the previous Conference the Imperial Institute of Entomology has founded, with the aid of a grant from the Empire Marketing Board, its laboratory at Farnham Royal as an Imperial centre for work on biological control of insect and plant pests. In the morning meeting the biological control of insects was considered. It was opened by Mr. A. Gibson, who gave an interesting and detailed account of the work in progress on these lines in the Dominion of Canada. In the discussion that followed, many points of interest were brought up concerning the practice of biological control of insect pests in various parts of the world, and general satisfaction was expressed by all the delegates in regard to the initiative which Sir Guy Marshall, director of the Imperial Institute of Entomology, had taken in the creation of a special institution for work of this type within the Empire. The afternoon meeting was devoted to the control of weeds by insects. Dr. Miller, of the Cawthron Institute of New Zealand, who opened the discussion, gave an account of the work which is being carried on in New Zealand in collaboration with the Imperial Institute of Entomology at Farnham Royal on the biological control of some of the most important weeds of New Zealand, including particularly blackberry, gorse, ragwort, and bracken. He was followed by Dr. A. Nicholson, deputy chief of the Entomological Division of the Commonwealth Council for Scientific and Industrial Research of Australia, who described to the delegates the extraordinarily successful and interesting experiments carried on by the Commonwealth Prickly Pear Board against the various species

of prickly pear in Australia. He showed that the initial successes obtained in this work have now been very greatly extended, and that large areas formerly rendered uninhabitable and useless for agricultural purposes by the invasion of the prickly pear have now been freed completely from this pest and are being brought under cultivation.

The morning of June 25 was devoted to meetings of committees, and the afternoon to a discussion, opened by Dr. W. J. Hall, of orchard pests in various parts of the world. In the evening an official dinner was given to the delegates by His Majesty's Government at Lancaster House, St. James's, under the chairmanship of Lord Passfield, Secretary of State for the Colonies.

The final meeting of the Conference was held on June 26, and was followed on Friday, June 27, by a visit to the Rothamsted Experimental Station and Pathological Laboratory of the Ministry of Agriculture at Harpenden. W. R. THOMPSON.

Cellulose and Sodium Hydroxide.

THE British Cotton Industry Research Association has recently issued two memoirs (reprinted in the *Journal of the Textile Institute*, vol. 20, T. 373, 1929; and vol. 21, T. 225, 1930) in which S. M. Neale describes some work on the physical chemistry of cellulose. Regarding cellulose as a linked series of glucose residues with –OH and -O- groups as reacting points, it is shown that the behaviour in alkaline solutions can be explained by treating the –OH groups as sources of potential acidity, with their capacity for liberating hydrion governed by the law of mass action, so that an average dissociation constant can be assumed for the primary acid ionisation of cellulose in any state of complexity. In developing this idea it is necessary to employ the Donnan equation of membrane equilibrium to allow for the fact that the assumed cellulose ion is coherent and unable to diffuse. By assuming an approximate value of 2×10^{-14} for the dissociation constant it is possible to calculate approximately the osmotic swelling pressure of cellulose in solutions of caustic soda of any concentration. The calculated osmotic pressure curve is strikingly similar to the curve obtained by plotting the imbibition of water by regenerated cellulose (cellophane sheet) against the concentration of alkali in which it is placed, while the amounts of alkali taken up are shown to be consistent with the stoichiometric conversion of cellulose into the mono-sodium salt at high alkali concentrations, when allowance is made for the alkali imbibed in accordance with the Donnan equation.

The peculiar effect of temperature on the swelling curve of cellulose in sodium hydroxide solution is a consequence of the theory and arises essentially from the increasing hydrolysis of the cellulose salt at high temperatures. The amount of heat developed in the reaction between cellulose and sodium hydroxide has been determined and is found to rise continuously with the concentration of the alkali. The heat effects at all concentrations are in fair agreement with values calculated on the assumption that the heat of ionisation of cellulose is comparable with that of the monosaccharides. Allowance is made in these calculations for the very large additional heat effects arising from the higher energy content of alkali in concentrated as compared with dilute solution, and from the dilution of the bulk alkali by the water molecules set free and those formed as a result of the postulated chemical reaction.

When cellulose in equilibrium with any given solution is immersed in a solution of widely different concentration, striking transient volume changes are observed. These are explained in terms of the osmotic theory which is put forward, and arise from the fact that the water diffuses more rapidly than the alkali. The data presented in the second paper describe the behaviour of regenerated cellulose in solutions of sodium hydroxide more dilute than half-normal, and it is shown that in this region the absorption of alkali and the swelling of the gel are quantitatively explained by assigning to the ionisation constant of cellulose the value $1{\cdot}84 \times 10^{-14}$ at 25° C.

The considerations of these papers are largely applicable to the behaviour of cotton hairs in caustic alkali, and go far towards making clear the chemical and physical mechanism of the process of mercerisation.

Geology of Ceylon.

IN the little pamphlet referred to below [1] Dr. Adams brings together the work of former investigators in Ceylon, savouring his account with important conclusions derived from observations of his own. The geological structure of the island is outlined for the first time, analyses of rocks are given and, above all, there is an admirable geological map, the first of the whole island to be produced. A list comprising seventy references is provided.

The historical side is touched on briefly in an "Introduction", wherein it is stated that man had not reached the Palæolithic stage, when probably "by means of a then existing land bridge" he arrived on the island. The successive invasions from Neolithic time to the occupation by the British in 1796 are summarised in a few paragraphs. After a review of earlier publications, Dr. Adams deals with the topography and brings out clearly the three peneplanations to which the land has been subjected, illustrating his explanation with four admirable plates, two being reproductions of sheets of official maps.

Investigators in Ceylon are fortunate in having such a sound basis for their work as this topographical survey produces. To these three peneplains, clearly visible, must be added a fourth, the submarine plateau. The subaerial surfaces of erosion, representing stationary conditions in a periodically renewed upward movement, are respectively 100 feet (the coastal plain), 1600 feet and 6000 feet above sea-level and are of more than local interest. Whether they are or are not due to marine erosion is left an open question—the author inclines to subaerial denudation—one notes in passing that Wayland assigns the first and second to the former cause. Dr. Adams suggests that the Deccan Plateau is perhaps a continuation of the second, possibly the uplands of the Nilgiris represents the third planation, making the comment that so well defined a series of erosion surfaces may yet be recognised in other fragments of 'disrupted' Gondwana Land. He suggests Madagascar in this connexion. The present writer would add the Northern Frontier Province of Kenya; the type of country, a wide stretching plain with suddenly rising 'buttes' or residual hills, is essentially the same as that shown by Dr. Adams in Plate II.

As it must be, the topography is influenced by the strike of the foliation of the crystalline rocks, but in Ceylon ("an admirable relief map of the island" exists in Colombo) the strike ridges swing in successive loops resembling, as Dr. Adams has it, "a series of garlands pendent from the northerly extremity of the Island";

they follow approximately the outline of the coast. The island, in fact, is a portion of a much eroded syncline, the axis in general trending north and south a short distance east of Kandy and Nuwara Eliya. Altogether, this is a stimulating portion of the book.

For the Pleistocene, the Miocene at the extreme north of the island and the very small area of non-marine Jurassic beds at Tabbowa, the author relies principally on data collected by Wayland; for the Archaean, which constitutes so very large a proportion of the whole, Coomáraswámy is a noteworthy contributor. Acknowledgment for information received, especially concerning the gem deposits, is made to Mr. J. S. Coates, the Principal Mineral Surveyor. The crystalline rocks present many interesting features, and the resemblances they bear to those of other lands attract Dr. Adams's attention. He points out the essential identity of the dominant quartzose biotite-gneisses with "hundreds of occurrences in the Laurentian of Canada" and the "striking resemblance" of the limestones to those of the Grenville Series of the Canadian Shield. Doubtless the island is the southward extension of the Bengal gneiss with which, in Ceylon as in India, khondalites are associated. Of these analyses are given. Nine analyses of charnockites and four of allied rocks, together with a table of norms, increase our knowledge of that interesting series. Much petrographical detail is provided, but a few photomicrographs would have added to the value of the work.

The geological map, with an east and west section through the island, shows the limestones, quartzites, and khondalites differentiated from the huge expanse of biotite-gneiss, the distribution of the charnockites in the southern part of the island and in addition the Galle Series of Coomáraswámy, a group distinguished by the occurrence of scapolite and wollastonite. The strike of the foliation is made clear by broken lines. Doubtless, as Dr. Adams comments, there is yet room for additional study in Ceylon, but in this work we have the most valuable contribution to the geology and physiography of the island produced for many years.

JOHN PARKINSON.

[1] *Canadian Journal of Research.* "The Geology of Ceylon." By Frank Dawson Adams. (Ottawa: National Research Council of Canada, 1929.)

University and Educational Intelligence.

BIRMINGHAM.—At the recent degree congregation the degree of D.Sc. was conferred on Mr. Edward Tyler for published work on liquid jets, vortices behind aerofoil sections and rotating cylinders, eddy flow from annular nozzles, and other aerodynamic investigations.

Dr. H. B. Keene is resigning his post as lecturer in physics on being appointed head of the Physics Department of the Birmingham Municipal Technical College.

The fiftieth anniversary of the opening of Mason College and the thirtieth anniversary of the granting of the charter to the University of Birmingham are to be celebrated in October, the programme including a special degree congregation at which honorary degrees will be conferred on, among others: Sir William Hardy, Prof. R. Robinson, Dr. F. E. Smith, and Sir Thomas Lewis.

EDINBURGH.—At a meeting on July 14, the University Court accepted the resignation of Mr. J. G. Semple, lecturer in mathematics, on his appointment to the chair of mathematics at Queen's University, Belfast. Mr. Alexander Oppenheim was appointed lecturer in mathematics in place of Mr. Semple. The resignation of Mr. L. A. Harvey, lecturer in zoology, was intimated on his appointment as head of the department of zoology in the University College of the South-West at Exeter.

LONDON.—The following appointments have been made: Dr. Samson Wright, lecturer in physiology at King's College, to be University professor of physiology (Middlesex Hospital Medical School); Dr. Alexander Robertson, University reader in chemistry at East London College, to be University reader in biochemistry (London School of Hygiene and Tropical Medicine).

Mr. J. G. Thomson (medical protozoology) has been given the title of professor in respect of the post held by him at the London School of Hygiene and Tropical Medicine.

Dr. G. S. Wilson (bacteriology as applied to hygiene) has been given the title of professor in respect of the post held by him at the London School of Hygiene and Tropical Medicine.

The title of emeritus professor of physics in the University has been conferred on Prof. C. H. Lees on his retirement from East London College.

OXFORD.—Applications are invited from members of Magdalen College for the Edward Chapman research prize, value £20, for a published piece of original research in one of the following departments of natural science: physics or chemistry, including the sciences of astronomy, meteorology, and mineralogy or geology, or the biological sciences of zoology and botany, whether treated from the morphological, palæontological, physiological, or pathological point of view. Competing essays should be sent by, at latest, Oct. 11 next, to Prof. H. L. Bowman, Magdalen College.

THE Ramsay Memorial Fellowships Trustees have made the following awards of new fellowships for the session 1930–31: Mr. W. R. Angus, a fellowship of £300, tenable for two years, at University College, London; Dr. K. Krishnamurti, a fellowship of £300, tenable for one year, at University College, London; Dr. James Bell, a Glasgow fellowship of £300, tenable for two years, at University College, London; Dr. A. Girardet, a Swiss fellowship of £300, tenable for one year, at the University of Edinburgh. The Trustees have renewed the following fellowships: Dr. H. Erdtman (Swedish Fellow), University College, London; Dr. A. Klinkenberg (Netherland Fellow), University of Cambridge; Prof. Y. Nagai (Japanese Fellow), University College, London; Dr. Lloyd M. Pidgeon (Canadian Fellow), University of Oxford.

NOTICE is given by the President and Council of the Royal Society of forthcoming awards of Moseley, Mackinnon, and Lawrence research studentships. The first-named will be for "the furtherance of experimental research in pathology, physics, and chemistry, or other branches of science, but not in pure mathematics, astronomy, or any branch of science which aims merely at describing, cataloguing, or systematising", and the value £350 per year; the second will be for the purpose "of furthering (i) natural and physical science, including geology and astronomy, and (ii) original research and investigation in pathology", and the value £350 per year; the third will be of the value of not more than £200 for one year, for research in some subject related to the cause and cure of disease in man and animals. Forms of application, returnable not later than Oct. 11, may be obtained from the Assistant Secretary of the Royal Society, Burlington House, London, W.1.

Historic Natural Events.

July 28, 1883. Destructive Ischian Earthquake.—Casamicciola, the chief town in the island of Ischia (Italy), was destroyed by an earthquake and about 1800 out of 3963 inhabitants were killed. The area of complete destruction, however, contained only 3 square miles, and the whole disturbed area between 300 and 400 square miles, that is, less than the area of a slight British earthquake. This implies a very shallow focus, the depth of which was estimated from the directions of fissures to be one-third of a mile. The epicentral area lay on the northern slope of Epomeo, a volcano that was last in action in 1302, and its longer axis was directed towards the centre of the old crater. Thus, the earthquake may have been the result of an unsuccessful attempt to force a new eruption.

July 29, 1875. Shower of Hay near Dublin.—About 9.30 A.M. a quantity of hay fell from the sky at Monkstown near Dublin, over an area of more than a mile in diameter, the shower lasting five minutes. There was a dark cloud overhead and the hay was wet, but no rain was falling, and the air was very calm.

July 29, 1911. Thunderstorms over the British Isles.—A line-squall traversed the British Isles from south to north between 2 P.M. on July 29 and 9 A.M. on July 30, and in the southern half of the country it was associated with violent thunderstorms and strong squalls. At South Kensington 1¼ inches of rain fell in a short time. The storm caused remarkable tidal oscillations in the English Channel, the water rising suddenly 3 feet with the onset of the squall.

Aug. 1, 1785. Swarm of Aphides at Selbourne.—Gilbert White records that about 3 P.M. a shower of Aphides or smother-flies fell in Selborne, blackening all the plants and covering persons walking in the streets. They were observed at the same time in great clouds about Farnham, and all along the vale from Farnham to Alton, and were probably migrating from the hop-fields of Kent.

Aug. 1, 1798. Mirage at Ramsgate.—A remarkable mirage was observed by the Rev. S. Vince from Ramsgate from about 4.30 P.M. until between 7 and 8 P.M. The day had been extremely hot and the evening was very sultry. The masts and upper sails of a ship were seen through a telescope; above it was a perfect inverted image of the same ship and a part of the surface of the sea, and above that again, and joined on to it, a third image showing the ship erect, these two images having their hulls joined. Similar effects were seen with various other ships. Most of the observations were made from a height of 25 feet, others from 80 feet, the phenomena not being altered by the change of height.

Aug. 1, 1846. Hailstorm in London.—During a violent hailstorm the glass in the picture gallery at Buckingham Palace was totally destroyed and the gallery flooded. 7000 panes of glass were broken in the Houses of Parliament and 10,000 at Burford's Panorama in Leicester Square. The glass arcade then covering the side walks in Regent Street was destroyed and the Surrey Theatre was flooded.

Aug. 1-6, 1901. "De Witte" Typhoon.—One of the most violent typhoons which have been systematically studied approached China, travelling in a west-north-west direction, on Aug. 1, 1901, and struck the coast in lat. 27° N. on the afternoon of Aug. 2. Thereafter it travelled on a great curve through Fuhkien, east of Kiangsi and across the province of Chekiang, and continued across Asia towards the north-north-west, a very abnormal path. Off the coast the barometer in the central calm fell to 915 mb. (27·03 in.). The storm is known for the destruction of the Russian vessel *Finanzminster De Witte*, a powerfully engined and well-found steamer of 2000 tons, less than two years old, which was knocked to pieces by the heavy seas.

Aug. 1, 1907. Ball Lightning at Alpena, Michigan.—On Aug. 1, 1907, during a heavy shower with thunder and lightning, a ball of lightning about six to eight inches in diameter entered a house. It dropped lightly on to the floor, moved round the room in circles, then entering the wall, moved up inside it and came out a few feet above the window. A four-inch brace was splintered and much plaster was forced into the room. The ball then travelled across the room again and out of the other wall, making a ragged hole. It struck into the earth about 30 feet from the house, leaving a hole about 6 inches wide and a few inches deep.

Aug. 2, 1837. The Hurricane of Los Angeles.—This was probably the most severe hurricane ever experienced in Porto Rico; it lasted only five hours, but its violence was so excessive that all the ships in the harbour of San Juan were wrecked and great damage was done to property throughout the island.

Aug. 2, 1906. Guildford Storm.—After a very hot day violent thunderstorms broke over south-east England during the evening, the most violent occurring between Hindhead and Ripley, and especially at Guildford. At Grayshott 1·17 in. of rain fell in 15 minutes between 8·23 and 8·38 P.M., accompanied by a violent squall. At Guildford the low-lying parts of the town were flooded to a depth of several feet and a great deal of damage was done by the wind and hail. Many large trees were blown down and several buildings wrecked, while there was some loss of life.

Aug. 2-3, 1922. Swatow Typhoon.—This storm, one of the worst in history in the China Seas, was first observed as a slight disturbance near the Caroline Islands on July 27. It moved towards the west-north-west, gradually increasing in intensity. On July 31 it was over northern Luzon, where it turned more towards the north and crossed the Chinese coast on the night of Aug. 2–3, the centre passing directly over Swatow. The barometer fell to 938 mb. (27·70 in.), the wind was very violent and the rain torrential. Both foreign and native shipping suffered heavily, but the worst damage was done by an enormous sea wave, which crossed the mud-flats in front of the city early on the morning of Aug. 3, and washed away all the houses which had not been blown down. Out of a population of 65,000 persons, it is estimated that 50,000 lost their lives, and it was several days before the water drained off the countryside.

Societies and Academies.

DUBLIN.

Royal Irish Academy, June 23.—**J. I. Armstrong, J. Calvert**, and **C. T. Ingold**: The ecology of the mountains of Mourne, with special reference to Slieve Donard. The vegetation of the area is mostly *Callunetum* of various types, growing on peat covering granite rock. The peat is mostly retrogressive, especially at high altitudes; rarely a progressive peat formation was seen. Examination of the peat (one station, 518 metres) shows in a two-metre section an extraordinary increase of pollen-grain at 66 cm. from the surface. All the pollen is considered to be wind blown.—**J. M. White**: Re-colonisation after peat-cutting. Studies were made mainly in Co. Armagh, where peat-cutting is still carried on on a considerable scale. The depth to which peat-cutting is carried was found to be the most important factor in the re-colonisation of the cut areas, when combined with the time factor.—**Miss M. Duff**: The ecology of the Moss-

Lane region, Lough Neagh. Gives a detailed account of the vegetation around Portmore Lough, which is the home of many rarities of the Antrim flora, and of much interest ecologically.—**K. C. Bailey**: The kinetics of the formation of malonamide from ethyl malonate and ammonia in homogeneous solution. A reaction of the third order. The reaction between ethyl malonate and ammonia in aqueous alcoholic solution takes place in accordance with the equation $v = k\ a\ b^2$, where v is the velocity of reaction, and a and b are the concentrations of ethyl malonate and ammonia. The velocity is increased by increasing the proportion of water in the solvent.—**Elizabeth Mary Ryan and Hugh Ryan**: Studies in the diflavone group (5). Metamethoxybenzaldehyde and diacetoresorcinol. In the presence of alcoholic alkali m-methoxybenzaldehyde condenses with diacetoresorcinol-dimethylether to form di-m-methoxybenzylidene-diacetoresorcinol. Nearly colourless prisms. M.P. 157°-158° C. Its dibromo derivative consists of prisms M.P. 213° C. (decomp.) and its tetrabromide also melts with decomposition about 176° C. With diacetoresorcinol m-methoxybenzaldehyde forms two chromisomeric *unsaturated ketones*. Both melt at 157° C. but one is orange yellow and the other is light yellow in colour. They form the same diacetate. Cream-coloured prisms. M.P. 122° C. The tetrabromide of the last body did not crystallise but was converted by alcoholic potash into nearly colourless crystals melting at 277°-279° C. which consisted mainly if not entirely of 3′·3″-dimethoxydicourmaranone. The dipiperonylidene derivative of 3′·3″-dimethoxy-diflavanone was obtained as yellow prisms melting at 245° C. by the action of piperonal on di-m-methoxy-benzylidene-diacetoresorcinol in the presence of alcoholic hydrochloric acid. Under the same conditions benzaldehyde formed the dibenzylidene derivative of the diflavanone and this consisted of yellowish-white prisms melting at 249° C. —**L. B. Smyth**: The carboniferous rocks of Hook Head, Co. Wexford. The Lower Carboniferous of Hook Head is conformable with O.R.S. The finding of *Avonia* (*Productus*) *bassa* Vaughan at the very base of the calcareous series shows that no appreciable amount of the underlying sandstones and conglomerates can be of Carboniferous age. The *K.Z* and *C* zones of Vaughan are identified. The latter two form a continuous zaphrentid phase, as in south Pembrokeshire. C_2 is recognised but it is uncertain whether S_1 is present. It is now proved that there is only one dolomite band, repeated by faulting (not two as previously believed) and that it is of *laminosa* dolomite age. The total thickness of Carboniferous beds exposed is 1300 feet. At the top they disappear under the sea. Several new species are described, and '*Michelinea*' *antiqua* (M'Coy) is shown to be a degenerate tabulate coral with porous tissues.—**Brian Coffey and Hugh Ryan**: The constitution of certain compounds formed by the action of alcoholic hydrochloric acid on unsaturated ketones. In a previous paper Coffey and Ryan (Royal Irish Academy, 39, B. 3) showed that where alcoholic hydrochloric acid acts on alcoholic solutions of unsaturated ketones such as a-benzylidene methylethyl-ketone, dimerisation takes place and compounds of the type represented by the formula I are formed.

$$\begin{array}{ccc} C_6H_5\cdot CH & \text{——} & CH\cdot CO\cdot CH_2\cdot CH_3 \\ | & \mathrm{I} & | \\ C_6H_5\cdot CH & \text{——} & CH\cdot CO\cdot CH_2\cdot CH_3 \end{array}$$

In the present communication an account is given of the monoxime of the compound I and of a compound formed by the action of phosphorus pentoxide on solutions in benzene of the monoxime. It appears that only monoxime is formed of the compound I and that by the action of phosphorus pentoxide internal rearrangement takes place with formation of the amide.

$$\begin{array}{ccc} C_6H_5\cdot CH & \text{——} & CH\cdot CO\cdot CH_2\cdot CH_3 \\ | & \mathrm{II} & | \\ C_6H_5\cdot CH & \text{——} & CH\cdot CO\cdot NH\cdot CH_2\cdot CH_3 \end{array}$$

R. W. Ditchburn: The uncertainty principle in quantum mechanics. The theory of errors and uncertainties in physical measurements is discussed so as to distinguish clearly between possible error and probable error. The discussion is applied to the formulation of the uncertainty principle. It is shown that the term 'product of the possible errors' is meaningless and that discussions which relate solely to the probable errors are likely to be misleading. It is suggested that the real meaning of the principle is contained in Bohr's probability theorem (Birtwhistle, "Quantum Mechanics", p. 280), no more precise formulation being possible.

PARIS.

Academy of Sciences, May 26.—**Ch. Achard and A. Arcand**: The lipidic phosphorus accompanying the globulins in the blood serum and in serosities. After extraction with acetone and ether the remaining proteins still contain a lipidic residue, and this can be extracted by Kumagawa's method. It consists mainly of sterols, with a small proportion of lecithine. —**André Blondel**: The conditions of stability of a turbo-alternator connected with a network of mains, taking the governor into account.—**P. Vincensini**: A transformation of surfaces with total constant negative curvature.—**Georges Durand**: Local properties and ensemble of points without tangent plane of the envelopes of spheres.—**F. Marty**: Some properties of normal families of meromorph functions. —**Georges Valiron**: On the differential of a meromorph function and on certain functional equations.—**Émile Merlin**: Some properties of perfect fluids, with spiral striæ in rotation.—**Paul Bary**: The vapour pressure of jellies. A discussion of the reason why a fragment of jelly can, under certain conditions, partially dry in an atmosphere saturated with water vapour.—**Charles Dufraisse and Léon Enderlin**: Researches on structures susceptible of exhibiting reversible oxidation: study of the benzofurane group. In a search for the grouping which endows rubrene with the property of reversible oxidation diphenyl-benzofurane was examined, but it was found that the photo-oxidation of this compound did not give a dissociable oxide.—**Paul Gaubert**: The influence of foreign materials held in suspension in the mother liquor on the facies of crystals. Methylene blue, added to a solution of lead nitrate, may give, according to the conditions of crystallisation and the quantity of particles in suspension in the liquid, either crystals in cubes or crystals more or less flattened along the faces of the octahedron. The crystalline form of lead nitrate is also modified by the presence of rosolic acid in suspension.—**R. Fabre and H. Simonnet**: Contribution to the study of the oxido-reducing power of the tissues.—**Mme. L. Randoin and Mlle. A. Michaux**: The lipocytic coefficient of the red corpuscles and the globular resistance in the course of experimental scurvy.—**Mlle. Andrée Courtois**: The high proportion of non-proteid nitrogen in insects.—**H. Bierry and B. Gouzon**: The influence of the pH on a colour reaction of the adrenalines. A steel needle, placed in an aqueous solution of adrenaline hydrochloride, gives rise to a series of colours depending on the ionic acidity of the liquid.—**Henri Devaux**: The connexion between the organisation and the vital activity. The rôle of the plasmic membranes.—**Mme. Y. Khouvine, E. Aubel, and L. Chevillard**: The transformation of pyruvic acid into lactic acid in the liver.—**Paul Durand and Ernest Conseil**: The experi-

mental transmission of Marseilles exanthematic fever by *Rhipicephalus sanguineus*.

CAPE TOWN.

Royal Society of South Africa, April 16.—**M. R. Drennan**: On a ground stone axe from a Cape Rock shelter. Cultural and other remains found on excavating a small rock-shelter at Witsands, in the Cape Peninsula. The implements retrieved were practically all of the type usually met with in the Kitchen-midden culture of South Africa. The most important find was a ground stone axe with a large grooved slab on which the polishing might have been done. The special features of the stone axe are described, especially its unique hafting notch, only paralleled in the culture of the Australian aboriginal, which supplements the evidence we already have that some of the South African aborigines fixed handles to their stone implements.—**A. J. H. Goodwin**: (1) Some ground axes from Rhodesia and the Transvaal. A description of six specimens of ground axes, four from Rhodesia and two from the Transvaal. They are associated with a Neanthropic culture of known type, namely, the Smithfield.—(2) A new variation of the Smithfield culture from Natal. A hitherto undescribed industry showing marked similarity to certain phases of the Smithfield culture of the Free State and elsewhere. It is probably a Natal variation of the Smithfield, fed from the phase known as Smithfield *A*, and has been named Smithfield *N*.—**P. v. d. R. Copeman**: Changes in the composition of oranges during ripening (Pt. 1): Changes in weight. Weight of orange, skin and pulp increase, and the changes may be expressed by an autocatalytic equation. At the end of ripening transpiration becomes the dominating factor in growth and the respective weights decrease. Spraying with lead arsenate mixtures does not produce any significant effects upon these factors. The weight of residue per fruit in the sprayed oranges remains practically constant during ripening, while it decreases in the unsprayed oranges. It would appear that the arsenate spray exerts an internal physiological action, resulting in a reduction of the 'active mass' of the cell-wall material.—**A. J. H. Goodwin and W. E. Jones**: A new stone implement technique from Natal. A series of minute cuts occur along the edge of stone implements of a hardened shale, discovered at Mfongosi, Zululand, by Mr. Jones. If these are human in origin they constitute an entirely new technique, hitherto undescribed; if of non-human origin they may illustrate the gnawing habits of a rodent, probably a field-mouse.

SYDNEY.

Royal Society of New South Wales, May 7.—**Leo A. Cotton**: An outline and suggested correlation of the Pre-Cambrian formations of Australia (Presidential Address). The study of the distribution and structure of the Pre-Cambrian rocks in Australia discloses three great massifs, the largest of which forms the greater part of Western and South Australia, embracing marginal areas in the adjacent states. For this block the name 'Yilgarna' is suggested. A second block forms a broad zone about the Gulf of Carpentaria, extending from Darwin on the west to the east coast of Queensland, north of Mackay. This is called the Carpentaria massif. The third massif is the Tasmantis of David and Sussmilch: the fourth and smaller massif is recognised in the Kimberley district. Between Yilgarna on the south-west, and the Carpentaria massif and Tasmantis on the north and east, lies the great Nullagine geosyncline. The interaction of these elements of the Pre-Cambrian framework of the continent has been the chief cause controlling the later geological history of Australia.

Official Publications Received.

BRITISH.

Annual Report of the Auckland Institute and Museum for 1929–30, presented at the Annual General Meeting held on 28th May 1930. Pp. 56. (Auckland, N.Z.)

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1928–29. Vol. 73. Pp. vii+184+xlvii+7 plates. (Manchester.) 12*s*.

City and Guilds of London Institute. Report of the Council to the Members of the Institute, 1930. Pp. liii+80. (London.)

Journal of the Indian Institute of Science. Vol. 13A, Part 6: Dilatometric Studies in Enzyme Action. By M. Sreenivasaya and B. N. Sastri. Pp. 57-62. 12 annas. Vol. 13A, Part 7: i. Studies in Neutral Salt Action, Part 1: Diastase, by D. Narayanamurti; ii. The Nature of Amylase, 2, by D. Narayanamurti. Pp. 63-72. 1.8 rupees. Vol. 13A, Part 8: i. Action of Sulphur Monochloride on Mercaptans, Part 2: Formation of Organic Trisulphides and Hexasulphides, by P. P. Patel, I. Sengupta and G. C. Chakravarti; ii. Action of Sulphur Monochloride on Mercaptans, Part 3: Oxidation of Unsymmetrically substituted Hydrazodithiodicarbonamides to Thiodiazoles, by P. P. Patel and G. C. Chakravarti. Pp. 73-92. 1 rupee. Vol. 13A, Part 9: i. Power Alcohol and Paper from Rice Straw, by D. D. Deshpande; ii. Estimation of Pentoses and Pentosans by different Methods, by D. D. Deshpande. Pp. 93-112. 1.4 rupees. (Bangalore).

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 14: Technological Reports on Standard Indian Cottons, 1930. By Dr. A. James Turner. Pp. iv+122. (Bombay.) 2 rupees.

Proceedings of the Royal Society. Series A, Vol. 128, No. A807, July 1. Pp. 360. (London: Harrison and Sons, Ltd.) 18*s*.

Annals of Eugenics: a Journal for the Scientific Study of Racial Problems. Vol. 4, Parts 1 and 2, April. Pp. 282. (London: Francis Galton Laboratory for National Eugenics, University College.) 35*s*. net.

Quarterly Journal of the Royal Meteorological Society. Vol. 56, No. 236, July. Pp. 271-358. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Journal of the Royal Microscopical Society. Series 3, Vol. 50, Part 2, June. Pp. xvi+161-296. (London.) 10*s*. net.

Experimental and Research Station, Nursery and Market Garden Industries Development Society, Ltd., Turners Hill, Cheshunt, Herts. Fifteenth Annual Report, 1929. Pp. 88. (Cheshunt.)

British Empire Cancer Campaign. Seventh Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 14.7.30. Edited by J. P. Lockhart-Mummery. Pp. 198. (London.)

Proceedings of the Royal Society of Edinburgh, Session 1929–1930. Vol. 50, Part 2, No. 15: Do the Wireless Echoes of Long Delay come from Space outside the Moon's Orbit? By Carl Stormer. Pp. 187-199. 1*s*. Vol. 50, Part 2, No. 16: A Simple Spectrum Comparator. By Dr. David Jack. Pp. 200-203. 9*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 22: Studies on the Scottish Marine Fauna. Additional Observations on the Fauna of the Sandy and Muddy Areas of the Tidal Zone. By A. C. Stephen. Pp. 521-535+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*.

Technical College, Bradford. Diploma and Special Day Courses, Session 1930–31. Pp. 230+26 plates. (Bradford.)

FOREIGN.

Bernice P. Bishop Museum. Special Publication 15: Proceedings, Hawaiian Academy of Science, Fourth Annual Meeting, May 9-11. 1929. Pp. 20. (Honolulu.)

Journal de la Société des Américanistes de Paris. Nouvelle Série, Tome 21. Fasc. 1. Pp. ii+306. Fasc. 2. Pp. xxxi+307-556. (Paris.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 60: A new Ultra-Speed Kinematographic Camera taking 40,000 Photographs per Second. By Prof. Toyotaro Suhara, Naozô Sato and Sidutaka Kamei. Pp. 187-194+plates 18-24. 0.28 yen. No. 61: Action of Antioxydants in Oxidation of Unsaturated Fatty Oils. 1: Mechanism of Inhibitory Action of Diphenylhydrazine and α-naphthylamine. By Bunnosuke Yamaguchi. Pp. 195-229. 0.33 yen. (Tokyo: Koseikai Publishing House.)

University of Illinois Engineering Experiment Station. Bulletin No. 208: A Study of Slip Lines, Strain Lines and Cracks in Metals under Repeated Stress. By Prof. Herbert F. Moore and Prof. Tibor Ver. Pp. 60. 35 cents. Bulletin No. 209: Heat Transfer in Ammonia Condensers, Part 3. By Prof. Alonzo P. Kratz, Prof. Horace J. Macintire and Richard E. Gould. Pp. 50. 35 cents. Bulletin No. 210: Tension Tests of Rivets. By Prof. Wilbur M. Wilson and William A. Oliver. Pp. 36. 25 cents. (Urbana, Ill.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 8: Notes on the West Indian Crabs of the Genus *Actaea*. By Lee Boone. Pp. 117-127. (New York City.)

Publications of the American Association of Museums. New Series, No. 10: Nature Trails in Cleveland. By Edmund Cooke. Pp. 18. (Washington, D.C.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1627: The Hessian Fly and how Losses from it can be Avoided. By W. R. Walton and C. M. Packard. Pp. ii+14. 5 cents. Technical Bulletin No. 183: Life History of the Oriental Peach Moth at Riverton, N.J., in relation to Temperature. By Alvah Peterson and G. J. Haeussler. Pp. 38. 10 cents. (Washington, D.C.: Government Printing Office.)

Cornell University Agricultural Experiment Station. Bulletin 501: Social Relationships of Slaterville Springs — Brooktondale Area, Tompkins County, New York. By Glenn A. Bakkum and Bruce L. Melvin. Pp. 55. Memoir 127: The Bacterial Diseases of the Bean; a Comparative Study. By Walter H. Burkholder. Pp. 88+6 plates. (Ithaca, N.Y.)

The Carnegie Foundation for the Advancement of Teaching. Twenty-fourth Annual Report of the President and of the Treasurer. Pp. vii+204. (New York City.) Free.

Conseil Permanent International pour l'Exploration de la Mer. Faune Ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 4. 24 planches. 4.00 kr. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Vol. 18, pour l'Année 1928. Pp. 80. 3.25 kr. (Copenhague: Andr. Fred. Høst et fils.)

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 4, No. 1, May. Pp. 51. (Kobe.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 88: Cattle Plague in Egypt. By Dr. I. F. Salem. Pp. 82. (Cairo: Government Publications Office.) 5 P.T.

CATALOGUES.

A Catalogue of Books on Hunting, Horsemanship, Deer-Stalking, Shooting, Angling, Cricket, Golf, Big Game, etc. (Catalogue 527.) Pp. 40. (London: Francis Edwards, Ltd.)

Catalogue of X-ray Accessories. Pp. 48. (London: Watson and Sons (Electro-Medical), Ltd.)

Diary of Societies.

FRIDAY, JULY 25, TO *THURSDAY*, AUGUST 7.

GEOLOGISTS' ASSOCIATION.—Summer Field Meeting in the St. David's District, Pembrokeshire.

SATURDAY, AUGUST 2, TO *TUESDAY*, AUGUST 12.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section).—Summer Meeting in the Ruhr area and Switzerland.

CONGRESSES.

AUGUST 3 TO 9.

INTERNATIONAL CONGRESS FOR SEX RESEARCH (at House of British Medical Association).

Monday, Aug. 4.—Prof. F. A. E. Crew: Puberty and Maturity (Address). Papers relating to Puberty and Maturity.

Tuesday, Aug. 5.—Papers on the Biology of Testicular and Ovarian Function.

Wednesday, Aug. 6.—Papers on Hormone Therapy.

Thursday, Aug. 7.—Discussion on Psychology and Biology.

Friday, Aug. 8.—Papers on the Biological and Therapeutical Aspects of the Control of Human Fertility.

Among the papers to be communicated to the Sectional Meetings are The Aschheim-Zondek Test for Pregnancy (Prof. Aschheim), The Corpus Luteum Hormone (Dr. Clauberg); Biological Tests of the Female Hormone (Menformone) (Assistants from Prof. Laqueur's Institute); The Channels and Significance of Excretion of the Female Sex Hormone (Prof. R. T. Frank), The Male Sex Hormone (Prof. S. Loewe); Evidence for the Metabolic Basis of Sexuality (Dr. O. Riddle); Human Hybrids (Prof. C. G. Seligman).

AUGUST 4 TO 9.

INTERNATIONAL CONGRESS OF EXPERIMENTAL CYTOLOGY (in conjunction with the Anatomical Congress) (at Amsterdam).

AUGUST 5 TO 7.

IMPERIAL HORTICULTURAL CONFERENCE (to discuss the best methods of approach to horticultural problems and the technique involved) (at Royal Society of Arts).

Tuesday, Aug. 5, at 10 A.M.—Sir Robert Greig: Bureaux and their Work. The Director and Chief Officer of the Bureau: Discussion of the Work of the Imperial Bureau of Fruit Production and Future Lines of Development. This will be prefaced by a précis of the work already done.

At 11.30 A.M.—F. L. McDougall: Possible Development of Fruit Growing in the Empire from an Economic Point of View.

At 12.15.—J. L. Brown: The Evolution of the New Zealand Fruit Board.

Experiences of Horticultural Research—

At 2.30.—Dr. W. T. Macoun: In Canada:—(*a*) Centralised.

E. F. Palmer: (*b*) At an Unattached Station.

At 3.10.—Prof. A. C. D. Rivett: In Australia.

At 3.30.—Dr. B. Hahne: Horticultural Research in the Union of South Africa.

At 3.40.—W. G. Freeman: Tropical and Sub-tropical Fruit Industry. Difficulties Encountered and Lines of Attack.

At 4.15.—Sir Frederick Keeble: An Industrial Research Station.

Wednesday, Aug. 6, at 10 A.M.—Sir Daniel Hall: The Directions in which Experimentation is likely to be Valuable in Horticulture.

Field Experiments:—

At 10.45 A.M.—T. N. Hoblyn: The Adaptation of Modern Statistical Methods to Horticultural Conditions.

At 11.30 A.M.—Prof. E. E. Cheesman: Practicability of the Application of Statistical Method in the Case of Tropical and Sub-tropical and other Crops.

At 12.15.—F. J. Martin: Field Experiments in certain Tropical and Sub-tropical Crops in West Africa.

Application of Pure Sciences to Horticultural Problems under—Temperate Conditions:—

At 2.30.—Prof. B. T. P. Barker: Fruit Products and Associated Problems.

At 3.—Prof. V. H. Blackman: Some Physiological Considerations in Horticulture.

Tropical and Sub-tropical Conditions:—

At 3.30.—Dr. E. J. Maskell and Dr. T. G. Mason: Physiological Work in the Tropics. Some of the Problems with special reference to Cocoa, and some Possible Lines of Attack.

Soil and Climate Survey as a Basis for Fruit Research:—

At 4.—T. Wallace: Soil and Climate Survey as a Basis for Fruit Research.

T. Rigg: Soil Type and Manuring in Relation to Yield and Quality of Nelson Apples.

A. J. Prescott: Soil and Survey Work as a Basis for Fruit Production in Irrigated Areas.

At 4.30.—H. V. Taylor: Meteorology and Fruit Production: The British Scheme of Research.

Thursday, Aug. 7.—Progress of Fruit Storage Methods:—

At 9.30 A.M.—Dr. F. Kidd: A Survey of the Principal Fruit Storage and Transport Problems of the Empire to-day.

At 9.50 A.M.—T. Wallace: Factors influencing Storage Qualities of Fruits.

At 10.10 A.M.—Dr. A. J. Smith: Problems of Biological Engineering in the Cold Storage of Fruit.

At 10.30 A.M.—Dr. A. Horne: The Infection and Invasion of the Apple Fruit by Fungi in Relation to the Problem of Storage.

At 10.50 A.M.—Dr. D. Haynes: Chemical Change in Stored Apples: The Relation of the Time of Picking to the Chemical Composition and Storage-life of the Apple.

At 11.10 A.M.—Dr. L. P. McGuire and Dr. C. W. Wardlaw: Investigations of the Storage Behaviour of Bananas at the Low Temperature Station of the Imperial College of Tropical Agriculture, Trinidad.

At 11.30 A.M.—W. T. Hunter: Recent Progress in the Study of Johnathan Breakdown in U.S.A. and Canada.

At 11.50 A.M.—R. G. Tomkins: Biological Effects of Atmospheric Humidity.

At 12.10.—Meirion Thomas: Biochemical Study of Functional Diseases in Fruits.

Dr. B. T. Dickson and W. M. Carne: The Present Position of the Bitter Pit Problem in Australia.

R. Wheeler: Fruit Transport Problems in Canada.

E. A. Griffiths: Problems of Storage and Transport.

Prof. J. Young: Citrus Storage Investigations in Australia.

At 12.30.—F. A. Stockdale: Sources and Training of Future Horticultural Research Workers.

AUGUST 7 TO 15.

INTERNATIONAL HORTICULTURAL CONGRESS (in London).—*Papers to be read on Aug.* 8, 11, *and* 13:—

Prof. Priestley: Vegetative Reproduction from the Standpoint of Plant Anatomy.

Dr. Van der Lek: Anatomical Structure of Woody Plants in Relation to Vegetative Propagation.

Dr. R. Salaman: Vegetative Mutations.

Prof. E. Baur: Production of Mutations by External Stimulus.

Dr. F. E. Denny: The Excitation of Dormant Buds under External Influence.

John Innes Horticultural Institution: Graft Hybrids.

John Innes Horticultural Institution: Vegetative Production of Polyploids.

John Innes Horticultural Institution: Sterility.

G. E. Yerkes: Raising Root Stocks from Seed.

Dr. C. G. Dahl: Root Stocks from Seeds of known Parents.

Dr. R. J. D. Graham and L. B. Stewart: Special Methods of Practical Utility in the Vegetative Propagation of Plants.

Miss Mary E. Reid: The Influence of the Nutrient Conditions of Seeds and Cuttings upon the Development of Roots.

Prof. P. W. Zimmerman: Factors influencing Root Growth of Cuttings.

Dr. A. B. Stout: The Inter-relations between Vegetative Propagation and Seed Reproduction.

N. Esbjerg: Varieties grown on own Roots.

Prof. N. I. Vavilov: The Wild Progenitors of Fruit Trees in Turkestan and in the Caucasus.

R. G. Hatton: The Development of a Research Programme around the 'Build Up' of a Fruit Plant.

Dr. H. Faes: Vine Propagation.

L. Ravaz: The Influence of American Stock on French Vines.

W. G. Freeman: Vegetative Propagation of Cacao and the West Indies Citrus.

Prof. T. Tanaka and Y. Tanaka: Propagation of Citrus Fruits in Japan.

Prof. H. J. Webber: Studies on Rootstock Reactions in Citrus.

Dr. F. F. Halma: The Propagation of Citrus by Cuttings.

Dr. H. P. Traub: The Ripening Process in Fruits, with special reference to the Fig and the Grapefruit.

Prof. B. T. P. Barker: The Fruit Tree Complex in Relation to Environment: Some current Investigations at Long Ashton.

Prof. N. E. Hansen: Fruit Stocks where Mercury Freezes.

Prof. E. C. Auchter: American Experiments in Propagating Deciduous Fruit Trees by Stem and Root Cuttings.

W. T. Macoun: National Tastes in Apples.

Dr. L. Filewicz: The Frost Injuries of Fruit Trees in Poland in 1928-29, with special reference to the Influence of the Stock and Scion upon the Resistance of the Apple-trees against the Frost.

Dr. P. J. S. Cramer: Rubber Budding.

W. A. Orton: Propagation in Tropical Countries.

Prof. P. Work: Some Scientific Problems in connexion with Vegetable Seeds.

Eng. G. Jacobsen: Electric Heating of Soil in Hotbeds and Hothouses.

Prof. B. Fedtschenko: The Horticultural Work of Russian Botanical Gardens.

Prof. C. Regel: The Botanical Garden of the Present Day.

H. J. Rumsey: Horticultural Progress in Australia.

SATURDAY, AUGUST 2, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3170, VOL. 126]

Government Control in Scientific Research.

THE nature and extent of government control in scientific research and its results, especially those which may involve monopoly in some form or other, has always been a matter of deep interest to all men of science. Indeed, its interest is not confined to them alone, for it is a question which vitally concerns the whole nation. It is scarcely too much to say that, to-day, when technical prowess and invention have reached a dominating position in connexion with national strength and well-being, this matter of government and science is among the most important of the present age.

Sir Ambrose Fleming discusses the question in the July issue of the *National Review* in an article entitled "Technical Inventions and Government Control". At the very outset he strikes the right note by exposing the absurdity and shallowness of the usual query—Of what use is it?—applied to any new advance in pure science. The classical example, often quoted but losing nothing by repetition, is afforded by Faraday's discovery in 1831 of induced currents, for which at that time no one would have paid him a shilling, though since worth untold millions. This example not only shows to what heights potential use may rise, but also indicates to what a remarkable degree new wants may be created by invention of means to satisfy them, a most interesting economic phenomenon.

A peculiar position arises, however, when the satisfaction of these wants leads, or may lead, to the establishment of a monopolistic industry. It was chiefly with the view of controlling and limiting monopoly that Government has intervened in highly technical industries, such as the electrical, often with very disastrous results. "The baby is put in handcuffs to prevent him becoming a burglar when he grows up." The nascent electric telegraph industry in Great Britain was bought up by the Government in 1868–69 at a cost of £10,000,000 from private interests and handed over to the Post Office to prevent monopolistic abuse; and so skilfully—accidental or otherwise—were the acts of transfer drawn that they covered all forms of electric communication, including wireless. It is open to question whether one form of monopoly has not been exchanged for another, possibly worse.

Sir Ambrose emphasises the need for generous and, so far as possible, intelligent treatment of

men of genius when they appear. It is preposterous that the work of such men, and its results in epoch-making discoveries—of which an infinite number are still possible and are hidden in the unknown—should be judged or in any way controlled by a single departmental head. Many such departmental heads lumped together might not make one good one. In the specific case of electric telegraphs and telephones, it is only fair to admit that State control has probably led to their greater extension into remote rural parts than might have been possible to private enterprise; but on the general question of government intervention it is of the utmost importance that there should be the closest and most effective co-ordination between State departments concerned and private enterprise and research.

An encouraging sign of the times and a step in the right direction is the organisation and work of the Department of Scientific and Industrial Research, to which Sir Ambrose Fleming pays a well-deserved tribute in the article to which we have referred. The part of the government is to encourage and stimulate research in the right direction (though who shall specify what is 'right direction' is perhaps difficult), and prevent exploitation of the public. Co-ordination is once more found to be the key to much blessedness.

H. J. Elwes, as Naturalist, Explorer, and Sportsman.

Memoirs of Travel, Sport and Natural History. By the late Henry John Elwes. Edited by Edward G. Hawke. With an Introduction by the Rt. Hon. Sir Herbert Maxwell, and a Chapter on Gardening by E. A. Bowles. Pp. 317+18 plates. (London: Ernest Benn, Ltd., 1930.) 21*s*. net.

IN describing his journeys in Sikkim, Elwes writes that Claude White's "Sikkim and Bhutan" forms a fitting supplement to Hooker's "Himalayan Journals". A perusal of parts of these memoirs, nearly a third of which are devoted to India and journeys in Sikkim and round Darjeeling, will readily show to the initiated that Elwes's reminiscences and experiences cover a very valuable period of years between the day of Hooker and that of White in this region. Before treating of this aspect a few general remarks will be necessary on this remarkable and fascinating book. It is difficult to recall any book of quite its type published during the last, perhaps, forty years. If the knowledgeable reader is left with one regret it will probably be that Elwes did not commence the publication of the memoirs during his lifetime, and give them to us in two or three volumes.

Sir Herbert Maxwell, a contemporary of Elwes at Eton, has written a most appreciative and informative introduction to the book; and Mr. E. A. Bowles, in a last chapter entitled "Gardening and Horticulture", embodies personal impressions and recollections of Elwes and his botanical and horticultural work, with some descriptions of the remarkable gardens brought into being by Elwes at his Gloucestershire home, Colesborne.

Anything approaching a detailed review of the memoirs is out of the question. The book well reflects the personality of Elwes himself; it is inexhaustible. In order, however, to render the following remarks intelligible it must be understood that apart from sport provided by rifle and gun, in the use of both of which he was expert, the author started early in life collecting birds. His first expeditions, undertaken as a young man, with the chief object of increasing his knowledge and his collections of birds, were made in the Hebrides (1865–68) and Turkey—Macedonia (1869). These were made during the period he served in the Scots Guards. Later his main interest centred in butterflies and moths, although he never gave up bird-collecting—and lastly, after some twenty years during which Lepidoptera were his chief interest, although he also collected both birds and plants, he definitely concentrated his attention chiefly on plants with the most valuable results. For, as his numerous friends were well aware and his book will disclose unerringly to future generations, this man was possessed of immense energy, powers of observation of no mean order, which he cultivated to a very high pitch, and a shrewd mind. These attributes enabled him, as his experience grew with his varied voyages and the management of his own estates, to deduce reasons, sum up arguments, and present solutions of value. He contributed many valuable papers dealing with his collections to scientific societies.

Sir Herbert Maxwell says it was enthusiasm, aroused by reading Hooker's "Himalayan Journals", which first took Elwes to India in 1870. He landed at Madras in January from the old P. and O. *Mooltan*. Two brother officers of the Scots Guards joined him, and their chief object was to kill elephants, a sport which after a brief experience Elwes did not think much of, much preferring "stalks after stags, elk, and chamois". From Madras they sailed to Calcutta. From here Elwes had wished to explore the wild Mishmi Hills on

the north-east frontier of Assam, the flora and fauna of which were unknown. Owing to the recent murder of missionaries the Viceroy, Lord Mayo, would not assent to the suggestion and Elwes went north to Siliguri, at the foot of the Himalaya, where he says there was even then a fair dâk bungalow. There was to be a big tiger-shooting party in the Jalpaiguri Duars and Cooch Behar jungles. To this fortunate fact we owe Elwes's eye picture of this country as it was sixty years ago, and about twenty-two years after Hooker's visit and description. What is now a great stretch of tea-gardens was then dense forest and grass jungle on both sides of the Tista River, with a few scattered tea-gardens only; the country contained numerous rhinoceroses, elephants, and tigers. Before the end of the century the rhinoceros had been exterminated in these parts and elephants did not come so far west from the Assam border. Elwes comments on the magnificent forest of sal he saw stretching out from the foot of the hills and climbing up some way, to be replaced by sub-tropical species up at Kurseong (about 4500 ft.). There was no railway then; and later Elwes was as much put out by the spoiling of the beauty when the railway was carried up to Darjeeling, as I was astonished when (in 1925) I went up there from Siliguri by motor-car!

Elwes lost his heart to Sikkim on his first visit in 1870. Finding Darjeeling too muggy and misty in the rains for his liking and purposes, he descended to a tea-garden named Ging, managed by Mr. Macdonald. This was in the early days of tea-planting in that region and many ignorant mistakes had been made and much money wasted. With the assistance of Macdonald, Elwes bought neighbouring land and commenced a garden of his own under Macdonald's supervision. Elwes said later that he had never made a better investment than in that garden. During the following sixteen years he made four visits to Darjeeling and the garden—but they were to some extent mere pretexts upon which to hang one of his journeys out into his loved Sikkim hills; though the last was connected with the proposed but abortive Tibet Embassy of 1886. But this time he got up to the Rishi-la and practically explored a new route to the Tibet boundary.

I spent the best part of the last three years of last century in Sikkim and on the Darjeeling side. The Tista valley, roadless in 1870, the Rangit valley, and the roads and paths up into the Sikkim hills, the wonderful views and the extraordinary tropical, semi-tropical, and sub-temperate flora and fauna were my companions on many solitary journeys for weeks at a time; and oft did I ride with a dripping jacket, as Elwes had done, through the magnificent uncanny forests, the trunks of the trees coated with long beards of grey moss and lichen.

It is with this later knowledge of the progress and development which have taken place in the region that it is possible to realise to the full the very great value of the chapters of Elwes's memoirs which are devoted to Darjeeling, to a visit to the Singalela Range dividing Sikkim from Nepal on the west, and above all to his four journeys into Sikkim, the first made with the late Dr. W. T. Blanford, director of the Geological Survey. They must have been a curious couple, for Elwes was but twenty-four years old, with his ideas quite unformed—but he recognises how much he learnt from and owed to his older and skilled scientific companion. The well-known names which cross his pages are in themselves a remarkable testimony to Elwes's wonderful life. For they are names well known to officers who served out east and to those connected with Kew and Edinburgh Botanic Gardens; but which were mostly quite unknown to men—squires of the social county position of Elwes. Hooker, Thiselton Dyer, and Prain, at Kew; Bayley Balfour at Edinburgh; Anderson at the gardens in Calcutta; C. B. Clarke at the Cinchona Garden at Mongphu, followed by Gammie; F. D. Godman, A. O. Hume, Godwin Austen, Hampson, Knyvett, de Niceville, Mandelli, Atkinson, Woolly-Dod, and a host of others.

In none of the journeys Elwes paid to other parts of the world did he find any country to outvie the Tista Valley and the Sikkim Hills for scenery and variety in flora and fauna. The great fascination which this region exerted over him, in spite of its drawbacks at the lower elevations of damp heat and innumerable leeches, is comprehensible to the naturalist. It was the first part of the Himalaya I visited, and subsequent journeys all over India and parts of Burma never showed me anything to compare with Sikkim.

During these visits Elwes collected and sent home or brought back valuable collections of birds, butterflies, and moths, many now in the national collections; and also introduced numbers of plants and bulbs and orchids into England. His own gardens and greenhouses at Colesborne (in spite of the thin poor soil of the region limiting his possibilities) gradually included a wonderful collection of plants, orchids and rhododendrons being perhaps his favourites. In addition to his

four visits to Sikkim he made a last journey to India to visit Nepal in 1913–14, being then aged sixty-seven, and his account of the trip shows that his keenness and his powers of observation were as great as ever.

Apart from India, Elwes made an adventurous trip with a companion to the Altai Mountains in 1898 and shot *Ovis ammon*, but, as he relates, he was keener on collecting. He twice went to North America (1888 and 1895) and on each tour did a certain amount of collecting. Another interesting journey was undertaken to Chile (1901–2) with three main objects in view—as he says: (1) To gain some idea of the peculiar conditions which make the fauna and flora of Chile so interesting; (2) to collect as many as possible of the Lepidoptera "which had never been studied by a competent entomologist"; (3) "I wished to learn something about the very beautiful plants of Chile which we grow in gardens and of whose habitat we know but little, and to introduce to cultivation the terrestial orchids which are such a marked feature in the flora of the country". There speaks the man—and this is his life's note. He always had quite clearly conceived ideas before he started on a trip—and he was amazingly successful as a result.

One of not the least interesting of Elwes's journeys was the one made in 1911–12 to the Malay Peninsula, Java, and Formosa. The similarity of parts of the latter to Sikkim appears to have struck Elwes forcibly, but it is impossible to follow him through these interesting countries. Two points may be made. His study and comparison of the cinchona-growing in Java with the Indian gardens—Java exports the largest amount of quinine, *C. Ledgeriana* being the best species for sulphate production. His remarks on the growth of rubber in Malaya, and, as an old tea planter, the advice he tendered—advice as true to-day as it has been any time during the last century in the British Empire—are worth recording: "I could not help thinking that if rubber planters were not so anxious to get a large area cleared at once, it would probably pay better in the end to leave all the poorer patches of land in forest as a shelter to the rubber (*Hevea*)". In the hills this would prevent the rapid erosion and loss of valuable humus, etc., which total clearance gives rise to; whereas in the plains great pure blocks of one species of tree would be broken up and therefore suffer less from insects and fungus pests.

The last four chapters are devoted to home—two discussing problems of rural life and farming, with the great knowledge and shrewdness of a fine intellect; the others devoted to a description of how his great book "The Trees of Great Britain" came to be written in collaboration with Prof. A. Henry; and a review of the Committee's Report on the Deer Forests of Scotland (1922), written in the year of his death.

For the sportsman not the least interesting and remarkable parts of these fine memoirs are the chapters devoted to sport. For twenty years (1891–1911) Elwes rented shoots in Norway, where he stalked the elk, bear, and reindeer; he also shot wild boar in the Ardennes and rented a shoot in the Austrian Alps where the quarry was red deer, chamois, and roe deer. These chapters, which cover a considerable period of shooting years, would render any book remarkable, not only for the interesting accounts of the various animals and the methods employed in hunting them, but also owing to the care with which Elwes describes the country and the natural history of the locality visited.

I feel confident that this book is destined to become a classic; higher praise no book can achieve.

E. P. STEBBING.

Foundations of Silviculture.

Foundations of Silviculture upon an Ecological Basis. By Prof. James W. Toumay. Vol. 1. Pp. xxv+438. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 20*s*. net.

IN this manual, Prof. Toumey, of Yale University, deals with silviculture from the point of view of the forests of the United States, a country which, he correctly says, owing to its vast size and diverse character, imposes inevitable limitations. But this is not the only point in which Prof. Toumey's work differs from the usual type of silvicultural manual. He writes:

"In the evolution of the subject, the vast body of accumulated facts which gradually came into being, relating to trees and their environment, though useful in silvicultural practice, lacked for a long time the following basic concept: Forest vegetation is composed of plant communities or units of vegetation, developed and arranged in accordance with definite biological laws and is not an aggregation of trees and other plants brought together by chance." . . . "Foundations of silviculture as we conceive it to-day is not an outgrowth of plant ecology, but rather plant ecology is an outgrowth of it. When biologists took their investigations of the relation of plant to the environment from the laboratory to the field, they found

the silviculturist already there with the accumulated facts of a century of field work."

The latter allusion is to the work of men like Cotta, Hartig, Köenig, and Pfeil. But in the preceding century these latter had had forerunners in Duhamel du Monceau in France and Euderlin in Germany. This work had for its chief basis the relation of soil factors to forest vegetation, studies which were continued in the later works of Mayr, Duesberg, Wagner, Reuss, Dittmar, and others. In these works the authors apply fundamental sciences such as biology, physics, and chemistry to the theory of silvicultural practice.

Forest experiment stations were established in several countries from 1861, and though the results attained have not perhaps reached the somewhat sanguine hopes placed in them, certain useful data have been arrived at.

It is perhaps in its connexion with ecology that this manual differs from many of its predecessors. Haeckel, in 1866, defined ecology as the science treating of the reciprocal relations of organisms and the external world. Says Prof. Toumey:

"Until recent times, what is now conceived as ecology was included under biology. Biology is a general term including both botany and zoology, and ecology is a part of each. Although biologists have for many years been concerned with the relation of plants to their environment, the term plant ecology has come into use within comparatively recent times. As a science, it is a branch of botany, which is concerned with the relations of the individual plant, the species and the plant community to the site. It has its roots firmly anchored in the basic principles of physics, chemistry, physiography, geology, and meteorology."

This recognition is not only of interest but also of considerable importance to the future value of the large amount of silvicultural research work awaiting the forester in many parts of the world. But when dealing with a consideration of silviculture proper in a forestry manual, it becomes necessary to consider the limits to which a treatment of the subject should be set.

In the manual in question, the author divides his subject into three parts: (1) the site factors; (2) the forest vegetation; (3) the methods of investigating the site factors and the forest vegetation and their relation one to the other. Only parts 1 and 2 are treated of in the volume under review, part 3 appearing in a later volume. Out of 423 pages in this first volume, some 250 are devoted to the site factors which, after a chapter on definitions, are treated of under climatic factors, physiographic factors, biotic factors, and the reaction of forest vegetation on the site factors.

The author deals with these matters in the greatest detail and with admirable lucidity; for example, the sections on light effects, intensity, etc., are of absorbing interest: but the question thrusts itself forward— Is the detailed treatment of such matters in its proper place in a manual on silviculture? Should we not recognise the fact that this subject has now become so broad that it requires an introductory manual dealing with such matters as are considered in Part 1 above and including sections of Part 2 treating of the origin and development of forest communities, succession, and so forth. The word ecology is a new one. It should prove possible to find a satisfactory term for the considerable introductory matter which now leads up to silviculture proper – for silviculture, both in derivation of the word and its practice, belongs of right to the practical executive forester working out in the field.

This being said, Prof. Toumey is to be congratulated on a remarkable piece of work. His second volume will be awaited with considerable interest.

Coal Carbonisation.

Coal Carbonisation. By R. Wigginton. (Industrial Chemistry Series.) Pp. x + 287. (London: Baillière, Tindall and Cox, 1929.) 21*s.* net.

"BUT for its obvious importance, no one would interest himself in the action of heat upon coal." This is surely a strange doctrine, for scientific men do study many things out of mere human curiosity. Mr. Wigginton presumably means that the problem is so involved as to discourage inquiry. Even the action of heat, he points out, on so simple a compound as ammonia has provoked a mass of research, collated in Chapter v. How much more complex will be the action of heat upon coal, "a mixture of altered plant tissues, the original plants being composed of substances chiefly of unknown constitution".

The book is concerned with this question of the action of heat on coal, first historically (Chapters i. and ii.), then with the science of the subject (Chapter iii.), as it has developed from modern laboratory work. Chapter iv. treats of coal gas manufacture and purification, Chapters v. and vi. of the by-products ammonia and tar, while the last chapter is devoted to the formation and properties of coke.

The book is not intended to be a manual for industrial practice, which is treated only in broad

outline, illustrated by simple diagrammatic sketches. The value of the book is due rather to the fact that it gives a conspectus of the subject in the light of recent laboratory studies. Anyone desiring to get to grips with the science of carbonisation will scarcely find a better channel of access, for the author is evidently familiar with the British, European, and American investigations of the last decade. The collection of information on the decomposition of ammonia and hydrocarbons at high temperatures is valuable—especially the recent work on pyrolysis carried out at Sheffield. On p. 42 he says: "At the time of writing, the high (though declining) price obtainable for creosote oil is having a considerable bearing on the economics of the process". If he were writing that sentence to-day, he would have to substitute 'low' for 'high' and say that creosote is such a drug on the market as to make its disposal a real problem. Ammonia has also ceased to be a considerable asset, and indeed sometimes is a charge on the process. Nothing could indicate better the need for caution in placing any high value on the gain obtainable from by-products of carbonisation. The sale of gas according to heating value dates from 1920—not 1922 (p. 132). The description of the manner of removing naphthalene from gas (p. 138) does not suggest the continuous process now in use. On p. 173, 'undecomposed' steam should be added as an additional source of water in gas liquor from vertical gas retorts, which constitute more than half the plant in use to-day in British gasworks.

The publisher invites criticism at times. On p. 104 he has not done the author justice in reproducing curves on so small a scale as to make them difficult to read. Again, the price is the highest in the whole "Industrial Chemistry Series", while books of similar size are priced at 10*s*. 6*d*. upwards. The number of guineas which young students can afford is limited, and this is a book which one would like to recommend them to buy.

H. J. H.

Geography and Regional Studies.

Studies in Regional Consciousness and Environment. Essays presented to Prof. H. J. Fleure. Edited by Iorwerth C. Peate. Pp. xii + 220 + 14 plates. (London: Oxford University Press, 1930.) 21*s*. net.

By a curious coincidence, the publication of this volume of essays presented to Prof. Fleure by a group of former students on the completion of his twenty-five years at Aberystwyth coincides with the announcement of his departure for Manchester. Few tributes could be more eloquent, few more acceptable, than such an acknowledgment of the inspiration afforded by academic leadership. At first sight the essays seem extraordinarily diverse, ranging from geology to helminthology, economic history, and French politics, and in area from Wales to Natal and the Great Barrier Reef. But the whole collection is united in that it is concerned with the world as the environment of the central figure—man—and typifies the science for which Prof. Fleure has stood for more than a quarter of a century—the science of modern geography.

Amongst the more purely geographical researches included are Miss R. M. Fleming's "Outline of some Factors in the Development of Russia"—a valuable summary which incorporates a considerable amount of material formerly only available in Russian; Miss F. F. Laidler's study of the limits of certain cultivated plants in Spain—an important contribution to the solution of the vexed problem of how far Spain can be regarded as a 'Mediterranean' country; and Mr. E. E. Evans's geographical study of the Pyrenees as a barrier to mankind. The editor of the volume, Mr. Iorwerth C. Peate, contributes an account of the old Welsh wood-turning industry; Wales also figures in a geological contribution by Prof. W. J. Pugh and a study of miners' phthisis in Cardiganshire by Mr. E. G. Bowen.

Miss H. A. Wilcox has attempted to throw light on the former distribution of natural vegetation in southern England—a subject fraught with difficulty but of the utmost importance to the prehistorian. Mr. S. J. Jones deals with the distribution of perforated stone axes in Europe, Mr. R. A. Pelham with the trade of the Cinque Ports in 1307–8, Miss S. Harris with field systems in Guernsey. Mr. H. Hauck deals with the influence of geographical factors on the French elections of 1928. His maps emphasise the fact that the rich cattle-rearing and cultivated districts support the right wing party, the peasant owners of small farms maintain the radical faction, whilst the extreme left receives its main support from urban and industrial centres. It is interesting to notice how closely his conclusions would apply to Great Britain.

The last essay in the volume strikes a different note, giving a delightful sidelight on daily life and work with such an expedition as that to the Great Barrier Reef.

L. D. S.

Our Bookshelf.

Australian Rain-Forest Trees : excluding the Species confined to the Tropics. By W. D. Francis. Pp. xii + 347. (Melbourne : Council for Scientific and Industrial Research, 1929.) 10s.

ALTHOUGH this book is primarily intended for the Australian forester and botanist, it provides a wealth of information about the trees of the rain-forest of eastern Australia which renders it a useful work of reference. The outstanding feature is that the descriptions are drawn up by a botanist who is equally familiar with his specimens as trees in the forest and as herbarium material.

The practical side of the work is further enhanced by an artificial key to the trees described, which has been worked out and drawn up by the author in the field. Keys of this nature are difficult to make as a rule, but undoubtedly they are appreciated more by the forester, who often finds difficulties in working in the field with keys prepared from herbarium material only and worked out on a phylogenetic basis. As the systematic enumeration of the species is according to Engler and Prantl, it would have been helpful had page references been inserted against the names of the species where they occur in this artificial key. The book itself is not a convenient size for field work (9 in. × 6 in.) and it would be advisable to issue the artificial key in pamphlet form so that its usefulness can be extended.

The book is profusely illustrated by plates which are given generally in pairs—one plate showing the lower part of the bole of each trunk, the nature of the bark, the base of the tree, and the character of the surroundings; the other, a more detailed view of leaves, flowers, and fruit.

This is a very good example of a work which cannot have more than a local—though a very wide local—interest and application. So much work of this nature is never able to be published because it cannot be considered to be an economic proposition. It is very gratifying, therefore, to note that Mr. Francis was able to secure official publication through the recommendation of Mr. Lane-Poole, Inspector-General of Forests. This is the second publication by the Commonwealth Government under the scheme for assisting the publication of work carried out by Australian scientific workers which is not likely to prove financially remunerative and therefore is unattractive to commercial publishing houses.

Marriage, Past, Present and Future : an Outline of the History and Development of Human Sexual Relationships. By Ralph de Pomerai. Pp. xvii + 370. (London : Constable and Co., Ltd., 1930.) 15s. net.

MR. DE POMERAI's book is a welcome and opportune addition to the literature on marriage, even though Prof. Westermarck has published within the last few years a revised and enlarged edition as well as an abridgment of his classical work on the subject. The author of the present book holds that both Westermarck and Letourneau, having written exclusively from the viewpoint of the family and regarded procreation as the sole or highest function served by matrimony, have paid insufficient attention to the urge of the gregarious. In other words, he suggests that they have fallen out of date owing to the institution and spread of 'companionate' unions and the changed ideals and ideas which they imply. Further, there has to be taken into account the effect of current psychological theory in relation to sexual activity and repression.

The reader will here find the evidence to be collected from primitive peoples reviewed from a new point of view ; the practices of the present day, both orthodox and those regarded by some as unorthodox, are analysed; and the probable course of future development is sketched in the light of tendencies here revealed. Much of the book is naturally of a highly controversial character. The validity of the argument, in fact, depends upon whether its viewpoint rests upon what is merely a passing phase or on a development which is to be a permanent directional factor in the future evolution of society. This is too large a subject for discussion here, much as Mr. de Pomerai invites it. It may be pointed out, however, that the modern attitude towards marriage and sex appears to give too great weight to factors which are secondary to the main biological purpose of society and of sexual relations.

Gnetales. By the late Prof. H. H. W. Pearson. (Cambridge Botanical Handbooks.) Pp. vii + 194 + 4 plates. (Cambridge : At the University Press, 1929.) 18s. net.

THE class Gnetales is unique among seed-bearing plants in the habit and habitat diversity of its members and in the use made of it by those interested in phylogenetic hypothesis. The appearance of a monograph by the late Prof. H. H. W. Pearson is, therefore, a matter of considerable importance. The manuscript was completed and prepared for printing by Mrs. Thoday, who has added valuable notes and is largely responsible for the final theoretical chapter.

The first chapter summarises the habit, distribution, ecology, and taxonomy of the three genera *Ephedra*, *Gnetum*, and *Welwitschia* ; the second gives details of their vegetative morphology and anatomy ; the third considers their inflorescence and flower structure ; and the fourth deals very fully with their reproduction. A frontispiece of the author, three plates, and 89 figures illustrate the book.

The interrelationships of the three genera remain obscure, and proof that they are of near affinity is lacking. The somewhat diverse views held as to the natural position of the Gnetales most often agree in placing the group in the vicinity of the top of the Gymnosperms and the bottom of the Angiosperms. The Angiosperm characters have been emphasised by recent writers, and Pearson agreed "that there must be a Gnetalean-Angiosperm alliance" but probably not a direct one. A hypothesis is outlined which derives the

Angiosperm embryo-sac from a primitive form the essential characters of which are preserved in *Gnetum*, the evolutionary tendency being towards a shortening of that portion of the life-cycle which lies between the macrospore mother-cell and the functional gamete. W. B. T.

Œuvres d'Émile Godlewski, père. Publiées par Ladislas Vorbrodt. Vol. 1 (1870–90). Pp. viii + 599. (Cracovie: Académie Polonaise des Sciences et des Lettres, 1930.)

THE Polish Academy of Science and Letters is publishing in three volumes, of which the first has already appeared, the collected work of Émile Godlewski, the veteran plant physiologist who celebrated his eightieth anniversary in 1927. This first volume contains an early paper on the dependence of the amount of oxygen disengaged from leaves upon the carbon dioxide content of the air, which was carried out by the author in Sach's laboratories with apparatus previously used by Pfeffer, then also working at Würzburg, as were also the English botanists Vines and Francis Darwin.

The volume contains papers written prior to 1890; they are published usually in the language in which they originally appeared, but a few of the Polish papers are translated for the first time (into French). These papers alone are sufficient to show what a valuable influence Prof. Godlewski must have had upon the development of the biological sciences in relation to agriculture during his tenure, first of the chair of botany at the School of Agriculture in Doblany (1878) and then of the chair of agricultural chemistry at Cracow, where he was also in charge of the subject of vegetable physiology (1891–1919). Still vigorous upon the expiry of his post under the regulations for superannuation, Prof. Godlewski then accepted the direction of the agricultural section of the Institute of Rural Economy just established at Pulawy.

50 Jahre Kältetechnik 1879–1929: Geschichte der Gesellschaft für Linde's Eismaschinen A.-G., Wiesbaden. Pp. iv + 192 + 6 Tafeln. (Wiesbaden: Gesellschaft für Linde's Eismaschinen A.-G., 1929.)

THIS well-illustrated volume has been issued in commemoration of the jubilee of the foundation of the Linde company in 1879. It contains a short life of Prof. Carl von Linde, the founder, an account of his early work on refrigeration and on the use of the Joule-Thomson cooling as a means of liquefying gases on an industrial scale, and a history of the development of the company and its offshoots up to the present time.

Von Linde was born in southern Bavaria in 1842, a son of the manse. After education at the local Gymnasium, he spent three years at Zurich polytechnic and after two more years in locomotive works he was in 1866 appointed to the technical staff of the Krauss locomotive works at Munich. In 1868 he became additional professor and in 1872 ordinary professor of engineering in the newly founded technical school at Munich. Here he introduced such improvements in the theory of refrigerating machines that in 1879 the Linde company was formed with works at Wiesbaden to manufacture machines on his system. In 1892 he returned to Munich and lectured on refrigerating machines there until 1910. In 1895 he succeeded in liquefying air by the Joule-Thomson effect and this led to the liquefaction of other gases and the establishment of Section B of the company for the manufacture of machines for industrial liquefaction and fractionation of mixtures of gases.

Coleridge: the Sublime Somnambulist. By John Charpentier. Translated by M. V. Nugent. Pp. x + 332. (London: Constable and Co., Ltd., 1929.) 15s. net.

THIS is certainly a beautiful and inspiring book, in spite of a certain heaviness of style due partly to excessive faithfulness in the translation. It is remarkable how many English worthies are finding their best interpreters in Frenchmen. M. Charpentier does not compete with the vivacity of M. André Maurois in his lives of Shelley, Disraeli, and Byron, but he is a much more profound and sympathetic student. He judges very fairly the philosophic attainment of Coleridge, not rating it high; he is enthusiastic about the best in his poetry and he gives a penetrating and convincing study of his personality. The fight with opium, the devastating effects of the drug and the noble and finally successful struggle to overcome it, with the help of Dr. Gillman, could scarcely be better described, and will be to many readers the most interesting part of the book. But they should not resist the fascination of M. Charpentier's picture of the 'old man eloquent' in his last stages at Highgate. He was essentially good and would not have seemed old, had it not been for the ravages of his vice. He was but sixty-two when he died, and those who care for his memory, a number likely to be increased by this book, would do well to see that his tomb in the crypt at Highgate School is more reverently treated than it was when we last visited it. F. S. M.

Experimental Optics. By Prof Albert F. Wagner. Pp. xii + 203. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 16s. net.

THE course of optics outlined here is one which has been developed for an advanced class at the postgraduate school of the United States Naval Academy. Some ninety experiments are described, in general of an advanced type and requiring more elaborate apparatus than is found in most teaching laboratories in Great Britain. Its value for general purposes would have been increased considerably if more photographs and perspective diagrams of apparatus had been given, although those present are excellent. In spite of these minor defects, which are indeed only apparent when it is put to a use other than that for which it was originally intended, the book should be of much value as a work of reference for technical students and the more advanced degree classes. Prof. Wagner insists upon the importance of geometrical optics.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Single Collisions of Electrons in Nitrogen.

IN some recent experiments, I have measured the energy losses suffered by electrons of initially homogeneous speed in passing through nitrogen, the pressure of which was so chosen that no appreciable amount of multiple collisions should occur. The method consists in accelerating electrons from the hot cathode C into the field-free space bounded by A and B, where the collisions take place (Fig. 1). Those electrons which have not been deflected appreciably from the original direction of travel proceed through the perforated centre of B and through the narrow slit S_1 enter the box D, where their speed is measured by means of a deflecting electric field between E and F and a box collector G, placed immediately behind the exit slit S_2.

Hughes, Rojansky, and McMillen[1] have shown that in such a cylindrical deflection condenser refocusing of the electron paths takes place for a mean deflection of 127° 17′, which is the distance along the arc from S_1 to S_2. Pure nitrogen is supplied through an artificial leak and, having passed the collision chamber, is pumped away to the right of S_1 by a large steel diffusion pump. Sensitive compensation devices enable bombarding and deflecting voltage to be checked and adjusted with a high degree of accuracy. A number of curves at constant bombarding voltage were taken by varying the deflecting voltage in small steps. In most experiments, however, the deflecting field was kept fixed, and the different parts of the electron distribution curve were measured in turn by applying an adjustable accelerating voltage between B and S_1. Bombarding voltages ranged from some 80 to about 600 volts; pressures of 1–4 × 10^{-2} mm. were used.

The distribution curves obtained with both methods of measurement exhibit a strong and sharp peak due to electrons which have retained the whole of their

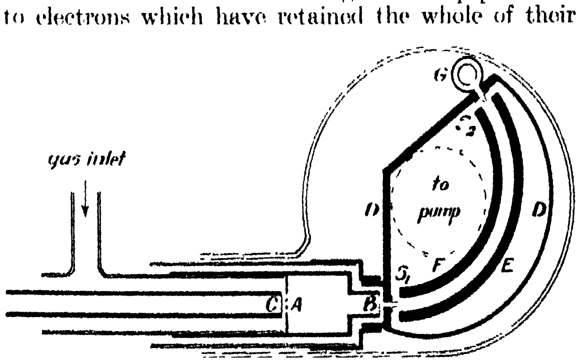


FIG. 1.

energy. Close to this peak, on the side of lower velocities, there are several small maxima in addition to a continuous distribution, which is rapidly approaching zero at greater distances from the primary peak. Fig. 2 shows the general appearance of the curve corresponding to energy losses of 0-30 volts. Part of the inelastic collisions responsible for this curve take place at the edges of S_1 and of the holes in B (possibly also to a small extent in A). From a comparison of curves with a high vacuum in the chamber and with different pressures of nitrogen it is usually possible to distinguish the effects of such collisions from those produced by impacts with molecules of the gas.

The volt equivalents of the energy losses indicated by the maxima in the distribution curves are tabu-

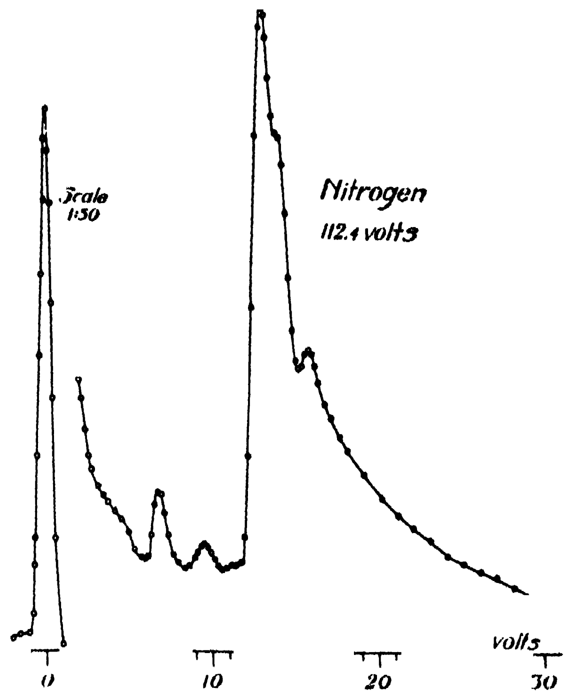


FIG. 2.

lated below, together with the number of independent determinations and the average error in each single determination.

	V_1	V_2	V_3		V_5	V_6	V_7
No. of determ.	22	23	9	24	19	23	
Average error		0·17	0·28	0·13			
Maximum	6·64	9·25	10·86	12·78	13·93	15·82	18·03
Interpretation	Pt 6·5 Cu 6·9	a (2) 8·91 a (3) 9·11 a (4) 9·31		b 12·52 b' 12·79 c 12·87-8			

V_1 must be attributed to impacts with the electrodes. In fact, I have previously been able to show[2] that there is frequently a loss of 6·5 volts with platinum —B is a platinum foil—and of 6·9 volts with copper (copper slits). Of the rest, at least V_2, V_4, V_5, and V_6 appear to belong to collisions in the gas.

By far the most conspicuous one of these is V_4. Energy losses of this magnitude have been observed by Langmuir and Jones,[3] and by Harnwell,[4] in connexion with other work. The value of 12·78 volts is in excellent agreement with a transition from the X level of zero vibration for the normal molecule to the group of electronic levels b, b', c, found by Birge and Hopfield.[5] The 0 level of the lower a state is only 8·51 volts above the normal level in the non-vibrating state. From the known emission intensities of this band, however, it appears that the most probable jump from the latter level to the a state would be to a level of vibrational number 3 or 4. If V_2 is attributed to such transitions, the observed value of 9·25 volts would, in fact, indicate a most probable end level of vibrational number 3 or 4. The considerable width of the 9·25 volts peak is consistent with this interpretation. The other maxima have not been correlated with any known spectroscopic levels at present.

One of the chief objects of this investigation was to look for evidence of excitation processes pertaining

to the K-level of nitrogen. Since $K = 388\cdot6$ volts for the nitrogen atom, these processes would be expected to give rise to a maximum in the region 370-410 volts below the primary peak. However, a careful search over this region with bombarding voltages as high as 590 volts failed to reveal any features of the kind expected. To give an idea of the sensitiveness of this test, it may be mentioned that in one case (bombarding voltage 540 volts) the total electron current received by the collector in the region in question produced a steady deflection of the shunted electrometer amounting to 3 mm. of the scale. A maximum of 2 mm. could not possibly have escaped detection. The $V_{4'5}$ maximum, however, was 9·5 metres on this scale and the primary peak 148 metres! Although it must be remembered that only nearly undeflected electrons are counted in these experiments, and that the chance for a colliding electron to continue in the same direction after the event could diminish as the amount of energy lost becomes considerable, one can scarcely but infer from this result that the probability that the electron will disturb a K-electron is small compared with that of the displacement of an outer electron.

ERIK RUDBERG.
Nobel Institute, Experimentalfältet,
Sweden, June 20.

[1] *Phys. Rev.*, vol. 34, pp. 284, 291; 1929.
[2] *Roy. Soc. Proc.*, A, vol. 127, p. 111; 1930.
[3] *Phys. Rev.*, vol. 31, p. 357; 1928.
[4] *Phys. Rev.*, vol. 33, p. 559; 1928.
[5] *Astrophys. J.*, vol. 68, p. 257; 1928.

The Dissociation Theory of Solution.

IT is now forty-three years since the electrolytic dissociation theory was proposed by Arrhenius in 1887, to account for the changes in the physical properties of solutions caused by electrolytes, which had compelled Van 't Hoff to introduce the coefficient i into the gas equation

$$PV = RT.$$

Impressed with the view that the osmotic pressure, depression of the freezing point, diminution of vapour pressure, etc., of solutions are functions only of the number of dissolved particles, Arrhenuius concluded that 'electrolytes' must contain a greater number of particles, which could only be derived from the dissociation of the solute. By choosing the 'dissociation' of each substance to fit the observed values the theory could easily be made to account for such effects. It can now be shown that the assumption involved is incorrect.

In a series of papers on the molecular theory of solution, and on the vapour pressure of liquids, in the *Philosophical Magazine* (**38**, 696, 1919; **44**, 897, 1922; **48**, 936, 1924; **50**, 1147, 1925; and seventh Ser., **10**, 160, 1930), I have shown that the vapour pressure of a liquid is produced by the particles that approach the surface with sufficient heat energy to enable them to overcome the attraction of the liquid and escape into the vapour. The vapour pressure is therefore a function of molecular attraction, volume, and motion only. It is expressed by the formula

$$p = 81\cdot84 \frac{T\lambda}{A\phi} e^{-\frac{9\cdot665SMA^{2/3}}{T\delta\lambda^2\rho}} \qquad (1)$$

in which T is the absolute temperature, λ the ratio of the total average velocity of the molecules in the liquid in the given circumstances to that in a perfect gas, A is the actual state of aggregation of the molecules in the given liquid, ϕ its co-volume, S its surface tension, M its molecular weight, $\delta \times 10^{-8}$ the nearest distance of approach of the centres of the molecules, and ρ the density of the liquid. In this formula the factor λ should be specially mentioned because its introduction amounts to a denial of the principle of the equipartition of energy. As we are considering the motion of molecules in a liquid, which are subject to the action of the tremendous forces that produce the cohesion of the medium, we are compelled to admit that their velocities cannot be the same as those of the particles in a perfect gas at the same temperature. The factor λ represents the ratio of the most probable speed of the molecules in the liquid to that in a perfect gas, and is a function of the cohesion, K, of the medium.

If this expression is extended to cover solutions of non-volatile solutes, it becomes

$$p = 81\cdot84 \frac{M_2 w_1 T\lambda}{(AM_1 w_2 + M_2 w_1)\phi} \times e^{-\frac{9\cdot665A^{2/3}M_1S_1^{1/2}\{S_1^{1/2}\rho_{12}w_1(\delta_2^{1/2} - A^{1/6}\delta_1^{1/2}) + S_{12}^{1/2}\rho_1(w_1+w_2)A^{1/6}\delta_1^{1/2}\}}{T\delta_1\delta_2^{1/2}\lambda^2\rho_1(w_1+w_2)}},$$

in which w is the weight of solute or solvent, the subscripts relating to solvent and solute respectively, and gives values for salt solutions in accordance with observation.

It follows that the vapour pressure of salt solutions is determined by the attractions, volumes, and motions of the particles only. When a salt is dissolved in water, the cohesion of the liquid is increased on account of the greater cohesion of the salt particles. In the case of a salt solution, therefore, as distinct from that of an inert substance that does not increase the cohesion of the liquid medium, the vapour pressure is diminished by the greater attraction to be overcome by the escaping molecules, as well as by the diminution in the number of particles of solvent present in unit volume of the liquid. That is to say, in an aqueous solution of urea, for example, the vapour pressure is less than that of pure water, merely because there are less water particles present in unit volume, but in a solution of common salt the fewer water particles must also overcome a greater attraction on the part of the solution before they can escape into the vapour. Therefore, the fundamental assumption of the dissociation theory, that the diminution of vapour pressure is proportional only to the number of solute particles present, is incorrect. The vapour pressure is determined also by the cohesion and volume of the solute particles. Instead of choosing the 'dissociation' to fit the observed properties, it is now possible to calculate the properties of solutions from the attractions and volumes of the particles of solvent and solute.

By a similar, though less direct, method it has also been possible to show that the extra depression of the freezing point of salt solutions is determined by the increase in cohesion of the liquid that is due to the presence of the salt particles in it.

Further, it is possible to give a direct disproof of the dissociation theory. Edser's formula for the cohesion, K, of a pure liquid,

$$K = \frac{4S}{\delta}, \qquad . \quad . \quad . \quad (3)$$

can be extended to give the cohesion, K_2, of the dissolved particles in a solution, in the form

$$K_2 = \frac{4(S_{12}^{1/2} - S_1^{1/2})^2}{\ldots} \qquad (4)$$

As the values of K_2 given by this formula are involved in the vapour pressure formula (2), which has been found to be correct, there is no doubt that the formula (4) corresponds to the actual attractions between the salt particles in solution. From this formula the attraction between two particles of, for example,

potassium nitrate in solution, at a distance of, say, 10^{-7} cm., is found to be $6{\cdot}24 \times 10^{-11}$ dynes. If the particles were 'dissociated', the electrical attraction between the 'ions' at the same distance would be $2{\cdot}21 \times 10^{-5}$ dynes, which is of the order of a million times as great, and is impossible. Therefore, the potassium nitrate cannot be dissociated.

By taking into account the attractions between the particles, it is possible to account for the solubilities of different substances and to explain the mechanism of solution, which the dissociation theory was unable to do.

The results are evidence that the so-called failure of the classical dynamics is due, not to inherent defects in the method, but to the omission on the part of mathematicians to allow for the attractions of moving particles in close proximity to one another.

S. C. BRADFORD.

Science Museum,
South Kensington, S.W.7,
July 5.

The Nucleus of *Amoeba proteus* Pallas (Leidy) [= *Chaos diffluens* (Schaeffer)].

IN "Ergebnisse mit der Nuclealfärbung bei einigen Rhizopoden", Aug. 12, 1929,[1] Bogdanowicz describes the effect of Feulgen's nucleal reaction on the nucleus of *A. proteus*. In a letter to NATURE (June 22, 1929) I briefly summarised my results of a long series of experiments on the same subject. It will be seen from a perusal of the two publications that our findings agree with regard to the presence of a reticulum of chromatin in the karyosome (a conclusion I had already arrived at by a study of the development of the nucleus[2]), but differ with respect to the nature of the so-called 'chromatin blocks' in the periphery of the nucleus. Bogdanowicz fails to obtain a chromatin reaction for these blocks. Now these 'chromatin blocks' have a twofold theoretical significance: (1) they form the karyosomes of the Agametes, (2) they show a very primitive type of mitosis.[3] It is, therefore, important to arrive at a decision with regard to their exact character. There is, however, another reason for endeavouring to clear up any discrepancies in the various descriptions of the nucleus of *Amoeba proteus*. As I have already pointed out, two large free-living amoebae have been confused under the name of *Amoeba proteus*, namely, *Amoeba dubia* (Schaeffer) and *Amoeba proteus* [Pallas (Leidy) = *Chaos diffluens* Schaeffer]. Therefore in making any reference to papers published before 1916 care should be taken to ascertain to which of the two amoebae reference is being made. As I know from experience, it is not always easy to do this. But failure in this respect is a fruitful source of confusion. Hence the justification of this summary of the results of many years' study of the nucleus of *A. proteus*, in its development and in its adult condition, by the ordinary microscopical stains; these results being checked and confirmed by a later investigation by Feulgen's method.

The nucleus of *A. proteus* consists of (1) a more or less centrally placed karyosome, (2) a peripheral achromatic network in which are suspended 'chromatin blocks', the whole immersed in nuclear sap and surrounded by a nuclear membrane. The karyosome is in the form of a thick disc with rounded edge, so as to appear circular in plan, 'band' shaped in elevation. It presents a variety of appearances when being rolled about in the cytoplasm, and thus changing from its 'plan' to its 'elevation' position.

The karyosome is made up of an achromatic ground substance on which is to be seen a reticulum of chromatin. The consistency of the karyosome differs in different specimens and varies according to the age of the amoeba and other circumstances. The amount and the distribution of the chromatin in the karyosome varies at different times. In the young, that is, immature, amoebae the karyosome is well marked off and is a conspicuous structure in the nucleus. But the chromatin is very sparse. In fact, I failed to get any positive reaction for chromatin in uncut nuclei, except the merest trace, until I had examined hundreds of specimens.

In the older, that is, fully differentiated, and adult amoebae the karyosome sometimes stains deeply by Feulgen's method, showing well-marked blocks and patches of chromatin which differ in colour tone in no way from the fully developed chromosomes in dividing nuclei of other animals and plants used by way of controls. At other times the karyosome appears to contain less chromatin.

It is important to emphasise the fact that chromatin is a living substance. It is, therefore, ever-changing, growing, increasing in amount, differentiating out of the chemical substances which build it up, dividing. The changes described above are clearly brought out when large numbers of *A. proteus* are studied by Feulgen's reaction, as is also the case when large numbers of amoebae are treated with aceto-carmine, as I pointed out long ago.

In the adult amoebae clearly defined chromatin blocks are to be found in the periphery, giving the reaction for chromatin by Feulgen's method as already stated. These similarly grow, differentiate, divide; when a 'block' is ready to divide, it stains very brightly; when it is in the 'resting' condition, it is not so evident and it does not stand out so prominently from the underlying ground substance.

In conclusion, I may add that, through the kindness of Prof. Robert Chambers of New York, I have been able to examine the *Amoeba dubia* of the States (it differs in no wise from the material obtained locally), and so to assure myself that not only do the cytoplasmic characters of the two species differ, but also, there is no karyosome in the nucleus of *A. dubia*.

MONICA TAYLOR.

Notre Dame, Dowanhill,
Glasgow, June 23.

[1] *Zeitschrift für Zellforschung und mikroskopische Anatomie*, 10 Band, 3 Heft.

[2] *Quart. Jour. Mic. Sci.*, vol. 71, part ii., August 1927.

[3] "Amœba proteus: some new observations on its Nucleus, Life History, and Culture." *Quart. Jour. Mic. Sci.*, vol. 69, p. 126, part i., December 1924.

Molecular Rotation in the Solid State.

THE determined crystal structures of a number of primary alkyl ammonium halides indicate that in such compounds the carbon atoms are arranged collinearly [1] in a particular group. Thus in the case of primary amyl ammonium chloride[2] the X-ray diffraction data from powders and single crystals can be completely explained by a tetragonal unit of structure containing $2NH_3C_5H_{11}Cl$ with $a = b = 5{\cdot}01$ A., $c = 16{\cdot}69$ A. The space group is D_4^2, V_d^3, S_4^1, C_{4v}^1, C_4^1, D_{4h}^7, and the Cl, N and C atoms are at $o\tfrac{1}{2}u$, $\tfrac{1}{2}o\bar{u}$, with $u_{Cl} = $ c. 0·095. The absence of reflections in odd orders from planes $(hk0)$ with $(h+k)$ odd and the intensities of reflections from other planes such as (200) require the carbon atoms of the C_5H_{11} groups to scatter X-radiation as if they are arranged collinearly in each group.

Prof. Linus Pauling, of the California Institute of Technology, has recently suggested to me that the indicated collinear arrangement of carbon atoms might be in error. If the carbon atoms of an alkyl group really have a 'zig-zag' arrangement and the group is

rotating[3] about its chain axis independent in phase of other rotating groups, then the result given above would be obtained. If the temperature should be sufficiently lowered, this complete rotation would be replaced by slight oscillation about some equilibrium positions.

Observations were made on primary amyl ammonium chloride at approximately liquid air temperatures. The density, determined by suspension in mixtures of liquid nitrogen and oxygen, is *c.* 1·0, probably a little greater than the value 0·953 at 25° C. Diffraction lines on powder photographs (CuK radiation) at liquid air temperatures are similar in spacings to, but markedly different in intensities from, those at room temperatures; some few additional lines requiring a larger unit of structure are also present. It is difficult to determine accurately the structural characteristics of such a complex compound from powder photographs alone. The photographs at liquid air temperatures, however, indicate, from their similarity to photographs at 25°, that the crystals have approximately orthogonal axes and that the atomic arrangement in the unit of structure containing $4NH_3C_5H_{11}Cl$, with the dimensions $a - b = 7·0$ A., $c - c.$ 16·6 A., is closely similar to that in the unit of structure previously described. The presence of planes such as (210) and (300), referred to the axes of the larger unit of structure, could be explained by alteration in the structure but probably is best accounted for by absence of the suspected molecular rotation that leads to the fortuitous determination of the unit of structure and atomic arrangement at room temperatures.

The best test for a possible collinear arrangement of the carbon atoms of a C_5H_{11} group is the absence of reflections in odd orders from planes ($hk0$) with ($h + k$) odd. (Indices referred to a unit of structure having $a = b = 5·0$ A., $c = 16·6$ A.). The large axial ratio makes it difficult to distinguish between reflections from ($hk0$) and (hkl) with l unity on powder photographs. Reflections from (200) and (201), however, are very weak at liquid air temperatures, while reflections from (200) are strong at room temperature. This change in the intensity of (200) could be explained by a great departure of the chain axes of the C_5H_{11} groups from parallelism with the tetragonal axis of the crystal at liquid air temperatures, or, as is most probable, by a departure of the carbon atoms from a collinear arrangement.

The most immediate conclusion is that the carbon atoms in a C_5H_{11} group are arranged in a 'zig-zag' manner and that the characteristics of the X-ray diffraction photographs made at room temperatures from crystals of primary amyl ammonium chloride arise partially from rotation of the C_5H_{11} groups about their chain axes. The configuration of a hydrocarbon chain as deduced from the crystal structure of the primary alkyl ammonium halides is thus probably the same as that first found by Müller and Shearer[4] for some long chain aliphatic compounds. The carbon to carbon separation along the chain axis is *c.* 1·20-1·30 A., and the carbon-carbon distance might well be *c.* 1·54 A.

It thus seems, as Pauling has indicated, that in a crystal containing molecules or molecular groups with small moments of inertia about some axes, these molecules may undergo rotational motion about these axes.

STERLING B. HENDRICKS.

Fertilizer and Fixed Nitrogen Investigations,
Bureau of Chemistry and Soils,
Washington, D.C.

[1] S. B. Hendricks, *Z. f. Krist.*, **67**, 106, 475; 1028; **68**, 189; 1928.
[2] S. B. Henricks, *Z. f. Krist.* (In press.)
[3] See Linus Pauling, *Phys. Rev.*, July 1930.
[4] *Jour. Chem. Soc.*, **123**, 3156; 1923. G. Shearer, *Proc. Roy Soc.*, A, **108**, 655; 1925.

Raman Effect, Fluorescence and Colour of Diamonds.

THE Raman spectra of various simple substances, including especially the non-metallic elements such as phosphorus, chlorine, and carbon, have been investigated by me. In the course of this work numerous samples of diamond were examined, and a brief report of the results may be of interest as supplementing the accounts which have already appeared in NATURE of May 10.

The extreme sharpness of the Raman lines observed with diamond invited attempts to measure their wavelength with all possible precision. Seven different diamonds gave results identical within the limits of error of measurement. The best representative value for the infra-red wave-number was found to be 1331·5 ± 0·5 cm.$^{-1}$, in agreement with Ramaswamy's measurements but differing rather seriously from the value 1342 given by Robertson and Fox. In the case of

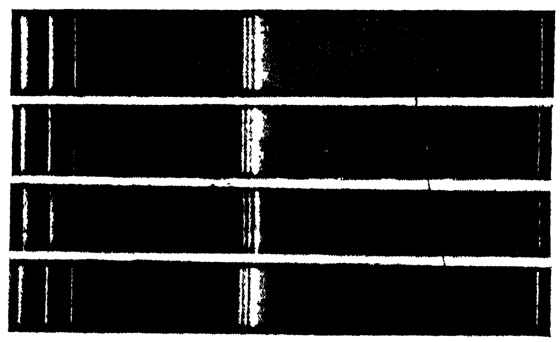


FIG. 1.

one very imperfect diamond, it was noticed that the line was diffuse and distorted and was accompanied by a faint companion line on the longer wave-length side.

A feature of importance not mentioned in NATURE of May 10 is the continuous spectrum accompanying the Raman lines. This appears with a fairly well defined edge on the violet side at about λ4240 A., and stretches out towards the visible region. Immediately preceding it are two bands of which the first at 4152 to 4162 A. is the more intense. The intensity of the bands and of the continuous spectrum varies in a remarkable way with the colour of the diamond. They are specially conspicuous with diamonds of a pale blue colour, and are extremely feeble with white diamonds. *Per contra*, the Raman lines are very difficult to observe with blue diamonds, and are most easily obtained with colourless diamonds.

In Fig. 1, *A* taken with a blue diamond and *B* with a white diamond exhibit these features. *C* was taken with a diamond having the palest yellow tinge and showed both the Raman lines and the bands accompanied by a continuous spectrum of considerable intensity. From the fact that the introduction of a filter cutting out the mercury line at 4046 A. eliminates the bands and practically the whole of the continuous spectrum, it may be inferred that these represent fluorescence of a special type. The aggregate intensity of the continuous spectrum appearing in *A* must have been very considerable, and it was thought that the blue colour of the diamond in ordinary daylight was really due to this fluorescent radiation. *D* was obtained with another diamond of a strikingly yellow colour. It gave feeble Raman lines, and a continuous spectrum (without bands) stretching practically over the whole region from 3800 A. to the red end.

S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta, India, June 14.

Raman Effect in Paramagnetic Crystals.

VARIOUS crystalline sulphates have been examined for their Raman spectra by the same method as that used for crystalline nitrates and described previously (NATURE, Mar. 22, p. 463). The results indicate what appears to be a very remarkable influence of the paramagnetism of the cation on the intensities of the Raman lines. This appears very clearly when we compare the spectra of ferrous sulphate crystals ($FeSO_4$, $7H_2O$) with those of other isomorphous sulphates, for example, magnesium or zinc. In the latter substances, a strong line appears with a frequency shift of about 980 cm.$^{-1}$. This frequency is characteristic of the SO_4^{--} ion, though its exact value shows considerable variations with the cation present in the crystal. In the spectrum of the ferrous sulphate crystals, however, the line fails to appear even when exposures are given of such duration that the feeble continuous spectrum accompanying the mercury lines comes out strongly on the plate. With aqueous solutions of ferrous sulphate, however, the SO_4^{--} line appears feebly.

That the disappearance of the SO_4^{--} line with ferrous sulphate crystals is connected with the paramagnetism of the substance is indicated by the fact that in other paramagnetic sulphates, as, for example, those of copper and manganese, the characteristic SO_4^{--} line appears only weakly. A similar weakening of the line due to NO_3^- inactive frequency is also noticeable on comparing the nitrates of copper and manganese with the nitrates of other metals. The observations indicate that when the substance is in solution, the influence of the paramagnetism of the cation weakens or disappears.

P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, India.

Submarine Cable Interference.

THE description given by E. T. Burton [1] of his measurements of audio frequency interference is of great interest, and would be more so if quantitative values of the interference levels had been given. The similarity between the natural interference experienced on an untuned aerial and a cable is to be expected, but details of the depth and armouring of the cable would be valuable to estimate approximately the attenuation of the higher frequencies. Mr. Burton does not state whether a local earth was used, or a sea earth contiguous to the main cable; nor the length of the latter, if used.

An attempt at correlating the 'intermediate frequency' interference with the strength of the aurora borealis might meet with success; this suggestion is supported by (*a*) the partial correlation with magnetic disturbance, (*b*) the higher level at night, and (*c*) the interference level being on the increase when observations were apparently discontinued in September 1929. Extremely heavy and rapidly varying earth currents were observed at the Horta end of the Bay Roberts-Horta (1928) cable during the evening of Sept. 8, 1928, simultaneously with exceptional aurora at Bay Roberts.

The practical importance of interference measurements on submarine cables lies in the limit set by the interference level to the smallness of the received signals, and hence to the permissible amplification, both at low frequencies for telegraphy and at audio frequencies for telephony. The recent suggestions for a loaded trans-Atlantic telephone cable [2] will depend for their success on the degree to which natural and artificial interference can be eliminated, as for example by long, resistance-terminated sea earths, or by screening the cable by a high-permeability alloy. This will be realised when it is stated that an overall amplification of the order of 150 decibels will be required at about 2200 to 2500 c.p.s.[3]

The programme of tests on the La Panne-Lisbon cable, to be laid by the Telegraph Construction and Maintenance Co., Ltd., for the Italcable Co. later this year, includes the recording of telegraph frequency interference (from 0 to 200 c.p.s.) at La Panne. Should sufficient time be available, I hope to extend these observations to cover the audio frequency range. At this location, with a long length of cable in shallow water down the Channel, it is anticipated that the industrial interference will be very heavy; but the character and intensity of natural interference may be similar to that obtained at Trinity Bay.

A. L. MEYERS.

Telegraph Construction and Maintenance Co., Ltd.,
18 Wharf Road, London, N.1,
July 15.

[1] E. T. Burton: NATURE, **126**, p. 55; July 12, 1930.
[2] K. W. Wagner: *Elektrische Nachrichten-Technik*, **6**, p. 125; April 1929. H. C. Channon: *Jour. I.E.E.*, **67**, p. 500; April 1929. See also *Jour. Am. I.E.E.*, **48**, p. 635; August 1929.
[3] N. W. McLachlan: *Electrician*, **103**, p. 704; Dec. 6, 1929.

The Green Ray.

THE extract from a letter to NATURE by R. W. Wood (vol. 121, 1928, p. 501), in Sir Napier Shaw's recently published "Manual of Meteorology", vol. 3, suggested to me that an observation of the green ray I obtained last spring might be worth recording.

Wood remarks that the ray is more likely to appear when the horizon at which the sun sets is markedly colder than the air close above it.

While descending in clear weather as a passenger in a motor-car into a valley in Kincardineshire I watched the artificial sunset due to the obscuring of the sun by a hill some three miles away, the country being several inches deep in snow; the sunset occupied about five seconds; the last-disappearing edge of the sun turned from orange through yellow to a grass green. In spite of the rapid sunset which should have been unfavourable for seeing any green ray, the sharp increase of temperature with height usual above a snow surface appears to have produced a sufficiently high dispersion.

O. F. T. ROBERTS.

The University,
Aberdeen, July 3.

Plasmoidal Discharges in Gases.

IN the issue of the *Physical Review* of April 1, 1930, there appears a paper by Prof. R. W. Wood on high frequency discharges in gases at low pressure in which he describes a type of discharge, naming it a plasmoid. This appears to be a new name for a phenomenon which has been described before. In particular, it appears to be the same as a type of discharge described briefly by me in NATURE of Mar. 10, 1928. Such a discharge was also shown by Messrs. Gill and Donaldson at an exhibition during the British Association meeting at Oxford in the summer of 1926.

It does not appear that Prof. Wood has verified his references carefully. I find that a paper which was published by him in the *Philosophical Magazine* in August 1929 is referred to in his recent paper as having appeared in October 1929.

Also in his paper in the *Philosophical Magazine* of August 1929, he refers to another paper published by him in NATURE of Oct. 8, 1927, as having been published in NATURE 1926.

S. P. MCCALLUM.

Electrical Laboratory,
Oxford, June 6.

The Royal Society of Canada.

ANNUAL MEETING IN MONTREAL.

ON May 20-22 the Royal Society of Canada met at McGill University, Montreal. Prof. A. S. Eve gave his presidential address on the evening of May 20, his subject being "The Universe as a Whole". He dealt successively, and from the broadest point of view, with the macrocosm, space, the microcosm, atoms and electrons, the age of the universe, time, life and the origin of life, and domains of energy, and stressed the divergence of existing views on may important problems, and the number of such problems still to be solved. At the same session he presented the three gold medals of the Society. The Flavelle medal was awarded to Dr. A. B. Macallum, emeritus professor of biochemistry at McGill University, for his pioneer researches in micro-biochemistry, the Lorne Pierce medal for outstanding contributions to literature to Sir Andrew McPhail, professor of the history of medicine at McGill University, and the Tyrrell medal to Dr. Adam Shortt, of Ottawa. At the final session of the meeting the Hon. Vincent Massey, Canadian Minister to the United States, gave the popular lecture on "Art and Nationality in Canada".

Perhaps the most interesting and outstanding event of the whole meeting was the radio address delivered by Sir Ernest Rutherford, president of the parent of all Royal Societies, from his home in rural England to the fellows gathered in Moyse Hall at Montreal. The whole of the address, with the exception of a few opening sentences, was clearly heard by a large audience, as was the telephone conversation between Sir Ernest, at one end, and in turn Prof. Eve, Sir Arthur Currie, and Sir Robert Falconer, at the other. Only ten years previously it had been considered a remarkable event when, also under the direction of Prof. Eve, an artiste sang at Montreal to an audience of the Royal Society at Ottawa, 110 miles away (and the reception was much less perfect).

In Section I. (French Literature and History) eleven papers were read, and in Section II. (English Literature and History) twenty-five.

Section III. had to divide into sub-sections to hear the ninety-nine papers presented. The sectional presidential address was delivered by Dr. Daniel Buchanan, of the University of British Columbia, who spoke on the three-body problem and gave the historical development of this famous mathematical investigation. Prof. J. C. McLennan communicated a large number of papers by himself and his colleagues on spectroscopy and low temperature work. One paper with H. D. Smith and G. O. Wilhelm reported results indicating that there is no appreciable difference in the states of oxygen molecules in gas and in liquid form. Prof. McLennan himself described the construction of a new type of spectrograph which will photograph the auroral green line in less than twenty minutes, permitting comparison of its intensity in the light from the night sky for different periods of the night. With E. K. Moles he has found that there is appreciable absorption of the green auroral line in oxygen at high pressures. An interesting paper (with J. F. Allen and J. O. Wilhelm) on the non-superconductivity of bismuth alloys was also presented.

Dr. J. A. Gray gave several papers on X-rays and radioactivity. The most interesting of these (in conjunction with W. H. Zinn) showed that the scattering of X-rays at small angles to within five minutes of arc of the primary beam indicated an abnormal scattering with certain specimens of charcoal; the intensity increases so rapidly as the angle decreases that it is difficult to measure relative intensities accurately. Figures obtained show that with a certain specimen of charcoal the intensity of the scattered radiation at five minutes of arc is of the order of a million times that at ninety degrees. This abnormal scattering is also shown by the fact that the part of the mass scattering coefficient for radiation scattered between ten and ninety minutes is equal to 6·0, which may be compared with the total normal scattering coefficient which is of the order of 0·2. The scattering increased with rise of temperature. Different wave-lengths were used and it was not found possible to give an explanation of this new phenomenon in terms of the wave theory.

Dr. J. K. Robertson in a mathematical paper gave a rigorous treatment for measuring the half-width of spectral sources. Dr. A. N. Shaw and H. E. Reilley described a new method enabling the comparison of electrical voltages measured at different times and places to be made with the exceptional precision of two parts in a million. Dr. J. S. Foster and his students presented several papers relating to the Stark effect, including one (with H. W. Harkness) in which it was shown that in xenon the usual rule for hydrogen differences is not applicable. Papers on applied geophysics were presented by Prof. A. S. Eve, Dr. L. Gilchrist, and Dr. D. A. Keys, in which accounts of field work by different electrical and magnetic methods were described. An interesting demonstration of the piezoelectric pressure gauge combined with a cathode ray oscillograph was shown by H. G. I. Watson and Dr. D. A. Keys. Dr. W. L. G. Williams gave a paper on applications of the theory of formal molecular invariants to the theory of numbers, which leads to some rather general arithmetical results. Dr. S. Beatty spoke on the rôle of equivalent lines in a bilinear transformation in the plane, and Dr. C. T. Sullivan gave an interesting account of an investigation on an application of matrix rank to the classification of surfaces defined by a certain system of differential equations.

In the Chemical Sub-section Dr. Otto Maass and R. H. Wright described the physical properties of the system hydrogen sulphide–water, and F. R. Moorehouse and Dr. Maass described the preparation and properties of ethyl acetylene. Dr. R. H. Clark and E. G. Hallonquist reported a study of the

effect of a magnetic and also of an electrostatic field upon the ethylene linkage of the two electromers of 2-pentene. Dr. F. B. Allan gave a paper on the reaction of the solvent alcohol on dissolved esters in presence of calcium alcoholate, ammonia, or sulphuric acid. R. E. Whiting and Dr. W. H. Martin showed that extreme drying had no effect on either the light absorption or the photo-expansion of bromine. Dr. E. H. Archibald and F. Rendle made a communication on the solubility of beryllium hydroxide in solutions of sodium bicarbonate and the separation of beryllium from vanadium, chromium, and uranium.

In Section IV. (Geological and Mineralogical Sciences) thirteen papers were given, Mr. A. G. Burrows, provincial mineralogist for Ontario, presiding. Dr. F. S. Alcock presented a paper on the Silurian of Northern New Brunswick; his recent work in the Chaleur Bay region has indicated that Ordovician and Devonian as well as Silurian strata occur in the north-western part of the province, formerly mapped as occupied by Silurian; he included a discussion of the relations of the Silurian with older and younger strata. Dr. M. Y. Williams, in a paper on the Pierre Seas of Western Canada, advanced evidence to show that the great Colorado sea retreated to the north and south, leaving western Canada dry land. The rhythm of earth movements, however, continued, although with decreasing amplitude, and two or more invasions of the Pierre Sea closed the marine history of Cretaceous time. He discussed the areal extent, duration, and significance of the Pierre submergence.

W. A. Johnston and R. T. D. Wickenden gave a paper on the hitherto undescribed Glacial Lake Regina, Saskatchewan, which extended for 175 miles south-east from the elbow of the South Saskatchewan River, and had a maximum width of about 40 miles. The lake was formed as a result of damming of the drainage of the South Saskatchewan River by the retreating ice sheet of the last glacial epoch and outflowed towards the south-east by way of the Souris valley. In two other papers W. A. Johnston brought together scattered data regarding the occurrence of permanently frozen ground in northern Canada, discussed the question of the relationship of the frozen ground to present and past climatic conditions in the glaciated and unglaciated parts of Canada, and offered evidence in support of J. B. Tyrrell's view that fossiliferous clays on Roaring River, Duck Mountain, Manitoba, are interglacial in age. Dr. G. S. Hume dealt with features of foothill structures in Alberta, and pointed out that recent drilling for oil and gas in these foothills west of Calgary has revealed the presence of overthrust blocks lying on one another and separated by low-angle thrust planes dipping south-westerly. Turner Valley, New Black Diamond, and Jumping Pound structures are recumbent folds modified by faulting. Late Cretaceous rocks are believed to underlie and to be separated by a thrust fault from the Palæozoic rocks productive of oil and gas in Turner Valley, and it is suspected that the whole disturbed belt in this area is overthrust on to the relatively flat-lying sediments of the plains.

In Section V. (Biological and Medical Sciences) fifty-nine papers were presented, and in addition Dr. Szent-Gyorgyi, a guest at the meeting, gave a demonstration of the properties of hexuronic acid. Dr. A. T. Cameron, of the University of Manitoba, gave the presidential address of the section on temperature and life and death. Dr. Wm. Rowan communicated a description of a new species of *Hydra* found covering water-weeds in certain Albertan lakes; the body and tentacles when extended may measure four inches. Eggs are deposited in autumn and survive the winter. According to Dr. A. Willey, the young garpike, when less than a foot long, possesses a double tail, each part working separately; the tail-fin is a soft muscular process, which vibrates with great rapidity. Dr. C. M. Fraser reported the results of a study of the razor clam of the Queen Charlotte Islands. Dr. J. Playfair McMurrich presented a series of papers from the Anatomical Department of the University of Toronto. Amongst these was a report by Dr. J. C. Watt of a case of an adult man in whom there was a complete union of the membranes surrounding the heart and left lung, whence it was concluded that a special membrane of the heart is not necessary for its efficiency. Dr. H. A. Cates showed that the relative proportions of length and width of the skull do not alter to any considerable extent between infancy and adult life, but that the relative height, with measurement taken from the Frankfort plane, increases greatly. Dr. R. K. George showed, as determined by methods of precision, that in the majority of men the ring finger is longer than the index; in women the opposite holds. Dr. C. C. Macklin, of Western University, presented a study of stereoscopic X-ray films of lipiodolised lungs, which demonstrated that in inspiration the bronchial tubes become shorter and narrower, and in expiration the process is reversed, these changes facilitating air exchange, and being correlated with the minute anatomical structure. A network of smooth muscle with abundant elastic tissue envelops the tubes and controls the action. The results have a direct bearing on pathological conditions of the lungs such as pneumonia and tuberculosis.

Drs. J. G. Fitzgerald and D. T. Fraser, of the Connaught Laboratories, Toronto, presented an extended series of observations indicating that infants non-immune to diphtheria are the offspring of mothers who possess no natural protection, while the blood of adults shown to contain antitoxin continues to contain it for a period of years; non-immune adults remain non-immune. H. des B. Sims and D. A. Scott reported two absorption bands in the ultra-violet spectrum of solutions of crystalline insulin. Exposure to ultra-violet radiation lessens the potency of insulin. X-ray radiation produces no effect. A. F. Charles and D. A. Scott, from a study of enzymic digestion of crystalline insulin, find that loss of physiological activity apparently proceeds even faster than digestion, the result indicating that the activity is associated with the large molecule itself and not with some

constituent part of it. Dr. J. B. Collip, of McGill University, and his co-workers, outlined the preparation of the placental hormone emménin, and showed that immature female rats are brought to sex maturity by its injection, thereafter manifesting cyclic changes, while normal adult females are unaffected. R. L. Lutz outlined a method for determining potassium, sodium, calcium, and magnesium in biological material after initial fusion with fuming nitric acid, and described a crystalline organic substance isolated from fuming nitric acid hydrolysates of the protein fraction of beef muscle and of casein.

Drs. V. J. Harding and L. J. Harris, of the University of Toronto, described the production of convulsions and subsequent death in dogs after forced ingestion of large quantities of water. Recovery from the convulsive stage is rapid following intravenous or intraperitoneal injection of ten per cent saline. Dr. John Tait and W. J. McNally, of McGill University, reported that the croaking of frogs is essentially an under-water signal, conveyed by vibration, this vibration occurring when air is shifted from the lungs to the mouth and air-sacs. The fact that croaking can be heard merely implies that the signalling animal has its head above water at the moment. Dr. B. P. Babkin gave an account of a number of studies of gastric and intestinal digestion by himself and his students. Prof. A. H. R. Buller reported on some further experiments on sex in fungi. Dr. Marie-Victorin gave an account of a study of the literature and of the plant *Elodea canadensis*, leading to greater precision of nomenclature, and Prof. G. W. Scarth presented a series of sinkage studies of floating logs of various trees, the relative amount and distribution of the three phases, wood, water, and gas being studied by gravimetric and microscopic methods. Prof. F. E. Lloyd presented a comparative study of the traps of *Utricularia gibba*, *vulgaris*, and *capensis*.

The Society, under the presidency of Dr. Charles Camsell, Deputy Minister of Mines of the Dominion, has accepted an invitation from the University of Toronto to meet there in 1931, whilst a similar invitation to meet in Vancouver in 1932 was referred to the Council for favourable consideration.

A Study of the Phenomenon of Spin in Airplanes.*

By H. E. WIMPERIS, C.B.E.

METHOD OF STUDY.

SO much for what the spin is and what causes it. We come now to the best way to study it. This can be done by employing models or by the use of full-sized airplanes. The latter method avoids uncertainties due to any possible 'scale effect', that is, failure of the model to represent truly the motions of the full-sized machine, but adds the greater difficulty of making accurate quantitative measurements when in free flight and adds the risk of crash. Experiments with models have been made in wind tunnels and in free flight. Small light models—to one-twelfth or one-twentieth scale—have been made at Farnborough out of balsa wood, and these have been dropped through a free fall of 90 feet in the large balloon shed. Kinematograph records have been made and the motion afterwards measured up from the films. (One of these films was shown on the screen.) In certain of these model dropping experiments a Bristol Fighter model was used, and success attended the effort to reproduce various types of spin. In this particular machine the rudder was found to be surprisingly effective as a controlling organ, and if the spin were started against this control it was stopped in six turns.

Of all the various controls the aileron is normally the least effective; that is, the ordinary type of aileron. If, however, the possible aileron angle is arranged to be *very* largely increased, the spinning motion is affected. The following account of a model dropping experiment at Farnborough will serve alike to indicate this aileron effect and to illustrate the nature of this mode of this form of experimentation. A 1/20th scale model of a Bristol Fighter was used. Ailerons were fitted to the upper and lower starboard wings and provision was made for moving any of the controls at a predetermined time during the spin. This was done by means of a spring loaded dash pot with a variable air leak. The model was released from a swinging pendulum just under the roof of the balloon shed in such a way that it was at release moving horizontally at its stalling speed with 10° of sideslip. It was launched with full left rudder and with the elevators fully up. With ailerons neutral the model completed 4½ turns of a left-hand spin in as many seconds. A further test was then made with control release set to move the outer aileron to an angle of 65° after an interval of 2½ seconds, with the result that the model ceased spinning within about half a turn.

The flat spin with this model was found to be one of very small radius, the mean angle of incidence appearing to be about 75° (the smallness of the radius in flat spins is of course well known, as is the consequent extraordinary difference sometimes found in the centrifugal forces acting on the pilot's and observer's bodies). Whereas in the ordinary spins of this model four and a half turns were made in four and a half seconds, in the flat spin, eleven turns were completed in five and a half seconds, and the axis of the spin instead of being well ahead of the nose came close to the centre of gravity.

Sometimes the little model was made automatically to centralise its controls during the fall, and the effect of this on the resulting motion was studied. Sometimes the models were set into a spin at the moment of release and the effect of variations in wing arrangement ascertained. In this way the effects of stagger, wing gap, decalage, and other features can be studied rapidly This

* Continued from p. 136.

has proved a useful method of investigation; it is safe, speedy, and very picturesque.

The other way of using models is to mount them in a wing tunnel and measure the forces which arise during the spinning motion. This is an exceedingly difficult experiment to carry out for the motion is complex, and it is no very easy matter to lead out the connexions which will enable the couples about each of the axes to be measured. It is not so difficult to measure the moment about the autorotation axis, the axis of spin, and this investigation is now in hand. The amount of the autorotation moment will of course give a measure of one at any rate of the forces tending to keep the airplane in the spin. The fuller experiment will, however, be undertaken in one of the N.P.L. wind tunnels as soon as the apparatus is ready.

Yet another form of wind tunnel test is due to Prof. Betz. This consists in measuring the rate of autorotation of a hollow aerofoil in which air can be allowed to pass internally from one wing tip slit to the other. These slits are placed in the upper surfaces and are parallel to the wing spar. Measurements have been made in Germany with these slits in different symmetrical positions and with or without a free internal air passage. The result is found that with the best arrangement there is at some cost of maximum lift a distinct decrease of the tendency to autorotation, and that this gain is directly associated with the free lateral passage of the air inside the wing. The following explanation of the action is given by Schrenk.[1] It is known that the motion of a rotating wing produces different angles of incidence at corresponding sections of the two ends, such that at the rising end the flow adheres to the upper surface whilst at the other end it tends to break away. For this reason the lift on two such corresponding elements is not necessarily the same, and in no case will the pressure distributions on the elements coincide. The flow from slit to slit through the wing is caused by such differences of pressure, and acts in such a way that at the wing tip at which the flow breaks away from the surface the flow is improved by suction of the boundary layer towards the interior of the wing; at the other end the flow is rendered worse by the air streaming out of the slit. It follows that any autorotation there may be will tend to be much slower and therefore more controllable.

The first full scale experimental and mathematical investigation of spinning was that by Lindemann, Glauert, and Harris. This work was carried out at Farnborough, and in their report to the Aeronautical Research Committee, dated March 1918, full details of this very courageous investigation are given. It is noteworthy that they made use of streamers attached to outrigged spars, and by their use measured for the first time the angle of incidence.

At the present time full scale research on spinning is included in the research programme at Farnborough. Indeed, the phenomenon is one which requires continuous study since each new development of airplane design may bring in some new aspect of the spinning problem.

In addition to this work there are the normal 'performance tests' on spinning which are carried out at Martlesham on all new types of airplane, during which each machine is spun through not less than eight turns to right and to left with varying positions of the centre of gravity, and no machine is passed for service unless it can be readily bought out of such a spin by the normal use of the controls. Intrepid pilots are needed for such tests on new machines, and it does sometimes happen that the obstinacy of the airplane in its motion requires the pilot to resort to his parachute, though, curiously enough, the mere rising of the pilot in his seat with the view of leaving the airplane has on more than one occasion caused the machine to come out of its spin at once! Sometimes the engine throttle can be used as a control on the spin, since change of engine torque will of course tend to roll the machine to a new attitude. Spinning tests have also been undertaken by the Cambridge University Air Squadron with the help of Prof. Melvill Jones. In these tests the wool tuft method due to Flight Lieutenant Haslam has been found of use. This consists of mounting numerous little tufts of wool on the upper surface of the wing and watching (in some cases taking cinema records of) what happens when the machine gets into various attitudes. As I have already mentioned, a rather similar method of experiment has been used at Farnborough, in which long streamers have been attached to the wing tips or other airplane parts and their motion studied in the spin.

It is not pretended that the behaviour of these streamers is understood, but it is hoped that the continuation of the research will bring such knowledge as will enable these results to be usefully interpreted. As an example of the complexity the following extract may be given from a Farnborough report:

> It was decided to investigate the practicability of recording the direction of the air flow over various parts of the airplane while spinning by photographing streamers. Outriggers were fixed to the lower planes. These were attached to the front spars and projected two feet beyond the wing tips, fabric streamers four feet in length being attached to the ends. Streamers were also fixed to tubes projecting 9 inches in front of the leading edge of the tail plane three feet from the plane of symmetry. . . . The inclination of the wing tip streamers was found to vary in phase with the oscillation of the spin. In the left hand spin the mean inclination of the inner streamer to the wing cord was 73° and that of the outer streamer 24°. . . . The photographs of the tail plane streamers were less satisfactory, and it was only possible to determine the inclinations of the inner streamer; . . . the mean inclination of the streamer was about 15° from the *Z* axis towards the rudder, which implies a natural flow at the streamer which is opposite in direction to that caused by the rotation of the tail. An inward sideslip of the order of 20° would satisfy these conditions.

These experiments show that in nearly flat spins where the rate of rotation is high and the vertical velocity small, the tail unit has to operate in air previously disturbed by the passage of the wing tips. This disturbance of course does not add to the effectiveness of the tail control organs. The

sole merit to be found in the motion in a flat spin is that the vertical velocity is quite often so small that little more than a crashed under-carriage results from hitting the ground. In this type of spin the wings are acting rather like those of an autogiro, but very inefficiently, of course, since one wing is entering the air by its trailing edge.

Another method of full scale test making use of a kinematograph camera on the ground has been employed in Germany. The size of the image on the film gives a rough measure of the distance away of the airplane, whilst the angular distance and the time are readily noted. Cinema methods are also in use in U.S.A. (A cinema film furnished by the National Advisory Committee for Aeronautics of America, and showing a seaplane performing a flat spin, was shown at the end of the lecture.)

When new types of airplanes are tested at the R.A.F. Station at Martlesham in order to ascertain their performance under all conditions of flight, they need to be spun both to left and right and not merely in one direction only. This is because of the influence of the direction of engine rotation upon the slip stream, and because of the gyroscopic couple due to the rotating engine and airscrew which will try to depress the nose of the craft in one case and raise it in the other. Recovery is required to be simple and sure even when this gyrostatic couple assists the inertia couple in opposing the pilot's actions.

At first it was not realised that an airplane that could easily be brought out of a spin of a few turns would not necessarily be easily brought out if the spin were continued for a large number of turns. The reason for this is not certainly known, but it can scarcely fail to be associated with sheer lapse of time allowing the forces opposing recovery gradually to raise the nose of the machine, and so get it into a condition in which for one reason or another the pilot's controls are less effective. Nor has it long been realised that the effect of small differences in the actual mode of entry into the spin can persist even after many turns, and so sometimes render recovery unexpectedly difficult. This explains the previously puzzling question why pilot A's report on the controllability of a given machine in a spin differs entirely from pilot B's. The explanation no doubt is that the two pilots follow a slightly different technique in putting their airplanes into spins. For research investigations it is feasible always to employ the same technique, but during the performance testing of new aircraft consideration must be given also to what is likely to happen when this definite technique is not followed.

THE WOOF.

A recent discovery is the 'Woof'. This is a word coined by the Martlesham pilots to describe the unsteady form of spin sometimes met with in which there is an oscillation in pitch combined with an oscillation in spin, so leading to a very uncomfortable motion. This is so little understood at the moment that one of the Air Ministry Scientific Research Staff in a recent report had to admit that "the origin of the air forces necessary to maintain this fluctuation in attitude is at present a mystery, and this obscurity is typical of the present stage of the spinning problem". In one recent test the jerkiness of the motion could be distinctly seen from the ground. The unevenness of rotation was accompanied by an appreciable oscillation in pitch, the rate of rotation decreasing as the nose of the aircraft rose and increasing as it fell. Accelerometer records showed the mean period of the pitch oscillation to be rather more than 5 seconds, whereas the corresponding mean times per turn of these spins was only about 4½ seconds. The complexity of the motion may be inferred from the different periodic times.

It may be of course that, long before these highly complex phenomena are fully understood, some novel constructional device will be produced which will at once render all spins controllable. A device which went so far as to prevent spinning altogether would probably not be desirable since it might also prevent the useful manœuvre of the 'roll'.

It is true, I fear, that in these matters we ask a great deal. We ask that the airplane shall do everything that the pilot wishes, but shall have no will of its own other than a moderate wish to remain the right way up, but even this not to be thrust too prominently before the pilot's notice. We want a docile machine. We want, in fact, an amount of docility which though often sought is but rarely found, even in humanity.

[1] *Z.T.M.*, Nov. 14, 1929.

Obituary.

MR. W. J. GREENSTREET.

BY the death of William John Greenstreet on June 28 the mathematical world loses, not an explorer or a geographer, but, if the metaphor may be pressed, a traveller familiar with a larger variety of landscape than almost any of his contemporaries. Born in 1861 and educated at St. John's College, Cambridge, he was an assistant master from 1882 until 1889, and headmaster of Marling School, Stroud, from 1891 until 1910, when he retired to Burghfield Common, near Reading, with the intention of devoting himself to literary work. For many years he had been a regular contributor to *Notes and Queries* and to the *Westminster Gazette*, and editor of the *Mathematical Gazette*, and he had every reason to anticipate a life congenial to his frugal tastes.

The War, however, put an end to Greenstreet's work for the *Westminster Gazette*, and at the same time raised the cost of living to an unforeseen level. The result was an extension of an activity which he had created, namely, the supervision of the

education of pupil-teachers in village schools; the value of this work, which he had begun voluntarily in the schools nearest to his home, came to be recognised by the county educational authorities, and soon from eighty to ninety students looked to him for guidance, and he was known throughout the countryside, reaping in labours which earned him a livelihood the reward of spontaneous help given to his neighbours in happier years.

Meanwhile his editorship of the *Mathematical Gazette* continued, and it was this which made Greenstreet's name familiar to every mathematician in England. While the *Gazette*, as befits the organ of the Mathematical Association, has been concerned primarily with problems of school teaching, from elementary arithmetic to scholarship analysis, the characteristic features of the journal have revealed the editor. Greenstreet always desired to attain, and believed that all teachers benefit if they can attain, to such appreciation of current advances in mathematics as is possible without intensive study of special branches; he therefore encouraged ample notices of treatises, Continental and American as well as English, far beyond the range of school mathematics, until the review pages of his *Gazette* were admitted to be among the best in the world. Also, he had an immense knowledge of the personalities of literary, scientific, and social history, the product of omnivorous and rapid reading and a retentive memory; one result was that his own reviews of historical works, now tracing cross-currents of influence, now bringing a dead name to life by an anecdote or an epigram, enriched alike the books with which they dealt and the journal in which they appeared; another result was that every spare corner of the *Gazette* was filled by a 'gleaning', some quaint incidental reference to mathematics or to a mathematician found perhaps in classical literature, perhaps in a daily newspaper. In short, Greenstreet gave a character and a standing to a periodical which might have become nothing but a pedagogical mouthpiece; and this was the achievement that was acknowledged when the completion, in 1929, of thirty years of his editorship was the occasion of a testimonial to which some two hundred mathematicians subscribed.

Of Greenstreet's literary and musical interests it is impossible to speak here, but mention must be made of his enthusiasm for De Morgan. Once he was addressed as the De Morgan of his time, and this compliment pleased him as no other ever did. In wealth of biographical and bibliographical knowledge each was indeed unrivalled in his day, and this was perhaps all that the comparison was intended to convey, but one may recognise also in the two men the same sense of honour and the same sense of humour. Of the multitude of correspondents and contributors who were grateful for Greenstreet's help and counsel, few could claim to know him personally. His friends hold the memory of a man who never spoke a wounding or complaining word, of one who was prodigal of his knowledge, forbearing in his judgments, and ready with his laughter.

E. H. N.

Mr. G. H. Curtiss.

It is with great regret that we record the death at Buffalo, U.S.A., on July 23, after an operation for appendicitis, of Mr. Glenn Hammond Curtiss, whose name, as a pioneer of flight, will always be associated with those of his countrymen, Langley and the Wright brothers. Curtiss, who was born at Hammondsport, New York, was only fifty-two years of age and was therefore somewhat younger than either of the Wrights. Like them, he began life as a bicycle repairer and then turned his attention to motor cycles, motor racing, and engine making.

It was the chance order of an engine for an airship which stimulated Curtiss's interest in aviation. The Wrights had first flown in 1903, Santos Dumont in 1906, and experiments were being made by many other inventors. It was, however, the performances of Orville Wright at Fort Myer, U.S.A., and of Wilbur Wright at Le Mans, France, in 1908 which definitely established the aeroplane as a practical means of transport. That same year, flights were made by other pioneers, among whom was Curtiss. In the summer of 1908 he flew his machine, *June Bug*, a distance of a mile, and this success he followed up by competing with distinction at the famous Rheims meeting of 1909, while in 1910 he won a prize of 10,000 dollars for a flight from Albany to New York, two places associated with the historic voyage of Fulton's steamboat *Clermont* a hundred and three years before.

Continuing his work, Curtiss in 1911 produced the first hydroplane, and by 1914 he had taken up the serious construction of aircraft and had built a multi-engined flying boat. The vast extension of flying during 1914–18 led to the execution of many orders for Great Britain, Russia, and the United States, and to-day the firm Curtiss founded is one of the largest organisations of its kind in the United States.

Curtiss also came into prominence through the Hammondsport trials of the Langley flying machine, which had been tried, but without success, in 1903. Langley died in 1906 but his machine was preserved at the Smithsonian Institution, of which he had been the secretary. Placed in the hands of Curtiss in the spring of 1914, the machine was modified to a certain extent, and on May 28, 1914, Curtiss flew it a short distance. Other trials followed with a Curtiss engine fitted to the machine. These events, together with the wording of the label of the machine as it stood in the museum, unfortunately led to a bitter controversy. Curtiss himself at the time was defendant in a lawsuit concerning the Wright patents, and it is generally agreed that the machine should never have left the museum. The action of the authorities of the Smithsonian Institution has often been criticised, but a short time ago the present secretary, Dr. C. G. Abbot, published a pamphlet in which an effort was made to do justice to all concerned.

News and Views.

THE economic difficulties which beset agriculture has focused public attention on the industry, and to judge by the many remedies which have been put forward, it would not be surprising if the general public and even the farmer himself concluded that science as applied to agriculture has failed in its efforts to improve the lot of the agricultural producer. It is fitting, therefore, that a considerable proportion of the programme of Section M (Agriculture) for the Bristol meeting of the British Association will be devoted to the discussion of two subjects, namely "Veterinary Science and Agriculture" and "Management of Grass Land", the economic importance of which it is not easy to exaggerate. The former is the subject of the presidential address, to be delivered by Dr. P. J. du Toit, who has given a new lead to veterinary thought, and by his work on the relationship of nutrition to the incidence of disease has opened up a field which may enable the sorely pressed farmer to minimise the enormous losses caused to his herds and flocks through the ravages of disease. A full morning session is to be devoted to the address and the subsequent discussion, and amongst those who will take part are Dr. W. H. Andrews, Major Walter Elliot, M.P., Sir Robert Greig, and Dr. J. B. Orr. To the discussion on grass land management, Mr. Jenkins of Aberystwyth will present the plant-breeders' viewpoint; Dr. Orr and Mr. Godden, of the Rowett Research Institute, the nutritional aspect; and Prof. Hanley of Newcastle will deal with the matter from the animal side. In accordance with the usual practice in the Section, an afternoon session will be devoted to a series of short communications outlining the scope and character of the agricultural work undertaken by the University of Bristol. In addition there will be several technical papers and Sir John Russell will open a discussion on the "Influence of Fertilisers on the Yield of Crops".

THE programme of the Ninth International Horticultural Congress, which is to be held in London at the invitation of the Royal Horticultural Society on Aug. 7–15, has now been issued to members. The main subject for discussion at the Congress will be "Propagation, Vegetative and Seminal", and papers on this subject will be given in the Greycoat Hall on Friday, Monday, and Wednesday, Aug. 8, 11, and 13; on intervening days the members of the Congress are offered the choice of a very interesting series of excursions, including visits to various private gardens, to the Royal Horticultural Society's Gardens at Wisley, to the various research stations of interest to horticulturists, and to many of the big commercial nurseries, plantations, etc. Papers for the Conference are so numerous that the executive committee has arranged for three meetings to proceed simultaneously on each of the days given to papers. The papers have therefore been grouped so far as possible under three heads: (1) Propagation, (2) pomology, and (3) tropical and sub-tropical horticulture. Under each section communications are offered by British, American, and European workers, and many topics of considerable scientific interest are represented on the programme.

IT is only possible here to indicate some of the main items for discussion at the Ninth International Horticultural Congress. Vegetative propagation from the point of view of plant anatomy will be discussed by Dr. van der Lek (Holland) and Prof. J. H. Priestley, whilst practical and experimental methods will be discussed by Dr. R. J. W. Graham and Mr. L. B. Stewart from Edinburgh and Miss Mary E. Reid and Dr. Zimmerman (U.S.A.). Mr. Niels Esbjerg (Denmark) will describe some of his experiments in inducing scion varieties to grow upon their own roots. The forcing of dormant buds will be discussed by Dr. Denny and Prof. Loomis (U.S.A.), whilst British workers will discuss polyploidy in connexion with graft hybrids, sterility and vegetative mutations in potatoes. The directors of the East Malling and Long Ashton Research Stations are to speak in the Pomological Section, where also Russian, Polish, Czechoslovakian, and American contributions are promised. Italy, France, and Switzerland share an afternoon that will be given to the propagation of the vine and olive. British communications in the Tropical and Sub-Tropical Section will deal with horticultural work in the Dominions and Colonies, whilst America, Russia, and the Dutch East Indies will also contribute in this section. Dr. W. F. Bewley (Cheshunt) and Mr. G. Jacobsen (Norway), both interested in glasshouse propagation, will deal with the subject of the heating of soil in hot beds by electricity; this subject is, perhaps, appropriately placed under the 'tropical' section. Two papers on seeds will be taken in the last session of the Pomological Section, Prof. Work (U.S.A.) discussing scientific problems in connexion with vegetable seeds, and Prof. C. Tschermak-Seysenegg (Austria) discussing "Xenia in Leguminoseae".

THE serious floods that occurred in the neighbourhood of Whitby on July 22–23 last recall to some the disaster of ten years ago at Louth (Lincolnshire), when 22 persons lost their lives and damage estimated to exceed £100,000 was suffered by that town in a thunderstorm of exceptional severity on the afternoon of May 29, 1920. Meteorologically the two disasters were very unlike. In the Louth storm a belt of cold easterly winds over the North Sea opposed the advance of warm and moist southerly winds advancing across England. There was enough sunshine during the morning to raise the temperature of the southerly winds far enough to produce extreme instability, the easterly winds remaining cold owing to the low temperature of the waters of the North Sea, and the result was apparently an upward movement of the forward part of the warmer air stream and a thunderstorm which was estimated to have at one time a diameter of more than 60 miles. The storm lasted only a few hours, but during that time as much as 121 mm. of rain fell at one place near Louth, the final catastrophe

being apparently precipitated by the breaking down of a temporary dam formed of uprooted trees and other debris, which had held up a great volume of water on the outskirts of the town.

THE recent Whitby floods, on the other hand, were the result of prolonged rainfall of comparatively moderate intensity, due to an almost stationary depression off the east coast of England. Strong northerly winds prevailed throughout, and probably gave very much greater amounts of rain on the North Yorkshire moors than at coastal places of low elevation or inland stations referred to below lying to the west of the wettest region, which was probably the Cleveland Hills. The following totals refer to the period 17 h. or 18 h. G.M.T. on July 20 to 7 h. or 9 h. G.M.T. on July 23:

Scarborough	108 mm.	Ilkley	64 mm.
Bridlington	100 mm. (approx.)	Harrogate	57 mm.
Cleethorpes	65 mm.		

It is not clear from the accounts so far available of these floods to what extent floating wreckage may have assisted the river Esk to overflow its banks, but where rainfall representing the equivalent of about ten weeks of the normal precipitation is concentrated into such a short space of time, partial blockage of the normal drainage channels is to be expected. There is no evidence so far of there having been any particularly rapid rate of fall of rain at any one stage, and the amount measured in the night and early morning of July 22-23 just before the weather mended had been exceeded in a like period 48 hours earlier at all the stations mentioned above except Ilkley.

HAVING regard to the stringent financial conditions obtaining at present in Great Britain and their inevitable reflex upon employment, a welcome must be extended to any scheme which will, or even may, promote the utilisation of home products. It is opportune, therefore, to direct attention to the work of the National Benzole Association, the Research Committee of which has recently issued its seventh report. Despite the momentary restriction of work imposed by removal to convenient centralised premises, continued progress has been made in several directions: but the investigation of resin formation in benzoles and the thorough testing of the possibility of stabilising comparatively crude benzoles against resinification during storage and of afterwards utilising such benzoles satisfactorily as motor fuels, have been regarded as of primary importance. This problem of resinification, not being confined to benzole, has consequently interested workers in other fields. Thus, vapour phase cracked petrols contain appreciable amounts of unsaturated hydrocarbons and show a strong tendency to gum formation; moreover, on storage, they rapidly lose the appreciable anti-knock superiority which they possess over straight run petrols.

ALTHOUGH there are certain minor points of difference between the gumming of benzoles and of cracked petrols, in the main, similar conclusions are drawn in the two cases as to the mechanism of gum formation and the possibility of preventing deterioration of motor fuels containing unsaturated hydrocarbons, by the addition of small quantities of certain substances capable of inhibiting the oxidation and resinification of those bodies. More practically, extensive road trials have shown that comparatively crude benzoles, stabilised by the presence of 0·03 per cent of mixed cresols, are little if at all inferior to acid refined benzoles in their freedom from gumming in engines. The chapter is not yet completed, for the effects of the present inhibitor may be rendered void by the presence of small amounts of impurities, accidental or natural.

A SELECTION of the zoological and botanical specimens collected during Lord Howard de Walden's recent expedition to Uganda and the eastern Belgian Congo was exhibited at the meeting of the Trustees of the British Museum held at the Natural History Museum on July 26. The collection, which is the gift of Lord Howard de Walden to the National Collection, is one of the most important accessions received by the Museum of recent years. The expedition left Fort Portal for the Semliki Valley on Feb. 17 last. Collecting was carried out within twenty miles of Lake Albert, and afterwards in a south-westerly direction to the Semliki Valley, crossing over into the Congo on Mar. 7. The route then led up the western escarpment of the Semliki Valley to Mboga and then west into the Ituri Forest. On Mar. 29 the expedition divided, one party proceeding south to Beni, the other going west to the Ituri River. Both parties came out of the Congo via Irumu and crossed Lake Albert into Uganda on the homeward journey during May. Lord Howard de Walden, in addition to spending some time with the expedition in the forest area, made a special trip to the Birunga Mountains lying to the north-east of Lake Kivu, with the object of photographing the eastern gorilla (*Gorilla gorilla beringeri*) and its habitat. The personnel of the expedition to the Ituri and Semliki Valleys, in addition to Lord Howard de Walden and Dr. Avery, consisted of Mr. R. Akroyd, who as well as organising the expedition did valuable work as a collector of the larger mammals, Capt. F. A. B. Holloway, who concentrated chiefly on invertebrates, making a large collection of butterflies and other insects, and Mr. R. W. Hayman, a member of the Museum staff, who specialised on the medium-sized and small mammalia. Two white hunters accompanied the expedition as guides and supervisors of the 'safari'. The mammals collected number 427 specimens, including 67 monkeys, 110 bats, 71 carnivores, 23 ungulates, and 147 rodents. The reptiles and amphibians collected number 65 specimens representing 31 species in all. Many birds and a very considerable collection of invertebrates was also made.

THE complexity of the problem of the adaptation of varieties of farm crops and the value to the practical farmer of the results already obtained by the National Institute of Agricultural Botany were the theme of the address delivered by the chairman of the Institute, Sir Frederick Keeble, at the annual general meeting of the Institute held at Cambridge on

July 25. Choice of variety or strain, Sir Frederick said, is as potent a factor for improvement in the plant world as in the animal; and it has the merit of being the cheapest remedy for some at any rate of the ills of agriculture. The right sort of seed need cost the farmer no more money than the wrong, but there is generally a difference of ten per cent in the results and often very much more. The discovery of the best variety for each of the innumerable combinations of soil and climate which occur in the British Isles is the formidable task to which the Institute has set its hand, and a valuable nucleus of information has already been formed. The fact that in the famous wheat districts of Essex the best-paying varieties are grown on only forty per cent of the area is a measure of the need for extending the investigations and in particular the collection of records from farmers themselves. No more fruitful task, concluded Sir Frederick, could be undertaken by the Ministry of Agriculture than the provision of wide and effective publicity for the knowledge won by the National Institute of Agricultural Botany and kindred institutions. The Director of the Institute, Mr. Wilfred H. Parker, described the manifold ways in which the Institute has set about its work. Co-operation is the keynote of its success, and this is being given generously by universities, agricultural colleges, farm institutes, plant breeders, county agricultural organisers, research institutions, the National Farmers' Union, the National Association of British and Irish Millers, the Institute of Brewing, and numerous other bodies and individuals.

THREE interesting reports are included in the *Journal of the National Institute of Agricultural Botany*, vol. 2, No. 3, namely, those of the trials of spring-sown barleys, spring-sown oats, and maincrop potatoes. Each report marks the end of a series of trials continued over a number of years, and, as such, represents the considered conclusions of the Institute. The barley variety trials were carried out at six different centres, yield, quality of grain and malt, disease resistance, and differential response to intensive manuring being taken into account. Spratt-Archer and Plumage-Archer 1924 are definitely indicated as giving the highest average return per acre, the former variety being most suited to light and the latter to heavy soils. Of the different varieties of spring oats none showed any marked preference for light or heavy land, or, except as regards strength of straw, for land in high or low condition. In general, taking into consideration yield and both feeding and market value of the grain, farmers are advised to grow either Victory or Golden Rain, but if the soil is rich and lodging is likely to occur, Thousand Dollar is more suitable. Abundance is a further good variety, but this should not be grown on rich land. Oat trials were not carried out in the north of England, so that these recommendations should be applied with caution in that district. A large number of varieties of maincrop potatoes were tested at Ormskirk, Kirton, and Truro. Kerr's Pink, Arran Banner, and Majestic are decidedly the best croppers, although as regards earliness Ally has the advantage. All four varieties are, however, recommended. Golden Wonder and King Edward retain popularity on account of their quality, but their yield is inferior to that of the above-named varieties.

IN an authoritative article on "Unemployment" contributed to the July-September number of the *Political Quarterly*, Sir William Beveridge states that the continuance of unemployment does not invalidate the diagnosis of unemployment made by the Poor Law Commission of 1903-9 or the policies adopted in 1909, because these have not been carried through. Unemployment insurance, with all its devices for reducing claims to benefit, has been transformed into unemployment relief. The Labour Exchanges, after a hopeful start, were sunk in a flood of War tasks and post-War doles and they are only now reviving as employment agencies though their special and most needed services of de-casualisation have gone by the board. Sir William Beveridge points out that unemployment to-day contains two new features. A part of it is due to changes in industrial structure. Another part is almost certainly due to disequilibrium between wages and productivity, following the abnormal rise of real wages since the War. A further possibility is that of a permanent shift in the economic balance of the world, transferring industry from the coal of Great Britain to competitive sources of power elsewhere. Effective organisation of the labour market is even more needed to-day than it was twenty years ago. In so far as unemployment to-day is due to permanent changes of industrial structure involving changes of location, rather than to transient depression, it is more important than before to make labour mobile, locally and between industries.

IN a paper entitled "Economic Quality Control of Manufactured Product", presented before the American Association for the Advancement of Science last December, Mr. W. A. Shewhart advocates the use of modern statistical processes in practical manufacturing work, and particularly for judging whether variations in manufactured material are due to chance. The application of statistical methods in commerce and industry was discussed in a leading article in NATURE of Jan. 9, 1926, when it was pointed out that it would be unfortunate if those responsible in practical affairs failed to take advantage of the improved statistical machinery available. It is satisfactory to find that this statistical machinery has been used successfully in connexion with the work of the Bell Telephone System to show where the cost of inspection and of rejections can be reduced; there has also been a consequent improvement in the quality of the articles produced. The author does not describe in detail the statistical methods he used, possibly because he was afraid of lessening the appeal of his paper to practical men who might be confused by statistical technicalities. The paper has been reprinted in *The Bell System Technical Journal* for April 1930 and is well worth reading.

FEW people realise how flourishing the broadcasting industry is in the United States. Last year, more than a hundred million pounds was spent on

radio instruments. Eight years ago there were 60,000 receiving sets; to-day there are about ten million. In England, many who possess good radio sets scarcely ever use them and look forward with indifference to the coming of television. In the United States, however, there are many enthusiasts who are looking forward eagerly to improved methods of broadcasting the older arts and to the introduction of television. In *World-Radio* for July 25 there is an interesting account of the 'radio city' in New York, work on which will start this autumn. It will be built on Manhattan Island and will take all the space between 48th and 51st Streets and Fifth and Sixth Avenues. The estimated cost is fifty million pounds, and as it is intended to be as permanent as a cathedral, it will take three years to complete. Portions of 49th and 50th Streets will become tunnels. A sixty-story tower will rise above the main buildings to house the studios and office suites. This radio city will have four large theatres, the largest being capable of seating 7000 persons, a motion picture theatre with 5000 seats, an auditorium for comedy and another for drama, and probably a great concert hall. In addition, there will be a bank and shops with frontage on Fifth Avenue. A noteworthy feature is the faith which the supporters of the radio city have in the future of television. They believe that all the present experimental difficulties will be overcome in a few years and that sight and sound broadcasting will be transmitted to homes and hamlets all over the American continent and possibly all over the world.

ONE of the developments of British ornithology in recent years has been the identification of northern geographical races of birds, examples of which, captured in Britain, have shed fresh light upon migratory movements. Greater definiteness is likely to be added to knowledge of these movements by the institution of systematic marking of birds in Iceland, from which some useful records have already been obtained. In the July number of *Discovery*, P. Skovgaard, the Danish ornithologist, gives a first account of the recovery of 124 birds out of 4464 ringed. Of these, 86 were captured away from Iceland and 54 in Britain. One cannot help being struck by the great differences in the migratory habit of different birds revealed even by these limited results. Thirty-one widgeon were recovered and twenty-three golden plover, but whereas the former ranged over a wide area in its southern migration, from the eastern coast of North America to central Russia, the latter moved in a narrow path which probably brought every individual within the compass of the British Isles. The value of the results of the Icelandic work is the greater because some of them refer to birds the headquarters of which are confined to northern latitudes. Comments on Skovgaard's data are contributed by E. M. Nicholson.

INFORMATION has been received that the Quebec Public Service Commission has awarded to the Shawinigan Water and Power Company a "certificate of public necessity and convenience" authorising the commencement of operations in connexion with the development of hydro-electric power at Rapide Blanc on the Upper St. Maurice River, for the power rights of which and certain adjacent sites a seventy-five years' lease has just been entered into. The head of water to be developed at Rapide Blanc will be approximately 110 feet, and the primary installation will make provision for the generation of 160,000 horse power, at an estimated cost of about 18,000,000 dollars. The complete installation on this site will be approximately 240,000 horse power, at an estimated cost of 20,000,000 dollars. The Company is under obligation to commence constructional works forthwith and to develop at least 100,000 horse power by July 1933. As soon as 75 per cent of the primary power at Rapide Blanc becomes available, construction on the second site will be begun under similar conditions, as also will third and successive developments. In connexion with the above projects, including power transmission, as much as 94,000,000 dollars will probably be expended and the total power realised is expected to reach 1,208,000 horse power.

A SECOND bulletin on spectrum analysis has just been issued by Messrs. Adam Hilger, Ltd. It refers mainly to quantitative metallurgical analysis, and half of the pamphlet consists of a tabulated summary of recent work of this type, with references to original papers and a statement of the smallest amounts of the materials experimented on which were estimated in a given matrix. Limits of error are occasionally, but not often, given. The technique used in the several investigations is also outlined. Much of the work referred to has been carried out in Messrs. Hilger's laboratories and in other laboratories with which the firm is in touch, and details of some of this work have not yet been published. A bibliography of recent papers on spectrum analysis follows, including a brief summary of each paper mentioned. Special notes are given on the use of the spectrograph in the rapid assay of lead, copper, and zinc for compliance with certain British and American standard specifications with regard to purity. The pamphlet concludes with accounts of sundry metallurgical applications of spectrum analysis, and a note on physiological, pathological, toxicological, and pharmaceutical applications.

A CONSIDERABLE difference in price exists between the native pearl and the 'culture' pearl and yet so far as visual examination goes there is no distinction between them. The native pearl has originated from a haphazard intrusion of some irritant, while man has been responsible for its insertion in the other instance; in both the outer coat is produced by the mollusc in the same way. The disparity in value makes it desirable to have means of ascertaining the nature of the interior of the pearl. Recently Mr. Jacob Vos, the well-known Dutch jeweller, in conjunction with Philips Lamps, Limited, 145 Charing Cross Road, London, W.C.2, has devised an X-ray apparatus for testing pearls. It makes use of the fact discovered by Dr. von Laue that these short waves are interfered with by a crystalline structure, the

character of the resulting figure on a fluorescent screen or photographic plate being dependent upon the symmetry of the structure. In the present instance the genuine pearl shows a characteristic hexagonal figure entirely different from the figure yielded by a ' culture ' or imitation pearl.

THE fifth ordinary general meeting of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, was held on July 9. The Chairman, Sir Charles McLeod, reviewed the work of the year. Sir Ronald Ross, Sir William Simpson, Sir Aldo Castellani, and D. Shaw-Mackenzie have continued their researches, and a new department in charge of Sir Malcolm Watson has been created to deal with malaria and its problems. Short courses for planters on malaria control have been held and much propaganda work on this subject has been prosecuted. The Institute has no endowment fund except a few hundred pounds and is dependent for its income upon contributions from companies and donations and subscriptions, an increase in which is appealed for.

THE Frederick G. Donnan Fellowship in chemistry, tenable for three years at Johns Hopkins University, Baltimore, has been awarded to Mr. Alkin Lewis, of King's College, London.

DR. H. A. HARRIS, assistant professor of anatomy at University College, London, has been awarded the Alvarenga Prize for 1930 of the College of Physicians in Philadelphia for his researches on bone growth.

BY an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Sir Charles Sherrington, Waynflete professor of physiology in the University of Oxford, and Dr. J. A. Arkwright, honorary bacteriologist to the Lister Institute of Preventive Medicine, have been appointed members of the Medical Research Council in succession to Sir Frederick Hopkins and Sir Charles Martin, who retire in rotation on Sept. 30.

DR. H. R. LANG has been awarded the Institution of Petroleum Technologists fellowship for a further period of one year, to continue his researches on "The Determination of the Variation of the Specific Heat of Typical Crude Oil with Temperature etc". This fellowship, of the annual value of £300, is granted for research work in technical and scientific problems which have a direct bearing on the petroleum industry, and applications for the 1931–32 award should be on a form which can be obtained from the Secretary of the Institution, and should be in his hands not later than June 1, 1931.

THE Trustees of the Beit Fellowships for Scientific Research founded and endowed in 1913 by Sir Otto Beit, Bart., have awarded fellowships, tenable at the Imperial College of Science and Technology, South Kensington, for the two years 1930–32 of the value of £250 a year, to the following: Mr. B. W. Bradford, Imperial College, for research upon the electrical condition of hot metallic surfaces when promoting the combustion of carbonic oxide; Dr. G. M. Richardson, for research into the further application of electrometric methods and theory to the study of problems of biological interest; Mr. G. H. Cheesman, for research on the electron distribution and structure of the halogen oxides.

ARRANGEMENTS are again being made this summer under the auspices of Prof. Patrick Geddes for a vacation tour of historical and archæological interest in the Dordogne. The tour will last from Sept. 12 until Sept. 25, of which period one week will be devoted to a stay at Domme for the study of the geography and objects of historical interest of the neighbourhood, and one week will be given to the prehistoric caves in the neighbourhood of Les Eyziès. A special study will be made of the everyday life of the Perigordian in relation to his geographic environment, under the guidance of M. Réclus, and at Les Eyziès M. Peyrony, by permission of the French Government, will act as guide. The cost of the tour will be £16 : 10s. Application for admission should be made to Miss Moya Jowitt, 33 Gordon Sq., W.C.1.

THE ' complete programme ' of the Anthropological Congress to be held in Portugal and summoned for September next by the Institut International d'Anthropologie of Paris, has now been circulated. The proceedings will be divided into four sections: morphological and functional anthropology with ethnology; palæontology with prehistoric archæology; eugenics and kindred subjects; ethnography, including linguistics, folklore, religion, and human geography. The contributions include 36 from Portugal, 11 from France, 8 from Poland, 6 from Spain, 4 from Holland, 3 from Switzerland, 2 from Russia, one each from Belgium, Finland, Canada, United States, and Brazil. Great Britain, Germany, Austria, Italy, and Scandinavian and south-east European countries are unrepresented.

A PRELIMINARY programme has been issued of the seventh annual conference of the Association of Special Libraries and Information Bureaux to be held at New College, Oxford, on Sept. 19 22, under the presidency of Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology. The programme includes general sessions to hear an account by Brig.-General Magnus Mowat of the year's work of the Association, and a paper by Herr A. Schlomann on the organisation of information in Germany. The sectional meetings will deal with the dissemination of information by exhibition and display (Sir Henry Lyons, Dr. F. A. Bather, and others), animal welfare and its dependence on accurate information (Capt. C. W. Hume), the inadequacy of the alphabetical subject index (Prof. A. F. C. Pollard, Dr. S. C. Bradford), surveys and planning (Mr. C. C. Fagg, Mr. G. L. Pepler, Mr. S. K. Ruck), training of students (Mr. G. F. O'Riordan, Mr. B. M. Headicar), technical English (Mr. C. C. Wharton).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A director of the Rural Industries Bureau—The Director, Rural Industries Bureau, 6 Bayley Street, W.C.1 (Aug. 8). A graduate master for electrical engineering at the

Sheerness Technical Institute and Junior Technical School—The Principal, Technical Institute, Sheerness (Aug. 11). A university lecturer in agricultural chemistry (soil science) at the School of Agriculture, Cambridge University—The Secretary, Appointments Committee, School of Agriculture, Cambridge (Aug. 11). A lecturer in mining electrical engineering in the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (Aug. 11). Two assistants in the art and industrial division of the National Museum, Dublin - The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Aug. 11). A lecturer and demonstrator in plant pathology at the Swanley Horticultural College—The Principal, Horticultural College, Swanley, Kent (Aug. 11). A professor of pure and applied mathematics at Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (Aug. 15). A demonstrator in pathology and bacteriology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (Aug. 23). An assistant lecturer in pharmaceutical subjects at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Aug. 25). An assistant lecturer and demonstrator in physics at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 5). Investigators under the British Cotton Research Association for research work in, respectively, the study of air currents in machines and tubes used for transporting cotton and its separation from dust; the correlation between physical and mechanical properties of cotton cloth and its structure; the physical chemistry of cotton and rayon—Dr. E. H. Pickard, Shirley Institute, Manchester (Sept. 7). An engineer (ferrous metallurgist) under the Department of Mines, Ottawa, Canada—The Civil Service Commission, Ottawa, Canada (Sept. 15). A teacher of science and mechanical engineering at the Technical Institute, Ashford, Kent—The Principal, Technical Institute, Ashford, Kent. An assistant master for junior mathematics and science at the Stanley Junior Technical School, South Norwood Hill—The Headmaster, Stanley Junior Technical School, South Norwood Hill, S.E. A graduate assistant master for science and mathematics at the Tottenham Polytechnic Junior Technical School for Boys—The Principal, Tottenham Polytechnic, High Road, N.17. A Samson Gemmell professor of medical pædiatrics in the University of Glasgow—The Secretary of the University Court, The University, Glasgow. A junior male assistant under the Directorate of Ballistic Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A scientific assistant in the Coastguards and Fisheries Service of the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1.

Our Astronomical Column.

Periodic Changes of Colour on Jupiter.—Mr. A. Stanley Williams has observed Jupiter assiduously for a period of nearly forty years; in *Mon. Not. Roy. Ast. Soc.* for May, he discusses the question of periodic changes of colour in the case of the two equatorial belts, using observations from 1868 to the present time. He gives graphs which indicate clearly that there is a 12-year cycle in the colour changes. The maximum redness for the south belt occurred about 1873, 1884, 1897, 1912, 1926; that for the north belt about 1868, 1880, 1891, 1903, 1918, 1928. It appears, therefore, that the two hemispheres have maxima six years apart, indicating that the effect is of the nature of a seasonal one. He notes that the material is scanty in the years when Jupiter was far south of the equator; that is, about 1865, 1877, 1889, 1901, 1913, 1925.

Astronomy in South Africa.—The *Cape Times* of June 16 contains an article entitled "South Africa for Astronomers", by Dr. R. T. A. Innes, who recently retired from the directorship of the Union Observatory, Johannesburg. He traces the present astronomical development in that region to Sir David Gill's invitation to European astronomers to visit the Cape more than forty years ago. Prof. Kapteyn's visit there resulted in the formation of the Cape Photographic Durchmusterung; Prof. de Sitter began there the important work on Jupiter's satellites that he has lately brought to completion; he has also concluded an arrangement for Leyden astronomers to visit Johannesburg Observatory and vice versa. Three North American observatories have established branches in South Africa: Harvard has a branch at Bloemfontein; Yale has one at Johannesburg; and Dr. Abbot, of the Smithsonian Institution, has established a solar observatory at Bukkaros near Windhoek, being led to this by advice from Dr. Innes. Allusion is also made in the article to the proposed moving of the Radcliffe Observatory to South Africa. Dr. Steavenson has been testing the seeing at various sites during the present year, using a 6-inch equatorial that was originally constructed for the observation of the transits of Venus in 1874 and 1882. Dr. Innes notes that there are already more astronomers per thousand of the inhabitants in South Africa than in any other country; and the climate is so well suited for observation that "still further increase in their numbers is desirable".

Annual Report of the University Observatory, Cambridge.—The report indicates that work has continued on the same lines as in recent years. The Sheepshanks telescope is being used for determinations of stellar magnitude with a photo-electric cell. Mr. E. B. Moss has devised a new method of measuring the photo-electric current. Four more fields have been measured for the determination of the proper motions of faint stars. Dr. Knox-Shaw has taken colour-index plates at the Radcliffe Observatory, Oxford, to determine the colours of the stars of which proper motions have been found. These have been measured at Cambridge. Many theoretical investigations on variable stars, proper motions, etc., have been carried on by members of the staff and published in the *Monthly Notices* of the Royal Astronomical Society.

Research Items.

Metals and Cosmetics at Ur.—The authorities of the Museum of the University of Pennsylvania have called in the services of a scientific expert, Dr. A. Kenneth Graham, of the Towns Scientific School of the University, to examine and deal with the finds which have been received as their portion of the antiquities obtained by the expedition working at Ur. Notes on some of the technological and chemical results of Dr. Graham's work are published in the *Museums Journal* (Philadelphia) for Sept.–Dec. 1929. While the early bronzes are of a composition and quality that have never been surpassed, the silver and gold are not of a purity that modern methods permit. Their workmanship, especially of the silver objects, is such as to command admiration. Some of the objects, indeed, it would be an achievement for a modern silversmith to produce. One silver bowl, for example, was first cut from a sheet of silver alloy cast in convenient form. In hammering it into the finished shape, at least three to five annealings would be required. Microscopic examination of the silver objects shows that the structure is similar to that of a modern silver article—that of an annealed metal with numerous twinnings indicating previous working by casting and then alternately annealing and hammering. A chemical examination of the cosmetics used by Queen Shubad shows that both eyebrow and lip paint contained a large and dangerous quantity of lead. One sample of the light blue clay contains large quantities of aluminium, phosphate, copper, lead, and carbonate, with traces of iron, calcium, and silica. Probably it is powdered turquoise. A black powder similar to antimony or 'kohl' contains a large amount of manganese and lead with a small quantity of copper, aluminium, phosphate, carbonate, silica, and iron. The last six were evidently present as turquoise. The black colour was due to the manganese, the black oxide of which occurs naturally as pyrolusite. The lead and carbonate must have been added intentionally. The oxides of lead when mixed with the above minerals give shades of brown, red, and purple, and it is probable that in early times a greater variety of colours was preferred to the red and black of to-day.

Reptiles and Amphibians of the Malay Peninsula.—Since Dr. G. A. Boulenger published his account of this fauna in 1912, collections have been made, especially in the northern part of the Peninsula, which have added considerably to the old list. The additions include 1 species of turtle, 16 of lizards, 12 of snakes, and 18 of amphibians, and these, with a revision of the old names and identifications, Dr. Malcolm A. Smith publishes in a supplement to Boulenger's work (*Bull. Raffles Mus.*, Singapore, No. 3, 1930). The supplement is furnished with useful keys to the genera and species, and a new feature is a key to the characters of the tadpoles of the amphibia. Smith notes amongst the reptiles and amphibians a very marked discontinuous distribution, a number of species which are to be found in the northern part of the Peninsula and in the islands of the Malay Archipelago being absent from the southern portion of the Peninsula. A similar discontinuity has been observed in the distribution of certain mammals and birds, and the indication is that some very general but still undetermined influence must have been at work over the territory.

Luminosity in a Squid.—The small Japanese squid, *Watasenia scintillans*, is famous for the brilliance of its phosphorescence. This is due to three types of luminous organs, all of different construction, skin organs, eye organs, and tentacle organs, but all possessing certain granules which are situated in the luminous tissue. The rôle of the granules has given rise to differences of opinion. Shima considered them to be luminous symbiotic bacteria, Hayashi thinks they play an important part in luminescence, and now Teijiro Kishitani has re-examined the light organs of *Watasenia* particularly with the idea of deciding whether photo-bacteria are present or not (*Annot. Zool. Japon.*, vol. 11, p. 353, 1928; just received by NATURE). His attempts to isolate bacteria from the luminous organs on culture media failed, and smear preparations showed that the rod-like granules behaved differently from bacteria with various stains. Further, the rods were never seen in process of dividing and they broke into minute pieces under slight pressure applied to the cover-glass. The author concludes that the granules are not luminous symbiotic bacteria, of which he found no trace, but the question as to whether the spindle-shaped granules and rods function merely as reflectors, or may be crystals of luciferin (such as occur in the luminous organs of the fire-fly) and of importance in the production of light, remains unsettled.

Percoid and Related Fishes.—Under the title of "Notes on Percoid and Related Fishes", Mr. Henry W. Fowler (*Proc. Acad. Nat. Sci.*, Philadelphia, vol. 81, 1929) enumerates a large number of fishes contained in the general series of the Academy. Upwards of 2000 specimens belonging to nearly 300 species are recorded, and the new sub-genus Cheiroxenichtys is described to embrace *Xenichthys agassizii* Steindachner, being distinguished chiefly by its long pectoral fin, nearly as long as the head, and its uniform silvery coloration. These records, in several cases accompanied by descriptive notes, which are mostly from the American coasts and West Indies, are of value in extending our knowledge of the distribution of many rare fishes.

Wild Populations of *Plantago maritima*.—The analysis of the populations of a particular species occupying various natural habitats is a subject offering considerable scope for investigation. Dr. J. W. Gregor (*Jour. of Genetics*, vol. 22, No. 1) has made such a study of the plants of *Plantago maritima* from one small locality on the east coast of Scotland. This common coastal plant is found also in certain inland locations, especially on mountains. Mr. Gregor shows that, as regards one character, the individuals of the species range from decumbent to erect (5 types). The plants growing on an exposed rock just above high tide were more dwarfed and more decumbent than those growing on an adjacent grassy slope. Plants grown from seeds of the two populations under uniform culture conditions showed significant mean differences in such features as height and relative spread. The rock-population had a larger percentage of low-growing forms, but the grass-population contained no type which was not also present in the population from the rock habitat. The cultures indicated that the latter population had been more modified by its original environment than the former. They also showed a phenotypic parallelism between the modifying effect of the environment on wild populations and on the growth-forms present in the cultures. There was variation in succulence of the cultivated forms, and it was shown that, by watering plants with a 3·5 per cent solution of sodium chloride, the fleshy habit of the leaves could be induced.

Permian Flora of the Grand Canyon, Arizona.—Monograph 405 of the Carnegie Institution of Washington contains a complete and well-illustrated

account of an interesting Permian flora, found in the Hermit shale of the Grand Canyon, Arizona, and under investigation by the author, David White, since its first discovery in 1915 by Prof. Schuchert of Yale. This flora is interesting as the latest Palæozoic flora as yet known in America and particularly because, composed mainly of plant forms previously unknown, it presents a unique aggregate of western European elements with others which show definite points of contact with the Gondwana flora. In this flora the herbaceous plants, including the Pteridosperms on one hand and the shrubby or arborescent Gymnosperms on the other, are fairly well balanced; the author recognises no forms as ferns, as yet. The apparent absence of the Calamariales may be due to the arid conditions under which this flora developed. The most characteristic plants appear to be a group which the author regards as Pteridospermic, with affinities with the Gondwana plants, and to which he gives the name of *Supaia*; they are characterised by once bifurcated fronds, in which the strongly asymmetrical divisions, facing each other, *vis-à-vis*, are simply pinnate or pinnatifid. The Gymnosperms are strongly represented in this flora.

The Upper Atmosphere.—The *Journal* of the Royal Astronomical Society of Canada for April contains an article by Dr. W. E. Harper on the upper atmosphere. He recalls the evidence for rapid movements at a high level that was afforded by the eruption of Krakatoa in 1883: the dust of the explosion was projected to a great height, and carried rapidly round the whole earth, reaching higher latitudes in successive revolutions. He discusses the presence of ozone in the upper atmosphere, and its useful effect in absorbing the short ultra-violet rays from the sun; he notes that an excessive supply of these rays would be injurious both to animals and plants. The ozone layer is thickest in the spring, and then slowly and continuously diminishes to a minimum in winter.

Air as a Thermal Insulator.—The *Gesundheits-Ingenieur* has published at 5 marks a 26-page pamphlet by Drs. W. Mull and H. Reiter, "Der Warmeschutz von Luftschichten", which gives the results of their measurements of the thermal insulating properties of layers of air in buildings. For dwelling-houses they find that the best thickness of the air layer in a cavity wall is 5 cm. if it is limited to a single layer. Multiple layers give better insulation than a single layer of the same total thickness. The rate of transmission of heat through an air layer depends on the radiation constant of the surfaces bounding the layer, on the mean temperature of the air, on the difference of temperature of its surfaces, on its thickness, and in the case of a vertical layer on its height.

New Swedish Magnetic Observatory.—Capt. A. Reinius, Director of the Swedish Hydrographic Service, in 1927 obtained State sanction for the institution of a Swedish magnetic observatory, primarily as a base station for the magnetic survey, but also for purely scientific work. An account by G. Ljungdahl of its initiation, buildings, and equipment is included in the first publication of the observatory (*Ergebnisse der Beobachtungen des magnetischen Observatoriums zu Lovö, Stockholm*) together with the detailed data for the first year of working, 1928, edited by S. Aslund. On account of its high latitude (59°) the institution of this observatory is an important and valuable step, and its usefulness is the greater in that it publishes hourly values of the magnetic elements. It is situated 14 km. from Stockholm, on an island in the State forests: both the absolute and the variation instruments are above ground, the latter being in an unheated concrete chamber covered with a great thickness of earth, and shaded by trees; the change of temperature inside it, from day to day, does not exceed 0·2°. The instruments consist of a Carnegie Institution pattern of combined magnetometer and earth-inductor, for absolute measurements, and two sets of variometers, of normal and reduced sensitiveness: the *Z*-variometer is of the type invented by Dr. La Cour, and installed by him at Rude Skov and Godhavn (Greenland).

Light Scattering in Liquids.—A paper by R. M. Langer and W. F. Meggers in the May number of the U.S. Bureau of Standards *Journal of Research*, on the scattering of light by liquids, raises some important questions in connexion with the interpretation of Raman spectra. It is pointed out that the quantum theory of the change of wave-length in scattering does not necessarily require that the same characteristic frequencies of a substance should be effective both in scattering and in infra-red absorption, but that, on the contrary, data obtained by the two methods would rather tend to be complementary. In the earlier experimental work, much of the apparent agreement between the two sets of measurements was fairly obviously forced. These investigators, from their own measurements of the changes in frequency of light scattered by benzene, toluene, chloroform, and carbon tetrachloride, which appear to be as accurate as any yet made, conclude that the original idea of a direct correspondence between absorption spectra and shifts in scattered light is completely discredited, and that it is futile at present to attempt a complete interpretation of the modified lines scattered by liquids, or to draw any final conclusions as to molecular structure from them. Only the systematic accumulation of trustworthy data for scattering substances belonging to distinct chemical families, and especially the investigation of the simpler molecular structures, can be expected to give clues to the correct explanation of light scattering in transparent media.

Radio Beacons and Aircraft.—The U.S. Bureau of Standards and the Department of Commerce in the United States have developed a visual signal-indicating device to guide mail aeroplanes over the Appalachian Mountains. An aural beacon system is at present in use. Coded signals are picked up by the head telephones, but this is found to put a great strain on the pilot as he has to concentrate his thoughts when listening and must wear the telephones practically all the time. The new device consists of two vibrating white reeds. These will be placed on the instrument boards of the New York to Cleveland mail aeroplanes. The aviator can tell whether he is on the right path or not by watching the reeds. If the reed on the left vibrates most, he has turned off to the left of his course. Similarly, if the amplitude of the vibrations of the right hand reed is greater, he will know that he has veered off to the right. When both vibrate alike the aeroplane is on the right course. The searchlights which are installed at ten-mile intervals along the route will still be used. When the visibility is good the lights can be readily followed, but at present in fog, rain, or snow the ground and the searchlights are invisible and the pilot has to rely entirely on the aural signals. A recent test flight from Detroit to Washington was made almost entirely by beacon signals and not by maps. We understand from the *Daily Science News Bulletin* for May 9, issued by Science Service, Washington, D.C., that there is no prospect at present of attempting 'blind' landings. The path of the aeroplane with the help of the beacon

guide brings the pilot near enough to the landing field for him to see the ground lights and so make a descent by sight.

Valve-maintained Quartz Oscillators.—Radio engineers are looking forward to a much more extended use of quartz oscillators in the immediate future, not only for maintaining the frequency of the waves emitted from broadcasting stations constant, but also for making receiving sets very selective. In a paper read to the Institution of Electrical Engineers on Mar. 5, and recently published in the Institution's journal, J. E. P. Vigoureux, of the National Physical Laboratory, describes an investigation he has carried out for the Radio Research Board on valve-maintained quartz oscillators. The combination of a quartz resonator and a valve circuit is called a quartz oscillator. The frequency of the oscillator depends mainly upon the natural frequency of the quartz resonator, and when the temperature is constant they are both nearly constant. The former can be varied, however, by altering the air-gaps of the resonator, that is, the air-gaps between the quartz and the two electrodes of the resonator, or by varying the constants of the plate circuit or the interelectrode capacities and inductances. These variations have been studied both theoretically and experimentally. The theoretical treatment has been rendered possible by the experimental work of Dye, who has shown that the quartz oscillator can be replaced by an equivalent electrical circuit. The equivalent circuit consists of an inductance, a resistance and a capacity connected in series, the whole being shunted by a second capacity. Making this substitution, the problem reduces to one which can be solved by ordinary mathematical methods. Formulæ are deduced which give the conditions for the maintenance of oscillations. It is shown also how the amplitudes of the oscillations depend on the values of the component parts of the circuit.

Corrosion of Steel by Concrete.—Special Report No. 15 of the Building Research Department of the Department of Scientific and Industrial Research (H.M. Stationery Office, 6*d.* net) deals with the corrosion of steel by breeze and clinker in concrete. It is shown that coal residues are definitely undesirable ingredients in concrete which is to be placed in contact with steel, since they cause corrosion. In the interests of safety it would seem desirable to abandon altogether the use of breeze and clinker aggregates for concrete in contact with steel.

Abrasives.—Report No. 699 of the Department of Mines, Canada, deals with artificial abrasives and their manufacture, and abrasive products and their uses. Three parts previously published dealt with siliceous abrasives; corundum, emery, and diamond; and garnet, respectively. The manufacture of grinding wheels, sandpaper, steel wool, and other abrasives is described in detail, as well as their principal industrial applications. Although the report contains a very extensive bibliography, much of the information has not previously been published. Copies of any of the parts may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa, Canada.

Dipole Moments.—A monograph by J. W. Williams, entitled "Molekulare Dipolmomente und ihre Bedeutung für die chemische Forschung", being one of the parts of the "Fortschritte der Chemie, Physik und physikalischen Chemie" (Berlin: Gebrüder Borntraeger), gives a useful condensed account of a subject which is now attracting a good deal of attention, the fundamental theories and the experimental results being dealt with. Particular attention is directed to the determination of molecular structure from dipole moments. It may be noted that the structural formulæ which have been used by chemists for half a century appear in general to be confirmed by the new investigations. The relations of the results to those of other fields of investigation are briefly considered and, since the mathematical apparatus is reduced to a minimum, this clearly written monograph of sixty-five pages should prove of great interest and utility to chemists who have found the more ambitious treatises too abstruse for their requirements.

Thermal Expansion of Glass.—The March number of the *Journal of the Society of Glass Technology* contains two papers on the thermal expansion of glass, by Prof. Turner and F. Winks. It was found by Peters and Cragoe in 1920 that there is a range of temperature, called the critical or annealing range, over which the thermal expansion was several times as great as that in the range lying between the ordinary temperature and the lower critical temperature. The first paper summarises investigations made during the past five years. Reproducibility over the whole range of temperature up to the softening point was almost attained with a number of glasses. The influence of lack of homogeneity on reproducibility was found to be small. The effects of tension, composition, and heat treatment were investigated, and a general analysis of the thermal expansion curve is given. The critical point, when the rate of expansion alters abruptly, was not always found, and the normal expansion curve may undergo changes of direction at temperatures below the critical point. In a discussion on the nature of glass, it is suggested that a 'vitreous state' of matter, as well as liquid and solid, should be recognised. The second paper deals with the expansions of a series of sodium metasilicate-silica glasses. The results are discussed in detail.

Conductivity of Solid Salts.—In previous experiments on the effect of temperature on the electrical conductivity, k, of solid halides of sodium and potassium, T. E. Phipps and co-workers found that the curves of $\log k$ plotted against $1/T$ usually exhibited two distinct slopes, which were interpreted as follows. It is assumed that the conductivity of a solid is proportional to the numbers of ions in its lattice which have an energy greater than a certain threshold value, and the slope of the curve then measures the heat of liberation which the conducting ion or ions must acquire in order to participate in the conduction. In the April number of the *Journal of the American Chemical Society*, Ginnings and Phipps show that the curves for lithium halides are similar. The slopes found in the lower temperature range measure the heats of liberation of the metal ion in the lattice, and those at the higher temperatures the combined heats of liberation of metal and halogen ions. Transference experiments had shown that, in the case of sodium chloride, only the sodium ion takes part in the conduction process over the temperature range of the lower slope, while in the higher temperature range both ions contribute to the conduction. The melting-points of highly purified lithium halides were found to be: LiCl, 606°; LiBr, 551°; LiI, 467°. The heat of liberation of either alkali ion or halogen was smaller the lighter the alkali metal in a series with a common halogen. In a series with a common alkali metal, the heat of liberation of either ion is greater the lighter the halogen ion. A linear relation between the heat of liberation and the absolute melting-point is indicated.

Statistics of the Universities of Great Britain.*

WITH the current academic year has ended the five years for which the Parliamentary grant for universities and university colleges in Great Britain was fixed at its present figure, £1,550,000. Since 1919 the duty of advising the government of the day concerning the financial needs of these institutions has been discharged by the University Grants Committee, and this body has accordingly been engaged during the past twelve months in visiting them. In the light of the personal knowledge thus acquired and the various returns annually submitted to it, the Committee has prepared a review of the period 1923–24 to 1928–29 and a report on present needs and problems. These documents have now been published, together with the customary statistical tables for the year 1928–29.

The total number of full-time students of both sexes last year was 44,309. The total shown in the returns for 1923 24 is 43,025, but this includes 1742 students of a special type not represented in last year's total, namely, those aided to take university courses under the Government scheme for the higher education of ex-Service men. Deducting those, the increase in five years was 7 per cent. Taking men students alone the increase was 11 per cent, the number of women students showing a decrease from 12,962 to 12,899, or from 31·4 per cent of the total of both sexes to 29·1. Dissection of the total enrolment figures according to the various subject groups discloses a marked contrast between an upward trend of enrolment in the arts faculties, including theology, fine art, law, music, commerce, economics, and education, and a downward trend in medicine (including dentistry) and technology (including engineering, applied chemistry, mining, metallurgy, architecture, etc.), and comparative stagnation in pure science and agriculture (including forestry, horticulture and dairy work):

	1923-24.	1928-29.	
Arts . .	18,981	23,625	+ 4644
Medicine . .	10,997	8,387	- 2610
,, women only	2,020	1,108	- 912
Pure Science .	7,402	7,377	- 25
Technology .	4,709	4,082	- 627
Agriculture .	856	838	- 18

The 'swing-over' from medicine and technology to arts was widespread but was most pronounced in Scotland, where the percentage of arts students rose from 44·2 to 59·3 (men 31·4 to 47·1; women 70·7 to 83·9), and there were corresponding declines in the proportions of students in other subject groups, and especially in medicine (men 38·1 to 29·3; women 17·9 to 7·4) and technology (men 17·8 to 10·5; women 0·5 to 0·4). It is accounted for thus: "The stationary position of the Pure Science group and the fall in the Technological group are no doubt due to the continued depression in many industries. The decreased number of students in the Medical group, which includes Dentistry as well as Medicine, seems to be the result of a reaction which followed the abnormally large entry of medical students just after the war." "The main reason for the growth in the Arts group is no doubt to be found in the attraction exercised, during a period of bad trade and restricted opportunities in other professions, by the securer and greatly improved prospects of the profession of teaching; in Scotland the general tendency has been intensified by the official requirement that only graduates can now normally be admitted to the Provincial Centres for training as men teachers."

Each of these factors is mentioned in an article in the April number of *The Universities Review* on overcrowding in the German universities. There, however, the students of the *technischenhochschulen*, corresponding more or less to the technological faculties of the universities of Great Britain, form nearly twice as large a proportion of the total number of university students as in Great Britain, and scientific education is very widespread. Whatever its causes, the falling off in the numbers of students in the scientific departments of British universities cannot but excite misgivings on the part of all who believe in the importance for our future welfare of "integrating into the intellectual structure of society", as J. B. S. Haldane puts it, "the scientific ideas which have furnished its material structure". In the part of the report relating to careers open to graduates (see below) the Committee indicates reasons for anticipating an increase in the enrolments in technology and pure science.

In the following tables universities are arranged in order of the numbers of their full-time students in 1928-29, first in all faculties and then (omitting many of the smaller enrolments) in the above-named subject groups severally. It will be seen that London heads the list in every case except arts and agriculture, in which, respectively, Oxford and Reading rank first, that Cambridge comes second in every case except medicine, and that Glasgow is third in every case except agriculture. The increase (+) or decrease (-), in comparison with the corresponding figure for 1923 24 is given in brackets:

All Faculties.

*London	9141	(+186)
Cambridge .	5653	(+670)
†Glasgow .	5329	(+562)
Oxford .	4559	(+396)
Edinburgh .	3616	(- 47)
‡Wales . .	2664	(+ 1)
§Manchester .	2314	(+ 52)
Liverpool .	1560	(-239)
‖Durham	1431	(+ 70)
Leeds .	1385	(- 90)
Birmingham .	1362	(-143)
Aberdeen .	1325	(-118)
¶Bristol .	859	(88)
Sheffield .	690	(7)
St. Andrews .	677	(6)
Reading .	615	(+ 37)

* 23 institutions: among them 2 medical schools, with enrolment 151, not represented in returns of 1923-24.

† Including Royal Technical College, Glasgow.

‡ University Colleges at Aberystwyth, Bangor, Cardiff, and Swansea.

§ Including Manchester College of Technology.

‖ Armstrong Coll., Newcastle-upon-Tyne, and Durham Colleges, including College of Medicine.

¶ Including Merchant Venturers' College.

Arts.

Oxford .	3789	(+342)
Cambridge .	3324	(+713)
Glasgow .	3275	(+1340)
*London .	3145	(+ 758)
Edinburgh .	2017	(+ 412)
Wales . .	1730	(+ 190)
Manchester .	918	(+ 214)
Aberdeen .	820	(+ 13)
Durham .	713	(+ 184)

* 8 institutions.

All other Faculties.

London .	5996	(-572)
Cambridge .	2329	(- 37)
Glasgow .	2054	(-778)
Edinburgh .	1599	(365)
Manchester .	1396	(162)
Wales . .	934	(189)
Liverpool .	921	(- 358)
Leeds . .	823	(180)
Oxford . .	770	(+ 54)
Birmingham .	729	(-233)
Durham .	718	(- 64)

Medicine.

London . .	3373	(-611)
Edinburgh .	1105	(-250)
Glasgow .	886	(-419)
Manchester .	412	(-165)
Cambridge .	386	(- 13)
Liverpool .	379	(-300)
Leeds . .	332	(- 52)

Pure Science.

London . .	1604	(+ 8)
Cambridge .	1184	(+ 43)
Glasgow .	588	(+125)
Wales . .	570	(111)
Manchester .	560	(+ 46)
Oxford . .	522	(+131)
Durham .	297	(+ 67)
Leeds . .	277	(- 46)
Liverpool .	275	(-111)
Birmingham .	238	(- 72)
Edinburgh .	220	(- 40)

Technology.

London . .	1019	(+ 31)
Cambridge .	581	(+ 57)
Glasgow .	554	(-469)
Manchester .	424	(- 43)
Liverpool .	267	(+ 53)
Birmingham .	199	(- 48)
Leeds . .	173	(- 84)
Edinburgh .	168	(- 46)
Sheffield .	167	(- 1)

Agriculture.

Reading .	181	(+ 46)
Cambridge .	178	(- 44)
Edinburgh .	106	(- 29)
Oxford . .	105	(- 22)
Wales . .	88	(+ 12)
Aberdeen .	78	(+ 13)

* University Grants Committee. Report, including Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1928–29. Pp. 74. (London: H.M. Stationery Office, 1930.) 3s. 6d. net.

The number of full-time advanced students (as distinguished from those pursuing courses for first degrees or diplomas) shown in the returns for 1928–29 is 2082, including 374 women. The following table compares their distribution over the various subject groups with the distribution of the total number of full-time students :

	All Students.	Advanced.
Arts . . .	53·3 per cent.	39·1 per cent
Medicine . .	18·9 „	4·8 „
Pure Science . .	16·7 „	42·6 „
Technology . .	9·2 „	11·4 „
Agriculture . .	1·9 „	2·1 „

Two-thirds of the total number of these advanced students were at work in London (696, including 246 at University College and 207 at Imperial College), Cambridge (378), Oxford (185), and Manchester (153). In the Scottish universities there were 182, and in the Welsh 97. Of the individual subjects by far the most popular among advanced students are chemistry (453) and physics (185).

The universities of Great Britain are drawing students from other countries in increasing numbers : so much so that more than half the total increase during the quinquennium in the number of full-time students is attributable to this source. Those from other parts of the British Empire numbered 2809 in 1928–29, being 14 per cent more than in 1923–24, whilst those from foreign countries numbered 1581, showing an increase of 26 per cent.

The financial resources of the universities of Great Britain are exhibited in the returns for 1928–29 in some detail. The incomes amounted in the aggregate to £5,174,510, and were derived from : (*a*) Parliamentary grants, 36 per cent ; (*b*) fees, 31 per cent ; (*c*) endowments, 14 per cent ; (*d*) grants from local authorities, 10 per cent ; and (*e*) other sources, 9 per cent. Capital benefactions received from other than Government sources in the course of the past five years amounted to more than £5,550,000, in which total are included gifts by corporations and individuals in the United States of America amounting to £1,700,000, nearly one-third of the total. Excluding these American contributions, the benefactions in five years amounted to less than one-sixth of the amount received as gifts and bequests in one year by universities and colleges in the United States, and about one-fourth of the amount received in one year by sixteen of the most favoured of them. The aggregate income is about half that of the universities and colleges of the State of New York. Sources of American university incomes are : (*a*) United States Government grants, 5 per cent ; (*b*) fees, 32 per cent ; (*c*) endowments, 16 per cent ; (*d*) grants from State or city governments, 26 per cent ; (*e*) other sources, 23 per cent.

Since figures for Oxford and Cambridge were not available at the beginning of the quinquennium on a sufficiently comparable basis to be included in the University Grants Committee's standard tables of financial statistics, the Committee's comparative statements of income and expenditure in 1923–24 and 1928–29 leave those two universities out of the reckoning. The comparison shows a growth of total income from £3,592,936 to £4,210,710, approximately 17 per cent. Rather more than half of the increase is under the head of Parliamentary grants. Income from endowment shows an increase of £72,822 (18 per cent), from donations and subscriptions £23,989 (26 per cent), from local education authorities' grants £92,926 (22 per cent), and from fees £44,267 (4 per cent). The proportion of Parliamentary grants to total income rose from 35·4 to 37·8 per cent, and that of fees to total income fell from 33·7 to 29·8 per cent. The only institutions deriving more than half of their income from Parliamentary grants are three of the London colleges, two Welsh colleges and Reading. Oxford and Cambridge get, respectively, 30 and 25·6 per cent of their incomes from this source. The Committee concludes an examination of the question of the increasing dependence of universities on State aid with the observation that the large increase in the grants given by the State five years ago has served to stimulate rather than to discourage the generosity of the other bodies and individuals to whom the universities have to look for support.

That dependence is about to be further increased by the raising of the amount of the annual Treasury subvention from £1,550,000 to £1,800,000. The report stresses, in this connexion, the fundamental importance of the teaching staff and the library and expresses the hope that one of the first uses to which the universities will put any increase they may obtain in their annual incomes will be to improve the lot of teachers of the senior lecturer class, many of whom find themselves in a serious plight. In discussing the position and prospects of the junior staff, the Committee directs attention to the barriers which stand in the way of their obtaining posts in secondary schools. These barriers have arisen through the operation of the new salary scales for teachers in schools and, in Scotland, the requirement that, whatever their previous experience, all applicants for such posts must have had a course of professional training for school work. This is, the Committee thinks, unfortunate, as the universities and schools both stand to gain by such exchanges.

In the part of the report relating to the careers open to graduates we find : "The need for a much more extensive application of scientific research to industrial practice is becoming more clearly realised every day, and the scientific departments of the universities are the obvious training grounds for men and women qualified either to undertake work on the fundamental problems, which are the field of the Industrial Research Associations established with State assistance, or to devote themselves, in the service of individual firms, to the improvement of particular industrial processes. . . . Some years ago it was common knowledge that the 'market' for chemists was seriously overstocked, and that many men with first-rate qualifications in Pure Chemistry were unable to obtain suitable employment, but we gather that the market has of late greatly improved, under the enlightened influence of the great combine over which Lord Melchott presides, and that though the output of students trained in Pure Chemistry continues to be, perhaps disproportionately, large, it is now being successfully absorbed. . . . There is evidence of an increasing range of demand for men who have had a good training in Physics, Geology, Biology, and such applications of Chemistry as Chemical Engineering or Fuel Technology."

The demand for university graduates is, moreover, we are told, extending rapidly to the administrative side of industry and of business generally. While it has hitherto been rare in Great Britain, though common in Germany, to give to men of high technical qualifications a place on the directorate of an industrial firm, many of the large industrial organisations are coming to look more and more to the universities for men of good general education and balanced character for the responsible administrative work which the vast range of their operations now involves, and even the smaller concerns seem more willing than they were to have recourse to the same recruiting ground.

The Italian Earthquake of July 23.

SINCE Jan. 13, 1915, when Avezzano and other towns in central Italy were ruined, there has been no earthquake in the peninsula so destructive as that which visited the provinces of the Basilicata and Campania shortly after 1 A.M. (0 A.M. Greenwich mean time) on July 23. The latest estimate of the number of persons killed is 1883, while the buildings of 34 communes are said to have been seriously damaged. The epicentre, which seems to be close to the town of Lacedonia, lies about 65 miles slightly north of east from Naples.

The area of slight damage, as at present known, is bounded by a curve that is roughly in the form of an ellipse directed west-north-west, 39 miles long, 16 miles wide, and containing about 490 square miles. The places that have suffered most are Villanova, Aquilonia, and Lacedonia, lying within a district about 19 miles long and 90 square miles in area, in the north-west half of the former curve, and Melfi and the surrounding towns near its south-east end. The principal centre apparently lies midway between Villanova and Lacedonia, but there may have been a secondary centre close to Melfi about 20 miles to the east-south-east. The shock was strong enough to damage a few houses in Naples and to have been felt in the province of the Marches, and even so far as Rome, so that the total area disturbed may contain about 95,000 square miles, or roughly that of the Hereford earthquake of 1896. The first movements were recorded at Kew at 0 h. 12 m. 11 s. and at Helwan (Egypt) at 0 h. 12 m. 42 s.

The province of the Basilicata is one of the most unstable regions in Italy. The great Neapolitan earthquake of Dec. 16, 1857, so admirably investigated by Robert Mallet, disturbed chiefly the southern part of the province. Mallet, from observations on the direction of the shock, placed the epicentre near the village of Caggiano, which lies about 34 miles to the south of that of the recent earthquake, but the principal centre was probably near Montemurro, 24 miles south-east of Caggiano. More closely connected with the recent earthquake are the Avellino earthquake of Sept. 8, 1694, and the Melfi earthquake of Aug. 14, 1851, described by Dr. Mario Baratta in his valuable work "I terremoti d' Italia" (pp. 173-181, 407-410; 1901). In 1694, the number of persons killed was 3571. The area of destruction was of unusual size, extending about 50 miles north-west from Potenza. In 1851, 628 persons lost their lives, and the meizoseismal area was small, not more than 11 miles in length, with its centre close to Melfi. The area strongly shaken by the recent earthquake thus includes that of the Melfi earthquake and lies along the northern boundary of that of the earthquake of 1694.

C. DAVISON.

The Skull of Peking Man.

DR. DAVIDSON BLACK'S interim report on the skull of *Sinanthropus* found at Chou Kou Tien at the end of last year was presented at a session of the annual meeting of the Geological Society of China held on Mar. 29 last, and has now been published in the *Bulletin* of the Society. It is illustrated by six plates which reproduce the natural size of the photographs of the frontal, right and left laterals, occipital, vertical and basal views of the skull.

The whole external surface has now been freed from travertine, with which, however, the interior is still filled. During the preparation of the skull, the major parts of parietals and the whole of the frontal bone were separated from the stone filling; but these were replaced for the purpose of the photographs, which show the parts in approximately correct relation. A table of measurements is given which supplements and corrects those of the previous report, but they are themselves only approximate and subject to correction.

The skull, doubtfully identified as female, has a glabello-occipital length of 192 mm. and a breadth of 132 mm. (?), the maximum breadth which falls between the supra-mastoid regions of the temporal bones being *circa* 144 mm. The least frontal breadth is 83 mm. (?) and the greatest frontal breadth 102 mm. (?). The auricular height is 97 mm. (?) The parietal eminences are quite well developed; but the sides of the cranial vault below them are markedly inclined toward one another. The bones are much thicker in certain regions than was supposed (for example, below the lambda). They do not show the excessive thickness of the Piltdown skull, but they are much thicker than in modern man.

One of the most, if not the most interesting point brought out by Dr. Black in this interim report is the bearing of certain unique morphological features which were not apparent at the earlier stages of preparation. It is now clear that what was previously considered to be a markedly developed post-glenoid process is seen to be a very peculiarly developed tympanic portion of the temporal. In the massive parts of the tympanic elements, the posterior moiety is developed to form a prominent crest which extends inward to the base of the minute styloid process, while the anterior portion of the tympanic bone forms a massive rounded wall limiting the mandibular fossa and rising abruptly immediately behind the petro-tympanic tissure. The glenoid cavities are thus obliquely placed deep fossæ, the visible floors of which are formed wholly from the zygomatic elements of the temporal bones. The mandibular fossæ are thus wholly hominid in character.

It is, however, extremely interesting to note that for the first time among hominids is found a stage of development much more archaic than in Neanderthal man and at the same time in certain features recalling some of the relations characterising this region in anthropoids, such, for example, as the chimpanzee. Dr. Black recalls that both Boule and Martin in reference to the La Chapelle and La Quina skulls respectively have pointed to certain resemblances to the chimpanzee in that region, placing them somewhat intermediately in type between that form and *Homo*. The Peking skull in this respect may be termed pre-Neanderthaloid, and in the hominid scale may be not far removed from the type which evolved both the extinct Neanderthal and the modern *Homo sapiens*.

University and Educational Intelligence.

LEEDS.—The Council of the University of Leeds has elected Dr. F. Challenger to the chair of organic chemistry shortly to be vacated by Prof. C. K. Ingold. Dr. Challenger, who is at present senior lecturer in chemistry at the University of Manchester, is a graduate of London and Göttingen. Throughout his career he has been actively engaged on research work; amongst the subjects to which he has given attention are the organo-derivatives of bismuth, the organic chemistry of sulphur and the technology of mineral oils, the production of acids such as citric and oxalic by biological processes, and the chemistry of petroleum.

MANCHESTER.—Applications are invited for the Amy Henrietta Worswick fellowship for the investigation of the causes and treatment of rheumatoid

arthritis. The annual value of the fellowship is £150. The tenure will be for one year with the possible renewal for a second year. Applications must reach the registrar by, at latest, Oct. 15.

IN schools in the United States of America are enrolled more than half of the total population of ages 15, 16, 17, and 18 years. Twenty-five years ago the proportion was only one-tenth. Some account of this remarkable growth is given, with voluminous statistics of public high schools in 1927–28, in *Bulletin*, 1929, No. 35, of the United States Office of Education. The rapid addition of large groups of pupils of types very different from those with which the traditional high school had been accustomed to deal necessitated radical changes, including an expansion of curricula from a strictly limited group of subjects (English, Latin, Greek, French, German, algebra, geometry, physics, chemistry, and general history) to very varied assortments of some two hundred and fifty subjects, of which many are definitely vocational and industrial in character. Other notable changes accompanied the 'junior high school' movement, started about the beginning of the present century. This has led to reorganisations, affecting nearly half of the total public high school enrolment, the main features of which are the differential treatment of the age group 16, 17, and 18 years (senior high school) and the absorption in junior high schools or departments of pupils of the higher grades (ages 13-14 years) of the primary schools. The place of sciences in the high schools seems to be a diminishing one, except as regards biology, hygiene, and sanitation. In 1910, eighty-two per cent of pupils were studying some science, in 1915 sixty-four per cent, in 1928 sixty-one per cent. The drop in numbers studying physics, from fifteen to seven per cent, is specially noticeable. Physical geography and physiology also show important decreases, and geology has almost disappeared from the high school programmes.

FROM the University of Leeds we have received two reports on its Clothworkers' Departments. They are of more than ordinary interest by reason of the highly important developments of research resulting from a special grant of £3000 by the Clothworkers' Company. A report on these developments describes in some detail researches conducted (i) under the direction of Mr. J. B. Speakman in the plasticity of wool, influence of plastic flow on the affinity of wool for water (already reported in NATURE of Sept. 14, 1929), rigidity of wool and its change with adsorption of water vapour, elastic properties of wool in water at high temperatures, examination of the fine structure of wool by X-ray analysis, thermal conductivity of and transmission of water vapour through textiles, and physico-chemical properties of wool fat; (ii) under Mr. W. T. Astbury's direction, some applying new X-ray methods of investigation inaugurated by Sir William Bragg to the problems of fibres in general and of wool and hair in particular, and others aiming at the solution of definite technological problems relating to the uniformity of yarns, the significance of fibre lengths, etc. In the Department of Colour-Chemistry and Dyeing, the progressive decline which has characterised enrolments of the past decade was followed last year by a considerable increase and the demand by industry for graduate students trained in the Department exceeded the supply available. Huddersfield Technical College also reports heavy enrolments in its dyeing department and an important growth of research work in all its departments, especially in colour chemistry and chemistry, and almost complete success by its appointment department in placing students in suitable positions.

Historic Natural Events.

Aug. 3, 1879. Hailstorm near London.—Over an area seven miles long and two miles broad, between Kingston and Ealing, violent hail fell. The stones were up to six inches in circumference, broke all glass exposed to them, pierced holes in zinc and slate roofs, and knocked out of shape the anemometer cups at Kew Observatory. The thunder and lightning were continuous from 9 P.M. to 3 A.M.; at Cambridge at 3 A.M. there were 120 flashes per minute.

Aug. 3, 1883. Cloudburst on Ochil Hills.—During the afternoon a violent storm burst on the Ochil Hills between Dollar and Alva. A flood of water poured down a deep narrow valley into Alva, the main street becoming deeply flooded in three minutes. Bags of flour and casks of butter were floated a distance of 100 yards from a baker's shop.

Aug. 4, 1577. Damage by Lightning in Suffolk.—On Sunday, Aug. 4, between 9 and 10 A.M., the parish church of Blythburgh, in Suffolk, was struck by lightning, which burst through the wall, struck almost a yard deep into the ground, and knocked down about twenty people who were on that side of the church. It then broke the door and badly damaged the steeple, breaking the timber and the bells. The people that were stricken down were found still grovelling more than half an hour afterwards, and two were dead. About the same time the parish church of Bungay, nine miles from Norwich, was also struck, the wire and wheels of the clock being broken and two men in the belfry killed, while in the church itself men were killed or burned.

Aug. 4, 1666. Hurricane at Guadeloupe. A hurricane began at 6 P.M. and continued for twenty-four hours. Every vessel and boat on the coast of Guadeloupe was dashed to pieces, all the vessels in the Saints were driven on shore, and of Lord Willoughby's fleet of 17 sail with 2000 troops, only two were ever heard of afterwards. Houses and trees were blown down and a great number of cattle killed. The sea rose to an unusual height and flooded the land.

Aug. 4, 1829. Moray Floods. Heavy rain began to fall on the evening of Aug. 2 in the upper parts of the valleys of the rivers Nairn, Findhorn and Spey, and continued almost without interruption until the morning of Aug. 4. It came mainly with a north-east wind, with such volume and force that it penetrated all the doors and windows facing in that direction. No rain-gauges were in operation in the area of heaviest fall, but it is not unlikely that the amount which fell on Aug. 3 exceeded any falls which have been actually recorded in the British Isles. The Findhorn at its greatest height filled the valley, 200 yards wide, to a depth of 17 feet above the normal surface of the river, this level being marked by a tablet.

Aug. 5, 1783. Great Eruption of the Asama-yama (Japan).—The Asama-yama, one of the principal Japanese volcanoes, lies 90 miles north-west of Tokyo and rises to a height of 8136 feet above the sea. The great eruption of 1783 began on May 9 and lasted 88 days, culminating on Aug. 5, when a huge mass of molten lava and hot mud descended from the crater and covered an area 2 miles from the crater and 4 miles wide at the base to a mean depth of 100 feet. This lava did not reach the villages and caused no loss of life or property. It was followed, however, by a great avalanche of volcanic materials that swept down, at first with a velocity of more than 50 miles an hour, and caused enormous damage in all the villages along the northern base of the mountain. The river Azuma-gawa was blocked for a time, but the gathering waters broke through the dam and

swept away houses along a course of more than 50 miles. The number of lives lost by the avalanche and flood was 1162. The district covered by the ashes was about 4250 square miles and the total volume about one-sixth of a cubic mile.

Aug. 7-14, 1899. West Indian Hurricane.—A hurricane of exceptional violence struck the West Indies near Guadeloupe, crossed the Leeward and Virgin Islands, Porto Rico, and the Bahamas, and continued along the east coast of the United States. There was great destruction of life and property, especially in the island of Porto Rico, where more than 3000 lives were lost, mainly by drowning, and many more died afterwards from starvation. The coffee crop, worth more than £1,400,000, was almost completely destroyed. The storm was traced from America across the Atlantic into the Mediterranean, where it finally dissipated.

Aug. 8, 1924. Transport of Insects.—The Oxford University Expedition to Spitsbergen recorded that after several days of south-westerly winds, on the morning of Aug. 8, living hover-flies and aphides were observed in considerable numbers, crawling on the ice of the glaciers. These were collected and were afterwards shown to have been carried from the forest belt of northern Europe, a distance of at least 800 miles.

Aug. 9, 1911. Heat in London.—The summer of 1911 was noted for its great heat in England. On Aug. 9 the thermometer in the Glaisher stand at Greenwich registered exactly 100° F., the highest authentic shade temperature in Great Britain. The maximum was not momentary, but was maintained almost continuously from 3 to 3.30 P.M.

Societies and Academies.

PARIS.

Academy of Sciences, June 2.—**Mesnager**: The optical determination of internal strains in solids of three dimensions. Remarks on a communication by Henry Favre on the same subject.—**H. Deslandres**: Properties of the series and abnormal lines in atomic spectra.—**L. Blaringhem**: The heredity of sex in *Aquilegia vulgaris*.—**Louis Lapicque** was elected a member of the Section of Rural Economy in the place of the late L. Lindet.—**Gaston Julia**: Some harmonic majorants.—**Georges Bouligand**; Poles, essential singularities.—**Victor Vâlcovici**: A mixed problem.—**T. Bonneson**: Inequalities between arithmetical means.—**Léonidas Kantorovitch**: Functions of the (U) type.—**Luigi Fantappié**: The singularities of a linear analytic functional of a function of several variables.—**J. Haag**: The theory of the spiral.—**Jean Chazy**: The velocity of propagation of attraction.—**N. Stoyko**: The orbit of the trans-Neptunian star discovered at the Lowell Observatory.—**J. Le Roux**: The interpretation of Michelson's experiment.—**Edgar Baticle**: The problem of the wall supporting a mass of powder.—**Mlle. Simone Boudin**: Coloured crystalline stratifications. Study of *p*-toluidine, *β*-naphthylamine and diphenylamine. A modification of the technique proposed by René Marcelin for the study of the development of the elementary leaflet of *p*-toluidine, with application to other substances.—**R. Forrer**: A method of discussion of the magnetic moments of alloys, and the common measure of atomic moments.—**A. Dauvillier**: The realisation of integral microradiography. The radiography of microscopic objects has offered great experimental difficulties. The author uses plates similar to those devised by Lippmann for interferential photography, prepared with colloidal silver according to the technique described by Watteville. A reproduction of a radiograph, with a magnification of 600, is given.—**Mme. Pierre Curie and Mme. S. Cotelle**: The average life of ionium. The method used, based on the rate of formation of radium in a mixture of ionium and thorium oxides, assumes only a knowledge of the atomic weights of ionium, thorium, and of the ionium-thorium mixture utilised in the experiments. The value obtained, 119,000 years, is intermediate between that of Soddy (110,000 years) and that of St. Meyer (130,000 years).—**F. Joliot and Mme. Irène Curie**: The radiations associated with the emission of the α-rays of polonium.—**G. Reboul and G. Déchène**: The activation of matter by the brush discharge. The brush discharge, produced by e.m.f. of 20,000-100,000 volts, activates metallic plates, communicating an activity measurable by an electrometer, and persisting for up to 72 hours. The curve corresponds to the superposition of three superposed exponentials of periods of 3 minutes, 27 minutes, and 20 minutes. The residual activity has a period of 10·6 hours. From these measurements the activity produced would appear to be due to the disintegration of the emanations of radium and thorium.—**Louis D'Or**: The manometric and spectrographic study of the thermal dissociation of pyrites, FeS_2. The thermochemical equation of the decomposition is $2FeS_2 = 2FeS + S_2 - 61,000$ cal. The energy of fixing the first atom of sulphur is 90,500 cal., whilst that of the second is 82,500 cal.—**M. Bourguel and P. Daure**: Chemical constitution and the Raman effect: the acetylene linkage.—**Ch. Jovignot**: Method and testing apparatus giving the extension coefficient and the breaking load of metallurgical products in thin sheets.—**G. Dupont, J. Lévy, and J. Allard**: The mechanism of the action of catalysts in the autoxidation of abietic acid.—**Georges Darzens**: The transformation by isomerisation of benzylvalerolactone into tetrahydromethylnaphthalene carboxylic acid. This transformation is effected by heating to 120°-125° C. with 64·5 per cent sulphuric acid with constant agitation for eight days. The reaction is very slow, but, allowing for recovered lactone, quantitative.—**Félix François**: The action of selenoxanthydrol on *β*-diketones and on ethyl acetoacetate.—**Mlle. Marie Thérese François**: The neutralisation of castor oil. A suggestion for the use of commercial triethanolamine for the removal of acid from castor oils used for lubricating purposes.—**Paul Combes and Roger Campredon**: The study of a new deposit of calcite exposed during the excavations for the new entrance to the port of Saint-Nazaire.—**Jacques de Lapparent**: The amount of titanium in bauxites.—**L. Dollé**: The *marcas* of the high plateau of Artois.—**A. Guilliermond**: Homo- and heterothallism in the yeasts.—**André Dauphin**: The histological characters of roots developed separately.—**Philippe Fabre**: An electrical hæmodromograph.—**Gordon H. Scott**: The arrangement of the mineral constituents of the nucleus during mitosis.—**I. I. Nitzescu and I. D. Georgescu**: The amount of citric acid in some animal fluids (cephalo-rachidian fluid, aqueous humour, follicular liquid, amniotic fluid).

BRUSSELS.

Royal Academy of Belgium, Nov. 9.—**G. Cesàro**: Cells with minimum surface. A mathematical discussion on the form of cell made by the bee.—**Th. de Donder**: Affinity. (Part 2.) Discussion of open systems with osmotic pressure, surface tension, and adsorption.—**G. Balasse and Mlle. G. Galet**: Iodine spectra with weak excitation. The tubes giving the spectra were without electrodes and the oscillating current, of 70 metres wave-length, was maintained by two triode emission valves. Details are given of

the method of purifying the iodine. All probable impurities were sought for spectroscopically and proved absent.—**F. Corin**: Contribution to the study of the chloritoides. An application of the methods of Fedorow to the study of these minerals.—**Marcel V. L. Homès**: Observations on the structure and cell division of living *Halopteris filicina*.—**Lucien Godeaux**: (1) The Lie quadrics of certain surfaces.—(2) The Guichard transformation and certain quadrics considered by M. Demoulin.—(3) The united points of the cyclic involutions belonging to an algebraic surface.—**Yvonne Désirant**: Ethyl-difluoracetoacetate. Full details are given of the preparation, physical properties, and chemical reactions of the ester. The enol-ketone equilibrium was studied.—**Raymond Defay**: The thermodynamical study of surface tension. Affinity and adsorption velocity.

Dec. 7.—**Paul Stroobant**: Observations of the partial eclipse of the sun of Nov. 1, 1929. An account of results obtained at the Royal Observatory of Belgium (Uccle) and at the Astronomical Institute of the University of Brussels.—**Jean P. Bosquet**: Contribution to the invariantive theory of the calculus of variations.—**J. Jaumotte**: The movement of masses of air in the atmosphere.—**L.** and **M. Lapicque** and **Henri Fredericq**: Nerve and muscle chronaxies of the heart of *Limulus polyphemus*.—**Radu Badesco**: A functional equation.—**Maurice Lecat**: The application of azeotropism to functional chemical analysis. On the basis of extensive experimental work on the constant boiling mixtures formed by various classes of organic compounds, the author has devised a scheme for determining the class of an unknown organic compound from its azeotropic characters.—**R. H. J. Germay**: The application of a method of successive approximations to the solution of the Gauss equation $\sin(z-q) = m\sin^4 z$.

Jan. 4.—**Th. de Donder**: The photonic field.—**G. Cesàro**: The ellipse circumscribed round a triangle and having for its centre the centre of the inscribed circle.—**J. E. Verschaffelt**: Determinations of surface tension by measuring the force required to remove a flat disc.—**H. Buttgenbach**: The optical appearances of the cleavage plates of rhodonite.—**J. Melon**: The orientation of the optical ellipsoid of rhodonite.—**Raymond Defay**: The chemical kinetics of Th. de Donder and stable and metastable equilibria.—**Jacques van Mieghem**: Study of retarded potentials.—**G. van Lerberghe**: The calculation of the fugacities of a solution.—**Th. Lepage**: A characteristic property of the equations of the extremals of multiple integrals.

Feb. 1.—**F. Corin**: Contribution to the petrographical study of the lodes of the Bastogne region.—**M. Kraitchik**: The statistical study of prime numbers.—**Raymond Defay**: (1) The thermodynamical study of surface tension. Affinity and adsorption velocity.—(2) The chemical kinetics of Th. de Donder and stable and metastable equilibria.—**M. Cosijns** and **R. Moens**: A precision wavemeter. Details of a wavemeter capable of rapidly measuring frequencies between 3×10^4 and 3×10^8 with an accuracy of 0·001 per cent in absolute value.—**J. Jaumotte**: A movement quasi-equivalent to the movement of the atmosphere.

CRACOW.

Polish Academy of Science and Letters, Jan. 13.—**F. Leja**: The linear transformations of double and multiple series.—**Mlle. A. Dorabialska**: The heat yield of some radioactive minerals. Results of measurements with an adiabatic microcalorimeter of the heat in calories per hour per gram of uraninite, johannite, thorianite, Arendal orangite, thorite and monazite. Three minerals, orangite, thorite, and monazite, give a calorific effect much greater than that calculated from their chemical composition: this requires theoretical and experimental explanation.—**K. Dziewoński** and **J. Reiss**: The oxidation of acetyl-acenaphthene.—**F. Górski**: Increase of accuracy in the method of counting the bubbles in photosynthetic researches.—**E. Godlewski, jr.**, and **Mlle. I. Latinik**: The ontogenetic and regenerative growth of *Axolotl*.—**A. J. Klisiecki**: The movement and pressure of the blood in the arteries.

Feb. 10.—The Starunia rhinoceros. (1) **J. Nowak** and **E. Panow**: Geological characters. (2) **J. Tokarski**: The mineralogical characters of the diluvial mud. (3) **W. Szafer**: Character of the flora. (4) **J. Stach**: Description and reconstruction of the rhinoceros.—**T. Mazewski**: Some points of the theory of length.—**E. S. Pearson** and **J. Neyman**: The problem of two samples.—**C. Zakrzewski** and **T. Nayder**: The refraction of electric waves ($\lambda = 12$ cm.) in some electrolytes. No difference could be found between the index of refraction of water and those of the solutions of electrolytes used. The value found, 8·8, was identical within the limits of experimental error with the index found with long waves.—**M. Lancucki**: Sorption and chemical reactions in the atomic radius.—**Mlle. M. Moraczewska**: New absorption bands of selenium vapour in the extreme ultra-violet.—**M. Centnerszwer** and **W. Wittandt**: The velocity of solution of aluminium in alkaline solutions.—**K. Dziewoński**: The syntheses of ketones, derivatives of 1-benzylnaphthalene.—**M. Książkiewicz**: Geological researches in the Wadowice Carpathians. Stratigraphic and tectonic relations.—**J. Talko-Hryncewicz**: A contribution to the craniology of the present population and of past races of central Asia.—**J. Lenartowicz**: Researches on experimental syphilis.

VIENNA.

Academy of Sciences, May 2.—**W. Knapp**: The action of *o*-phthalylchloride on thio-phenol-methyl-ether.—**R. Fischer**: Testing with blood-gelatin for saponin in plants.—**M. Beier**: Zoological expedition to the Ionian Islands and the Peloponnesus (12). The ants of the Ionian Islands by **B. Finzi**.—**M. Radakovic**: Studies on the Raman effect (8). Calculation of simple molecular models. A system of particles bound together by elastic forces and an attempt to calculate the oscillations in a simple case.—**H. Winter**: The pole of inertia and its application in the graphic dynamics of plane gears.—**E. A. W. Schmidt** and **G. Stetter**: Ionisation of single α- and H-rays at the end of their range.—**E. A. W. Schmidt** and **G. Stetter**: Researches on α-reflection and disintegration effects with light elements.—**A. Dadieu** and **K. W. F. Kohlrausch**: Studies on the Raman effect (9). The Raman spectrum of organic substances. Molecules of different patterns were considered, $X-CH_3$ and $X-(CH_2-X$, as systems of so many points and so many degrees of freedom, with an internal oscillation of the H atom and an external oscillation of the X with regard to the methyl group. As special examples $ClCH_3$, Cl_2CH_2, Cl_3CH gave useful results.—**R. Springer** and **H. Roth**: A sort of turbulence-friction in binary mixtures of liquids.—**R. Kremann, B. Korth**, and **E. I. Schwarz**: Electrolysis of molten silver-lead alloys. With high current density a limiting value to the concentration of silver round the cathode was observed.—**R. Kremann** and **E. I. Schwarz**: The electrolysis of bronzes with added silver. Silver and copper concentrate at the cathode. The percentage enrichment of silver is less with increasing concentrations of silver.—**R. Kremann, F. Bauer, A. Vogriň**, and **H. Scheibel**: The change in direction of migration of alkali and other metals during the electrolysis of their

nalgams in relation to the concentration. There is transformation point above which Na, K, and Ba oncentrate at the cathode; Bi even from the lowest ercentages moves towards the anode. Apparently e polarity of the components of the alloy determines e direction of migration.—**R. Kremann** and **W. iwetz**: Electrolysis of bronzes with added lead. opper migrates to the cathode, lead to the anode. or high current density the enrichment of lead is ater in the alloys that are poorer in lead.—**F. Hölzl** nd **K. Rokitansky**: The mobilities of some ions conaining iron (2). The influence of radicle substitution the mobility of complex iron-ions. Comparisons ere made between $Fe(CN)_6$, $Fe(CN)_5CO$, $Fe(CN)_5NO_2$, nd other groups. From conductivity measurements ere calculated the radii corresponding to the apparent mic volumes. The substitution of CO for one CN ade little difference. By contrast $Fe_4(NO)_7S_3$ has a ery small mobility.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 3, ar. 15).—**Albert F. Blakeslee** and **Ralph E. Cleland**: ircle formation in *Datura* and *Œnothera*. The view adopted that segmental interchange is a possible asis of circle formation of the chromosomes of those enera.—**Ralph E. Cleland** and **Albert F. Blakeslee**: nteraction between complexes as evidence for segental interchange in *Œnothera*. The segmental nterchange hypothesis leads to useful predictions chromosome configuration in certain complexombinations.—**J. T. Buchholz** and **A. F. Blakeslee**: en-tube growth of the primary mutant of *Datura*, olled, and its two secondaries. **R. B. Lindsay** and **J. Seeger**: Operational calculus in quantum meanics. Some critical comments and the solution of pecial problems.—**H. Bateman**: Physical problems ith discontinuous initial conditions.—**F. Zwicky**: the possible influence of the mosaic structure crystals on the determination of Avogadro's umber. There is a discrepancy between the wavength of X-rays as determined by the method reflection from a ruled grating and by reflection om a crystal of known structure, the latter of hich involves use of the density and Avogadro's umber. The conception of mosaic structure leads a correction to this method, bringing the two results to better agreement.—**Everett S. Wallis**: The oblem of preparing optically active free radicals.—**aymond F. Blount**: The implantation of additional pophyseal rudiments in urodele embryos. Where ecal endoderm only was transplanted, the results re negative. When grafts including ectoderm and derlying neural tube were used, pigmentation was creased and body length was decreased while certain rts showed disproportionate growth and there was rly sexual maturity.—**Andrew Watson Sellards**: he cultivation of treponemata from the blood of rmal monkeys (*Macacus rhesus*) and from the blood monkeys infected with yellow fever. Repeated noculations with culture from yellow fever animals used death, but the liver lesions were not always ose occurring in yellow fever. Thorough immunisan with culture of treponemata from yellow fever urces produced partial to complete protection ainst yellow fever virus.—**Marston Morse**: The oblems of Lagrange and Mayer under general end nditions.—**R. L. Wilder**: Concerning perfect conuous curves.—**M. H. A. Newman**: Combinatory ology of convex regions.—**Tibor Radó**: Some rerks on the problem of Plateau.—**Eldred Currier**: problem of the calculus of variations in *m*-space h end-points variable on two manifolds.—**Willem uyten**: (1) On some statistical properties of double stars in space. (1) A formula for the estimation of the period in a relatively fixed system. The formula allows of the calculation of the period of a binary system from the angular separation, the parallax and the luminosity, the chance being 2 out of 3 that the actual period is between 0·4 and 2·5 times the computed value.—(2) On the mean period of double stars in space. Computed values agree well with those known and the equation is applied to all double stars nearer than 10 parsecs. The general conclusion is that the median-mean period is about 300 years and half of the binaries in space probably have periods between 20 and 4000 years.

Official Publications Received.

BRITISH.

Interim Report (March 1930) of the Furunculosis Committee appointed July 1929 by the Rt. Hon. William Adamson and the Rt. Hon. Noel Buxton. Pp. 65+10 plates. (Edinburgh and London: H.M. Stationery Office.) 3s. 6d. net.

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 2, Part 2. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. 61-128. (London: G. Bell and Sons, Ltd.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1307 (Ae. 447): On the Effect of Altitude upon the Distance required for an Aircraft to take off and climb 20 Metres, giving Generalised Curves of Weight Reduction necessary if a given Aircraft is to comply with the Requirements of A.P. 1208 under adverse Atmospheric Conditions. By K. T. Spencer. (T. 2894.) Pp. 7+5 plates. 6d. net. No. 1309 (Ae. 449): Stresses in Wing Structures—Accelerometer and Incidence Measurements in various Manœuvres. By S. Scott-Hall. (T. 2723.) Pp. 6+6 plates. 9d. net. No. 1287 (M. 67): Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition (Continued). By S. L. Archbutt and Dr. J. W. Jenkin. (A. 61.) Pp. 16+3 plates. 1s. net. No. 1288 (Ae. 437): The Accelerations of a Fairey "Flycatcher" Seaplane during Aerobatic Manœuvres. By L. P. Coombes and A. S. Crouch. (S. 72, revd.) Pp. 4+6 plates. 6d. net. No. 1296 (Ae. 430): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 1: Supermarine S.5 Models. By W. L. Cowley and Dr. R. Warden. (T. 2550.) Pp 62+45 plates. 4s. net. No. 1297 (Ae. 431): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 2: Tests on the Gloster IV. Models. By W. L. Cowley and Dr. R. Warden. (T. 2550a.) Pp. 48+49 plates. 3s. 6d. net. No. 1298 (Ae. 432): Tests on Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 3: Tests on the Crusader Models. By W. L. Cowley and Dr. R. Warden. (T. 2550b.) Pp. 35+26 plates. 2s. 6d. net. No. 1299 (Ae. 433): Tests on Quarter Scale Models of High Speed Seaplanes for the Schneider Trophy Contest of 1927. Section 4: Comparison with Full Scale and Conclusions. By W. L. Cowley and Dr. R. Warden. (T. 2550c.) Pp. 32+13 plates. 1s. 9d. net. (London: H.M. Stationery Office.)

The Organization of Mosquito Control Work. By John F. Marshall. Pp. 10+8 plates. (Hayling Island: British Mosquito Control Institute.) 9d.

FOREIGN.

Ministry of Agriculture. A Brief Account of the Research Work of the Sections of the Ministry at Giza: Drawn up on the Occasion of the visit of H.M. King Fouad I. to those Sections (April 27, 1929). Pp. 15. (Cairo: Government Publications Office.)

Bulletin of the Imperial Earthquake Investigation Committee. Vol. 11, No. 4: Re-Survey of the Kwanto District after the Great Earthquake of 1923. By Rikuti Sokuryobu. Pp. 6+80+7 plates. (Tokyo.)

Proceedings of the Imperial Academy. Vol. 6, No. 5, May. Pp. xv-xviii+187-215. (Tokyo.)

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 3, No. 4: Announcements of Courses, 1930-31. Pp. 123. (Houghton, Mich.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 21. (New York City.)

Bulletin of the Geological Institution of the University of Upsala. Vol. 22. Pp. iii+308+4 plates. (Upsala: Almquist and Wiksells Boktryckeri A.-B.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 3, May. Pp. 175-280. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.50 yen.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 246-253: On the Physiological Rôle of Carotin and Allied Substances, by Kozo Kawakami and Ryang-ha Kimm: The Determination of the Helium Content of some Japanese Minerals, 2, by Jirô Sasaki; The Chemical Nature of Cypridina Luciferin, by Sakyo Kanda; The Band Spectra of OsO_4 in Gaseous State and in Solution, by Sechi Kato; An Attempt to prepare Higher Unsaturated Alcohols from certain Drying Oils, by Sin'iti Kawai; 4-Iodo-biphenyl-4-isocyanate as a Reagent for Alcohols, 1: Corresponding Urethanes derived from Fatty Unsaturated Alcohols, by Sin'iti Kawai: 4'-Iodo-biphenyl-4-isocyanate as a Reagent for Alcohols, 2: Corresponding Urethanes derived from C_1-C_{18} Normal, Saturated, Primary Alcohols, by Sin'iti Kawai and Kunisaburo Tamura; Study on the Corona Discharge at Large Gap Lengths in Air (Abridgment), by Takeshi Nishi and Yoshitane Ishiguro. Pp. 231-282. (Tokyo: Iwanami Shoten.) 80 sen.

Bulletin météorologique de l'Observatoire météorologique de Beograd. 1: Observations diurnes en Serbie, juillet-décembre 1905, et résumés annuels 1905. Publié sous la direction de P. Vujević. Pp. 43. (Beograd.)

CATALOGUES.

B.D.H. Medical Products. Pp. 68. (London: The British Drug Houses, Ltd.)

Wild-Barfield Air Tempering Ovens with Forced Air Circulation. (Section B.) Pp. 8. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue of Important Works on Mammals, Birds, Insects, Shells, etc., Geology, Fossil Plants, Botany and Horticulture. (No. 13.) Pp. 20. (London: John H. Knowles.)

The Nickel Bulletin. Vol. 3, No. 7, July. Pp. 209-240. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

SATURDAY, AUGUST 2, TO *TUESDAY*, AUGUST 12.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section).—Summer Meeting in the Ruhr area and Switzerland.

CONGRESSES.

AUGUST 3 TO 9.

INTERNATIONAL CONGRESS FOR SEX RESEARCH (at House of British Medical Association).

Monday, Aug. 4.—Prof. F. A. E. Crew: Puberty and Maturity (Address). Papers relating to Puberty and Maturity.

Tuesday, Aug. 5.—Papers on the Biology of Testicular and Ovarian Function.

Wednesday, Aug. 6.—Papers on Hormone Therapy.

Thursday, Aug. 7.—Discussion on Psychology and Biology.

Friday, Aug. 8.—Papers on the Biological and Therapeutical Aspects of Control of Human Fertility.

Among the papers to be communicated to the Sectional Meetings are The Aschheim-Zondek Test for Pregnancy (Prof. Aschheim); The Corpus Luteum Hormone (Dr. Clauberg); Biological Tests of the Female Hormone (Menformone) (Assistants from Prof. Laqueur's Institute); The Channels and Significance of Excretion of the Female Sex Hormone (Prof. R. T. Frank); The Male Sex Hormone (Prof. S. Loewe); Evidence for the Metabolic Basis of Sexuality (Dr. O. Riddle); Human Hybrids (Prof. C. G. Seligman).

AUGUST 4 TO 9.

INTERNATIONAL CONGRESS OF EXPERIMENTAL CYTOLOGY (in conjunction with the Anatomical Congress) (at Amsterdam).

AUGUST 4 TO 9.

INTERNATIONAL VETERINARY CONGRESS (in Central Hall, Westminster).—Discussions on Foot-and-Mouth Disease, Tuberculosis, Infectious Abortion, The Relationship of the Veterinary Surgeon to Animal Husbandry, Veterinary Science in Relation to Public Health, and The Law Governing the Practice of Veterinary Medicine and Surgery. Sectional Meetings on Variola in Domestic Animals, The Use of Drugs in the Treatment of Diseases caused by Worms, Theileriases, Fowl Typhoid and Bacillary White Diarrhœa, Anthrax, Swine Fever, Milk Fever, Fowl-pox, Genetics, Rabies, Standardisation of Biological Products, Acute Infectious Mastitis, Control of Trypanosomiases, Deficiency Diseases, Black-leg, Scientific Feeding of Animals, Distemper, Bovine Sterility, Rinderpest, Treatment of Parasitic Diseases, Diseases of the New-born, and Fowl Plague.

AUGUST 5 TO 7.

IMPERIAL HORTICULTURAL CONFERENCE (to discuss the best methods of approach to horticultural problems and the technique involved) (at Royal Society of Arts).

Tuesday, Aug. 5, at 10 A.M.—Sir Robert Greig: Bureaux and their Work. The Director and Chief Officer of the Bureau: Discussion of the Work of the Imperial Bureau of Fruit Production and Future Lines of Development. This will be prefaced by a précis of the work already done.

At 11.30 A.M.—F. L. McDougall: Possible Development of Fruit Growing in the Empire from an Economic Point of View.

At 12.15.—J. L. Brown: The Evolution of the New Zealand Fruit Board.

Experiences of Horticultural Research—

At 2.30.—Dr. W. T. Macoun: In Canada:—(*a*) Centralised.

E. F. Palmer: (*b*) At an Unattached Station.

At 3.10.—Prof. A. C. D. Rivett: In Australia.

At 3.30.—Dr. B. Hahne: Horticultural Research in the Union of South Africa.

At 3.40.—W. G. Freeman: Tropical and Sub-tropical Fruit Industry. Difficulties Encountered and Lines of Attack.

At 4.15.—Sir Frederick Keeble: An Industrial Research Station.

Wednesday, Aug. 6, at 10 A.M.—Sir Daniel Hall: The Directions in which Experimentation is likely to be Valuable in Horticulture.

Field Experiments:—

At 10.45 A.M.—T. N. Hoblyn: The Adaptation of Modern Statistical Methods to Horticultural Conditions.

At 11.30 A.M.—Prof. E. E. Cheesman: Practicability of the Application of Statistical Method in the Case of Tropical and Sub-tropical and other Crops.

At 12.15.—F. J. Martin: Field Experiments in certain Tropical and Sub-tropical Crops in West Africa.

Application of Pure Sciences to Horticultural Problems under—Temperate Conditions:—

At 2.30.—Prof. B. T. P. Barker: Fruit Products and Associated Problems.

At 3.—Prof. V. H. Blackman: Some Physiological Considerations in Horticulture.

Tropical and Sub-tropical Conditions:—

At 3.30.—Dr. E. J. Maskell and Dr. T. G. Mason: Physiological Work in the Tropics. Some of the Problems with special reference to Cocoa, and some Possible Lines of Attack.

Soil and Climate Survey as a Basis for Fruit Research:—

At 4.—T. Wallace: Soil and Climate Survey as a Basis for Fruit Research.

T. Rigg: Soil Type and Manuring in Relation to Yield and Quality of Nelson Apples.

A. J. Prescott: Soil and Survey Work as a Basis for Fruit Production in Irrigated Areas.

At 4.30.—H. V. Taylor: Meteorology and Fruit Production: The British Scheme of Research.

Thursday, Aug. 7.—Progress of Fruit Storage Methods:—

At 9.30 A.M.—Dr. F. Kidd: A Survey of the Principal Fruit Storage and Transport Problems of the Empire to-day.

At 9.50 A.M.—T. Wallace: Factors influencing Storage Qualities of Fruits.

At 10.10 A.M.—Dr. A. J. Smith: Problems of Biological Engineering in the Cold Storage of Fruit.

At 10.30 A.M.—Dr. A. Horne: The Infection and Invasion of the Apple Fruit by Fungi in Relation to the Problem of Storage.

At 10.50 A.M.—Dr. D. Haynes: Chemical Change in Stored Apples: The Relation of the Time of Picking to the Chemical Composition and Storage-life of the Apple.

At 11.10 A.M.—Dr. L. P. McGuire and Dr. C. W. Wardlaw: Investigations of the Storage Behaviour of Bananas at the Low Temperature Station of the Imperial College of Tropical Agriculture, Trinidad.

At 11.30 A.M.—W. T. Hunter: Recent Progress in the Study of Johnathan Breakdown in U.S.A. and Canada.

At 11.50 A.M.—R. G. Tomkins: Biological Effects of Atmospheric Humidity.

At 12.10.—Meirion Thomas: Biochemical Study of Functional Diseases in Fruits.

Dr. B. T. Dickson and W. M. Carne: The Present Position of the Bitter Pit Problem in Australia.

R. Wheeler: Fruit Transport Problems in Canada.

E. A. Griffiths: Problems of Storage and Transport.

Prof. J. Young: Citrus Storage Investigations in Australia.

At 12.30.—F. A. Stockdale: Sources and Training of Future Horticultural Research Workers.

AUGUST 7 TO 15.

INTERNATIONAL HORTICULTURAL CONGRESS (in London).—*Papers to be read on Aug.* 8, 11, *and* 13:—

Prof. Priestley: Vegetative Reproduction from the Standpoint of Plant Anatomy.

Dr. Van der Lek: Anatomical Structure of Woody Plants in Relation to Vegetative Propagation.

Dr. R. Salaman: Vegetative Mutations.

Prof. E. Baur: Production of Mutations by External Stimulus.

Dr. F. E. Denny: The Excitation of Dormant Buds under External Influence.

John Innes Horticultural Institution: Graft Hybrids.

John Innes Horticultural Institution: Vegetative Production of Polyploids.

John Innes Horticultural Institution: Sterility.

G. E. Yerkes: Raising Root Stocks from Seed.

Dr. C. G. Dahl: Root Stocks from Seeds of known Parents.

Dr. R. J. D. Graham and L. B. Stewart: Special Methods of Practical Utility in the Vegetative Propagation of Plants.

Miss Mary E. Reid: The Influence of the Nutrient Conditions of Seeds and Cuttings upon the Development of Roots.

Prof. P. W. Zimmerman: Factors influencing Root Growth of Cuttings.

Dr. A. B. Stout: The Inter-relations between Vegetative Propagation and Seed Reproduction.

N. Esbjerg: Varieties grown on own Roots.

Prof. N. I. Vavilov: The Wild Progenitors of Fruit Trees in Turkestan and in the Caucasus.

R. G. Hatton: The Development of a Research Programme around the 'Build Up' of a Fruit Plant.

Dr. H. Faes: Vine Propagation.

L. Ravaz: The Influence of American Stock on French Vines.

W. G. Freeman: Vegetative Propagation of Cacao and the West Indies Citrus.

Prof. T. Tanaka and Y. Tanaka: Propagation of Citrus Fruits in Japan.

Prof. H. J. Webber: Studies on Rootstock Reactions in Citrus.

Dr. F. F. Halma: The Propagation of Citrus by Cuttings.

Dr. H. P. Traub: The Ripening Process in Fruits, with special reference to the Fig and the Grapefruit.

Prof. B. T. P. Barker: The Fruit Tree Complex in Relation to Environment: Some current Investigations at Long Ashton.

Prof. N. E. Hansen: Fruit Stocks where Mercury Freezes.

Prof. E. C. Auchter: American Experiments in Propagating Deciduous Fruit Trees by Stem and Root Cuttings.

W. T. Macoun: National Tastes in Apples.

Dr. L. Filewicz: The Frost Injuries of Fruit Trees in Poland in 1928-29, with special reference to the Influence of the Stock and Scion upon the Resistance of the Apple-trees against the Frost.

Dr. P. J. S. Cramer: Rubber Budding.

W. A. Orton: Propagation in Tropical Countries.

Prof. P. Work: Some Scientific Problems in connexion with Vegetable Seeds.

Eng. G. Jacobsen: Electric Heating of Soil in Hotbeds and Hot houses.

Prof. B. Fedtschenko: The Horticultural Work of Russian Botanical Gardens.

Prof. C. Regel: The Botanical Garden of the Present Day.

H. J. Rumsey: Horticultural Progress in Australia.

SATURDAY, AUGUST 9, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Science and Food Supply.

IN a celebrated address to the British Association in 1898, Sir William Crookes, discussing what he called the "Wheat Problem", predicted a world shortage of 17 million bushels of wheat in 1931, and went on to assert: "it is the chemist who must come to the rescue of the threatened communities. It is through the laboratory that starvation may ultimately be turned into plenty." The warning was dramatic, and created something of a sensation at the time. The anxiety, it is true, was not shared by such agricultural authorities as Sir John Bennett Lawes and Sir J. Henry Gilbert, but they would have been the first to endorse all that Sir William Crookes said about the importance of the scientific worker in securing the maximum return in agriculture.

This historic address was mentioned by Dr. Levinstein in his recent presidential address to the Society of Chemical Industry. Dr. Levinstein pointed out that if a shortage of wheat is unlikely in 1931 it will be due, not to better fertilising and increased yields per acre, but to a larger acreage under cultivation. The enormous production of nitrogenous fertilisers during the last thirty years has had little effect upon the wheat supplies, and has gone instead to produce sugar, potatoes, rice, and other commodities. The difficulty has been met by extending the zone within which wheat can be profitably cultivated. This has been done partly by the development of new varieties of wheat better adapted to difficult conditions than those previously known, partly by the better utilisation of moisture reaching the soil, and partly also by improved agricultural implements. Thus not only the chemist but also the biologist and botanist, the soil-physicist and the agricultural engineer, have played their part in averting the food shortage which Sir William Crookes believed to be impending.

In this period agricultural chemists have produced no spectacular successes like those obtained with artificial fertilisers in the middle of the nineteenth century. The new methods of crop production have been made possible by an immense amount of scientific research, the practical importance of which was often not apparent at the time. For this reason, although agricultural science stands in higher repute with farmers than ever before, the contribution which science has made towards the improvement of agriculture is far from being appreciated by the community. Lord Melchett was undoubtedly right when he asserted recently that the importance of the chemist as a prime con-

tributor to the progress of civilisation is not yet realised, and this is notably true in the matter of food supply.

Even those who are aware of the part the chemist has played in developing the supply of artificial fertilisers by the fixation of atmospheric nitrogen, for example, or of his work as an analyst in detecting and preventing adulteration and in securing the purity of all kinds of foodstuffs, are unaware of the contribution of the biochemist and the important results of his study of the soil bacteria. In recent years the contribution of the chemist in the sphere of insecticides and fungicides has become as important as in the provision of fertilisers. At the last Imperial Agricultural Research Conference the need for a greatly extended chemical investigation of possible insecticides and fungicides for the control of diseases and pests was realised, and a resolution of the Conference recommended that an investigation of the whole chemical field should be undertaken by chemists working in collaboration with entomologists and plant pathologists. With the growth of intensive cultivation the control of plant pests assumes great importance, and the continuance of civilisation's power to feed the growing population of the world is largely dependent on the ability of the chemist and his fellow workers to protect our crops from such pests.

In a country such as Great Britain the adequacy of a food supply involves not only questions of production and protection of foodstuffs, but also their storage and transport, often for considerable periods. For the past ten years the Department of Scientific and Industrial Research has directed a number of investigations into the changes which occur in foodstuffs during cold storage. These investigations have already been of practical value in improving conditions of transport and storage of fruit and in checking wastage during long voyages from overseas. Success in the storage of fruit is now known to depend upon a close knowledge of chemical changes which follow severance from the tree and the effect upon them of temperature, humidity, age when gathered, soil, climate, etc. A relationship has been established between the chemical composition of an apple and its susceptibility to disease, and the first step has thereby been taken towards enabling the grower to control soil conditions so that the fruit possesses both better storage properties and greater resistance to disease.

Similarly, investigations at the Low Temperature Research Station at Cambridge have upset the accepted view that chemical reaction in tissues is almost completely inhibited in freezing and indicated the existence of a definite temperature zone within which the living muscle may be frozen and revert to its original condition on thawing. Other work on the conditioning of meat has indicated that the prejudice against frozen beef may be due to the use of inferior beef rather than to the effects of freezing, and researches carried out at sea in special trawlers have demonstrated the possibility of so improving the handling and transport of white fish that a higher proportion of the total catch can be handled in a 'fresh' and marketable condition after 10-11 days storage than was possible after 6-7 days by the old methods.

In such investigations not only the chemist but also other scientific workers have played their part. The majority of important advances in applied science under modern industry are the result of team work in which all kinds of scientific workers have co-operated, and equally with the chemist other classes of scientific workers are overlooked by the community. Thus scientific workers have already quietly averted a world shortage of foodstuffs which appeared to threaten us a generation ago. Until, however, the importance of their contributions are fully realised, the business or government of a country is unlikely to take the long range or scientific views of agricultural policy which Dr. Levinstein outlined.

For this position scientific workers are themselves at least in part to blame. With a wealth of material at their disposal—to take the report of the Empire Marketing Board as one example—they have done little to educate the community as to the contribution that science makes to the food supplies of the world, or to remove some of the pressing problems of food production out of the arena of political prejudices and debate into an atmosphere of impartial and scientific examination. Scientific workers must assume to a much greater extent the responsibility of leadership which their knowledge thrusts upon them, if mistakes of policy are to be avoided which prejudice the well-being of future generations. While there may be different opinions as to the precise manner in which science should exert a full and right influence on public affairs, there is little doubt that the recently revived Parliamentary Science Committee offers a valuable line of advance. Support of that Committee may not only provide a form for the expression of scientific opinion upon public affairs, but may also promote the participation of men of science in public life and their representation in Parliament, and even lead to the creation of the Ministry of Science which we have often advocated.

Natural History of New England.

The Boston Society of Natural History, 1830–1930. Edited by Capt. Percy R. Creed. Pp. xii + 117. (Boston, Mass.: Printed for the Society, 1930.)

FEW societies of natural history can boast such a fine record of achievement both in the encouragement of research and in public education as that of Boston, which recently has celebrated its hundredth anniversary. Boston in 1830 was the centre of a populous seaboard, through which most of the foreign commerce entered the United States, while it possessed a large fleet of clippers, merchantmen, and whalers. The land behind was settled by an industrious population, who feared only God and the devil. The Almighty gave such animals and plants as were beneficial, while Satan was responsible for the rest, about which it were safest to be incurious. The farmer's existence was unspeakably hard and his amusements were few. In the ports, however, there was great interest as to foreign lands, and skippers took a pride in bringing curios to deck such local museums as that of New Salem. The museum 'instinct' thus started began to spread to Nature in the country behind them, from which the Indians had already disappeared, but ideas were chaotic.

It was in these circumstances that about twenty Boston men banded themselves together to found their Society of Natural History. They included no one who even knew the birds, fishes, or mammals of their neighbourhood. The public was indifferent to their aims and regarded them as 'busy triflers'. There was no museum that could help them. Yet they dared to get themselves incorporated by the Commonwealth of Massachusetts, thereby undertaking the responsibilities of a national institution. They appointed fifteen office-bearers, including eight 'curators' whose duty was to collect the animals and plants of New England. They induced the legislature to appoint six persons to survey the natural history of the home State, these working largely under their advice. A small legacy overcame many difficulties and enabled their first hall to be acquired in 1848. Here they developed their collections, while they gave the only instruction in biology in Boston. The Society claimed with Louis Agassiz that the study of Nature should be made "an indispensable part of all education", and its classes were expressly designed to help teachers to acquire the necessary knowledge. In 1861 the Commonwealth recognised its position and gave a noble site in the 'west end' of Boston, whereon was erected a museum and library of natural history. In 1834 publication of the *Boston Journal of Natural History* was started, and this has been added to by Proceedings, Memoirs, and Bulletins, the contributors to which have comprised many of the best-known naturalists in America. These were used largely for exchange purposes, and the result is a library of 100,000 catalogue entries, nearly complete in all that concerns North America.

In 1871 practical steps were taken to develop New England collections of rocks, plants, and animals, all to be arranged on the logical background of relationship. Later, with the foundation and development of the Harvard University collections in the Agassiz Museum, these were further developed, and afterwards the two museums made such an exchange that the local collections became concentrated in Boston and the exotic in Cambridge. Thus the two museums, the world institution of Harvard and that of the local society of New England, have come to bear a peculiar relationship to one another, the authorities of one being equally interested in the other. Pupils from the State schools visit one and demand to be taken to the other. They do not understand what they see, but they have an insatiable curiosity to see—and one visit is not enough. Sunday afternoons with their 2000 visitors to these museums is interesting, the present writer having once been requested to explain exhibits to a group of about twenty who had motored in thirty miles with the thermometer below 0° F. expressly for this visit.

To mention the names of the more distinguished naturalists of the Boston Society of Natural History would recall the story of the development of natural history in America, since Boston is its true metropolis of this study. Amongst the foundation members are found Amos Binney and A. A. Gould, leading conchologists of their day. The former gave his collection of plants, and later were added the John A. Lowell flowering plants with other collections of lichens and algæ, these having the sympathetic interest of Asa Gray. To Jeffries Wyman and F. W. Putnam were owed the genesis of a fine fish collection, the basis of Humphreys Storer's "Fishes of Massachusetts", 1867. Marine invertebrates were largely given by the elder and younger Agassiz, but this section looks for a great development in the new museum that is now imperatively necessary. Dr. Thaddeus W. Harris gave lectures in 1831, preaching the need of a proper study of insects in connexion

with agriculture. In 1841 he published "The Insects of Massachusetts injurious to Vegetation", which passed through several editions. His collection of insects, made a hundred years ago, is the oldest general collection in North America, and his 4700 species comprise about half the present known species of New England. The fossils are not spectacular save for reptilian footprints. They are mostly primary invertebrates, especially trilobites and brachiopods. Mammals, birds, and reptiles are the work of many hands, but Barbour and Allen may be trusted to have made their groups as complete as they well can be.

John James Audubon was a visitor to the Society in 1832–33 when preparing his superb "Birds of America", and the great Humboldt was a close correspondent, as might be expected, since it was his financial loan that enabled Louis Agassiz to become a biologist. Amongst the active workers, sympathisers, and helpers we find the names of practically every one of the older families of New England. There are, too, noble eulogies of their fellow-members, who devoted their lives to the natural history of their State, by Longfellow, Oliver Wendell Holmes, and James Russell Lowell, men distinguished by their art and ennobled by that love of natural history which they deemed to be a vital factor in the programme of all well-educated persons.

J. STANLEY GARDINER.

The Expansion of Consciousness.

The Ascent of Humanity: an Essay on the Evolution of Civilization from Group Consciousness through Individuality to Super-Consciousness. By Gerald Heard. Pp. xiv + 332. (London: Jonathan Cape, Ltd., 1929.) 15*s*. net.

THIS remarkable book will attract deep, if not wide, attention for several reasons. In the first place, it gives an entirely new setting to the doctrine of progress which was generally believed in the last century and has lately fallen into temporary disrepute; the author moves the centre of discussion from the external and mechanically organised world into the evolution of man's spirit itself. Secondly, it appeals strongly, and, as we think, too exclusively, to the psychological interest of the present day; it attempts a psychological explanation of some of the greatest movements and most famous characters in history, and this, even when not convincing, is always interesting and suggestive. Thirdly, it fits in admirably with the growing interest in world organisations and especially with the ideas underlying the League of Nations. It is a striking proof of the strictly scientific, or at least theoretical, point of view of the author that such obvious applications of his theory are not even mentioned. It would have made the book easier to read and attracted a wider public had he allowed himself more popular and topical illustrations of this kind.

The general thesis, however, though difficult and at times doubtful in its development, may be quite shortly and simply stated: "Man's consciousness was once pre-individual, a group-consciousness; it is now individual and is becoming super-individual." Combining this main doctrine with the 'spiral' idea of human progress, Mr. Heard has many brilliant *aperçus* in his review of anthropology. As we advance in a spiral up the steep ascent, we are able at certain points to stand over our primitive ancestors, and, looking straight down upon them, understand them better than intermediate generations have done, who went off in another direction. This, in fact, is the main argument, or at least suggestion, in Mr. Heard's interpretation of the primitive mind. The individualist psychologist of the eighteenth and nineteenth centuries went astray in studying early man by treating him as a small and undeveloped example of the same sort of mind as he had himself. We now, gradually acquiring, at a higher level, a 'co-conscious' mind, more similar in that respect to his own, can understand him better.

It will be clear from this—a typical and frequently repeated argument in the book—that Mr. Heard makes no pretence to a final or comprehensive judgment on any of the questions he discusses; he is, on the contrary, extremely modest and tentative throughout. But the issues involved are of such supreme moment, and his goal and the spirit in which he approaches it are so fine, that his book deserves careful reading and the criticism for which he pleads. "All efforts to interpret human events in economic terms have failed to produce a philosophy of history. The real advance, consistent but elaborate and concealed, is in man's spirit." With that general doctrine we may heartily agree.

One or two criticisms may be added, such as the author desires. His matter is much more complete on the psychological and anthropological side than on that of history or the philosophy of history. He has thought deeply and read widely on psychic questions and primitive psychology, but, when he comes to a review of theories about progress and the evolution of civilisations, Vico, Flinders Petrie, Spengler, and Henry Adams are the only authors he

names. To mention only one omission, he would have found in Comte's philosophy of history much that fits in and fortifies his own. To Comte also the present age is *par excellence* that of revolution, and this revolutionism is due to the bursting out of a growth of 'individuals' who have not yet learnt to subordinate their selfishness to the new form of co-consciousness on which both Mr. Heard and Comte substantially agree. For what else is the new super-consciousness except the sense of a common humanity of which we are all, individuals and nations, only subordinate and inseparable organs?

On one other point, a question of substance and vital moment, many readers will feel that Mr. Heard does not do justice to the 'individualism' which must pass away, if society is to advance. This cannot be regarded as a wholly evil thing. Not only was it the necessary condition of rising to a higher plane at all, but also it must be fulfilled and sublimated by the higher consciousness and not abolished. If the humanity of the future were to consist of a species of higher ants, acting only through the group-instinct, however large the group may be, all the most valuable achievements of the intermediate stage would have been lost. No doubt Mr. Heard would accept this amendment of his general argument; to work it out in detail and in practice is the supreme moral task of the future. "Self-knowledge is self-creation"—one of the best of his many good sayings—conveys his consciousness of it and his idea of the right line of approach.

F. S. MARVIN.

A Source Book in Mathematics.

A Source Book in Mathematics. By Prof. David Eugene Smith. (Source Books in the History of the Sciences, Vol. 2.) Pp. xvii + 701 + 8 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw Hill Publishing Co., Ltd., 1929.) 25*s*. net.

THIS is a very entertaining volume, a surprisingly successful attempt to do what nearly all good judges would have declared to be impossible. Its aim is "to present the most significant passages from the works of the most important contributors" to mathematics "during the last three or four centuries".

It is easy to think of a dozen excellent reasons why such an attempt is sure to be a failure. Any compilation of this kind is bound to be scrappy, and in many ways unrepresentative, and no two competent mathematicians will ever be found to agree on principles of selection. The original presentation of an important idea is usually by no means the best, either logically or for purposes of instruction. The passages selected must be translated (if the book is to sell in the United States), and, however competent the translators, a great deal of the savour of the originals must be lost in translation. In short, it is very difficult to imagine any class of students or teachers to whom the book can possibly appeal except as a curiosity, and the time and money spent on its production might be used much more profitably in other ways.

The fact remains that Prof. Smith's volume is a very definite success; it is interesting to read and pleasant to possess. The translations are accurate and vigorous, the printing and illustrations excellent, and the general level of scholarship shown by the contributors is very much higher than is usual in scientific compilations. Among them are prominent researching mathematicians such as Bateman, Bell, and Tamarkin, as well as historians like Archibald, Cajori, and Smith; and Prof. Smith, as editor, has combined the activities of his collaborators with quite remarkable skill.

It is interesting to see what mathematician scores most freely, and no one will be surprised to find that it is Gauss. Gauss has five contributions; on congruences, on the law of quadratic reciprocity, on the fundamental theorem of algebra, on regular polygons, and on the conformal mapping of surfaces. Three of these at least would probably have been unanimous selections of any editorial board. Fermat also scores five, but one is merely the famous 'marginal comment' concerning the impossibility of $x^n + y^n = z^n$; Abel and Euler each score three. There is little Newton; but the volume is limited to pure mathematics. It is surely a mistake to have omitted Cantor and Weierstrass entirely, and Riemann is represented only on the geometrical side. I should have preferred to go without Horner's method or nomography, but I can see that a great many people would disagree with me. On the other hand, I was particularly pleased to find Tchebichef's work on primes, and the early writings on non-Euclidean geometry are particularly well represented.

I may conclude by mentioning a few historical curiosities chosen at random. The first use of π occurs in "Synopsis Palmariorum Matheseos: or, a New Introduction to the Mathematics" (1706), by William Jones, who seems to have been quite a good mathematician (p. 346). The addition formulæ for the sine and cosine seem to be due to Dithmarsus and Clavius (Christopher Clavius, "Astrolabium", 1593);

Clavius's 'method of prosthaphæresis' is almost an anticipation of calculation by logarithms (p. 459). Continued fractions are first found in Bombelli's "L' Algebra parte maggiore dell' aritmetica divisa in tre libri" (1572, p. 80); Cataldi (1613) gives what is practically the usual symbolism. G. H. Hardy.

Welsh Folk-lore.

Welsh Folk-lore and Folk-Custom. By Prof. T. Gwynn Jones. Pp. xx + 255. (London: Methuen and Co., Ltd., 1930.) 7s. 6d. net.

PROF. GWYNN JONES'S little book on Welsh folk-lore is a welcome companion and supplement to Miss Hull's "Folk-lore of the British Isles" in the same series. The author is able to deal in greater detail with topics on which Miss Hull could do little more than touch in covering the larger area. Here we have presented within a relatively small compass a much fuller statement of the chief features of the lore and custom of the Welsh people.

The composite character of English folk-lore and custom has often been pointed out. The same character is to be attributed to Welsh folk-lore in even a greater degree, where indeed it would seem probable that more of the earlier phases of primitive custom and belief have survived. This, perhaps, might have been expected from the cultural history of the principality. Settlers seem to have absorbed the tradition and culture of the earlier population to a greater degree than in England. It will be remembered that Giraldus Cambrensis noted this as characterising Norman invaders in Ireland, who became "Hiberniores ipsis Hibernicis".

The survival of very early tradition is exemplified in the stories of the Mabinogion, in which elements of a most primitive character are to be found side by side with features characteristic of the chivalrous civilisation of Norman times. Fairies and giants both figure prominently. As the late Sir John Rhys pointed out, the former are often of a pre-iron or even pre-metal age, as for example in the stories of the fairy-wife who vanishes on being struck accidentally by iron.

Prof. Gwynn Jones has devoted himself in the main to a record of fact; theories as to origins and parallels are mostly avoided. This is no doubt wise in view of the importance of securing a record of facts as extended as possible before they vanish entirely. But in a few cases a consideration of parallels found elsewhere would be of assistance to the reader who is not a specialist. As an example, the *Mari Lwyd*, the custom that at certain times a person known as *Mari* should carry round a horse's skull, should be compared with the similar traditional practice in the Isle of Man and at Ramsgate. It is suggested here that the custom may be connected with marriage; but more probably it is a general fertility rite which has been adapted to special occasions and seasons.

Among the many other topics with which the author deals, attention may be directed to the valuable account of holy and wishing wells. The book is a record of great value which, it may be hoped, will stimulate others to add to the material before it is too late.

Our Bookshelf.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Editorial Board: Hans T. Clarke, Editor-in-Chief; Roger Adams, James B. Conant, Henry Gilman, C. S. Marvel, C. R. Noller, Frank C. Whitmore, C. F. H. Allen. Vol. 10. Pp. vii + 119. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 8s. 6d. net.

Among the more familiar of the thirty-one preparations contained in this volume are benzenesulphonic chloride, benzophenoneoxime, methyl oxalate, and anhydrous oxalic acid. Useful practical details will be found under all these headings: thus, benzophenoneoxime is gradually converted into a mixture of benzophenone and nitric acid when kept under ordinary conditions, and a method of inhibiting this decomposition is given. The less common preparations include durene, duroquinone, and pyromellitic acid. The last-named compound is made by oxidising finely powdered pine or spruce charcoal with sulphuric acid in presence of a little mercury, and it is remarkable that ordinary willow charcoal failed to yield this benzene derivative when treated in a similar way. A useful apparatus for the application of superheated alcohols in the formation of various high-boiling ethyl and methyl esters is described under the heading of ethyl fumarate.

Of biochemical interest are the preparations of casein (from milk), *l*-tryptophane and *l*-tyrosine (from casein), taurine (from ethylene dibromide through sodium 2-bromoethanesulphonate), erucic acid (from rape seed oil), and lauryl alcohol (from cocoanut oil). There is also a noteworthy series of preparations departing from acetone and proceeding through bromoacetone and acetol to *l*-propylene glycol; the latter process affords an example of the biological method of asymmetric reduction by means of yeast reductase. An appendix contains later references to preparations in preceding volumes, but the index covers the current volume only. A revised collection of the contents of the first nine volumes is to be issued in due course. J. R.

American Geographical Society. Special Publication No. 11: *Brief History of Polar Exploration since the Introduction of Flying.* By W. L. G. Joerg. To accompany a Physical Map of the Arctic and a Bathymetric Map of the Antarctic. Pp. v + 50 + 2 maps. (New York: American Geographical Society, 1930.) 5 dollars.

BOTH these are layer coloured bathymetrical maps on a scale of 1 : 20,000,000. The Arctic map is a revised version with insets and names in English of the map in Andree's "Handatlas" (1924). It is an excellent map with much detail. A slight misuse is made of the name Svalbard. It is the name for all the islands, except Jan Mayen, under Norwegian sovereignty in the Arctic Sea and not a synonym for the island of Spitsbergen itself.

The Antarctic map is new and gives a new version of the bathymetry of the Southern Ocean, though Mr. Joerg avoids that name. We note that the soundings of the *Discovery* between Tristan da Cunha and South Georgia do not seem to be included and of course those of the *Discovery* in her present expedition were not available. It was perhaps a pity to bring out a new map of the Antarctic at a time when several expeditions are at work in the south. A delay of a few months would have allowed the addition of the important discoveries of Sir Douglas Mawson in the *Discovery* and Capt. Riiser Larsen in the *Norvegia* in the region of Kemp, Enderby, and Coats Land. The American work in the Ross Sea region is shown.

It is to be hoped that the omnibus name of Antarctic Archipelago for all the islands between Clarence Island and Charcot Island will be abandoned. It is neither explicit nor necessary. The practice of British cartographers of using Coats Land for all the land on the east of the Weddell Sea with differentiation into various 'coasts' has not been adopted. The old tendency on polar maps to multiply 'land' reappears. The notes accompanying the maps are chiefly useful for their account of Admiral Byrd's recent work, accounts of which have not, so far, been readily accessible except in American newspapers. R. N. R. B.

The Organization of Knowledge and the System of the Sciences. By Henry Evelyn Bliss. Pp. xx + 433. (New York: Henry Holt and Co., 1929.) 5 dollars.

DR. BLISS'S book makes a twofold appeal. It is written by a librarian as a guide for librarians, and it also has a philosophical purpose. It criticises, in the latter part of the volume, all the better-known systems of classification of knowledge, and Dr. Bliss maintains that it is necessary for a librarian, as for anyone else dealing with the instruments of knowledge, to have a correct idea of its natural articulations in order to serve and co-operate to the best advantage with others working in various parts of the field. We are therefore inclined to turn first to the later chapters, although the earlier contain an impressive account of the increasing complexity of functional organisation of all kinds in practical life. The need of right organisation of thought to secure right organisation of action is the keynote of the book. It is a serious and very suggestive compendium.

Turning to the later chapters, which will be of most interest to the scientific reader, we notice that Dr. Bliss gives the first place among his 'almosters' to Ostwald, for his classification of the sciences into three main groups, with three or four main subdivisions in each. We are inclined to agree with him, mainly on the ground of clearness and simplicity. The three main groups are: (1) The formal sciences, under the concept of order; (2) the physical sciences, under the concept of energy; (3) the biological, under the concept of life. It proceeds, as all these systems do, from Comte's original, but it corrects and completes it. As knowledge grows, the boundaries will no doubt be again corrected in future. Dr. Bliss deserves our thanks for directing attention to the importance of the subject and spurring everyone to improving it. F. S. M.

Sleep and the Treatment of its Disorders. By Dr. R. D. Gillespie. (Minor Monograph Series.) Pp. ix + 267. (London: Baillière, Tindall and Cox, 1929.) 7*s*. 6*d*. net.

DR. GILLESPIE, who is a member of the younger school of British psychiatrists, is to be congratulated on producing a most readable and at the same time stimulating book on what is one of the most interesting problems of modern physiology—sleep. The author provides us with a wealth of clinical material and discussion. He wisely points out that the effects of loss of sleep are by no means so serious as are generally presumed; at the same time there is no question that in the mentally disordered, loss of sleep is a serious question. Experience in a mental hospital soon provides confirmation of this. His discussion of the theories of sleep is well balanced and well set out. In discussing the treatment of the psychoses by means of prolonged sleep, we should prefer to see somnifen described as a mixture of the diethylamin salts of diethylbarbituric acid and allylisopropyl barbituric acid and not as a single substance.

Intermediate Dynamics and Properties of Matter. By Dr. R. A. Houstoun. Pp. ix + 139. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 3*s*. 6*d*.

THIS book, which is of intermediate examination standard, deals very ably with those branches of physics that border on applied mathematics, and which present considerable difficulty to elementary students. The subject offers little scope for novelty of treatment, but has nevertheless been presented in an interesting manner, whilst the book also includes sections on various important branches such as rotational motion and gravitation, which are often omitted, although with little justification. The chapter on pumps has good accounts of the modern Hyvac pump and the McLeod gauge, and the chapter on the properties of matter a few paragraphs on diffusion, osmosis, and absorption of gases. One wishes that there were more equally good elementary texts in existence.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Constitution of Chromium.

THE first mass-spectra of chromium were obtained by means of accelerated anode rays. The results were very feeble and only showed one line of mass number 52 (NATURE, Sept. 22, 1923, p. 449). I have now been able to make experiments with a volatile compound of this metal, the solid carbonyl, $Cr(CO)_6$, kindly prepared for me by Dr. A. v. Grosse, of Berlin. The vapour pressure of this is low but sufficient for use in the ordinary discharge tube when suitable arrangements are made. The intensity of the beam of mass-rays has been so increased that not only has it been possible, by the use of fine slits, to obtain a value for the packing fraction of Cr^{52} but also, by the use of coarse slits and long exposures, to reveal no less than three new isotopes, and to determine their relative abundance photometrically as follows:

Mass number . .	50	52	53	54
Percentage abundance	4·9	81·6	10·4	3·1

The packing fraction of Cr^{52} is -10 with a maximum possible uncertainty of ± 3 (pts. per 10,000, $O^{16}=0$) a large negative value, as expected from the curve. Correcting for this and for the change to the chemical scale we get

Atomic weight of Cr
$=52{\cdot}011 \pm 0{\cdot}006$,

a value identical with that in use.

It will be noticed that the lightest isotope is isobaric with the doubtful Ti^{50} and the heaviest with Fe^{54}.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, July 26.

Hydrogenised Iron of High Magnetic Permeability.

SINGLE crystals of iron produced some time ago in this laboratory by high temperature treatments in hydrogen [1] were found to have higher permeabilities than crystals grown by other methods.[2, 3, 4] Experiments soon showed that these high permeabilities were not the result of the large crystal size, but of the hydrogen treatment at the high temperature. As a result of further experiments great improvements in the permeability of iron have been obtained by heat treatments in hydrogen not resulting in large crystals, and values of initial and maximum permeabilities now repeatedly obtainable are 6000 and 130,000 respectively. For such specimens the coercive force is 0·05 gauss and the hysteresis loss for $B_m=14{,}000$ is 300 ergs/c.c./cycle. The magnetisation curves and hysteresis loop are shown in Figs. 1 and 2. For comparison, similar curves for ordinary annealed iron are also shown. Mechanically, this is the softest iron yet produced, having a hardness about the same as that of annealed copper.

These results have been obtained in cylindrical specimens of Armco iron one inch in outside diameter, ¾ inch in inside diameter and ¼ inch high, heat treated in moist hydrogen at between 1400° C. and 1500° C. for 12 hours. The specimens are then cooled to 880° C. or to room temperature, after which they are annealed at 880° C. for 2 hours. As a result of this treatment the specimens are etched as if by evaporation and have a grey colour probably due to a thin film of oxide. The grain diameter ranges from 0·1 to 2 mm. The magnetic properties are quite sensitive to mechanical strain but it has been found that deleterious effects due to overstrain, occurring at any time after the high temperature treatment, may be wiped out by a subsequent annealing at 880° C. This fact has been used to advantage where mechanical operations are desirable in the preparation of the specimens, the low temperature annealing being given after severe hard working of the material already treated at the high temperature. Experiments have also shown that the hydrogenising process may be applied in the melt.

Various experimenters have reported improvements in the magnetic properties of iron by heat treatments in hydrogen,[5, 6, 7] but the results obtained have not been so good as for specimens treated in vacuum [8, 9, 10] or nitrogen [6] or slightly oxidising atmospheres.[11] Such improvements as have been obtained have usually

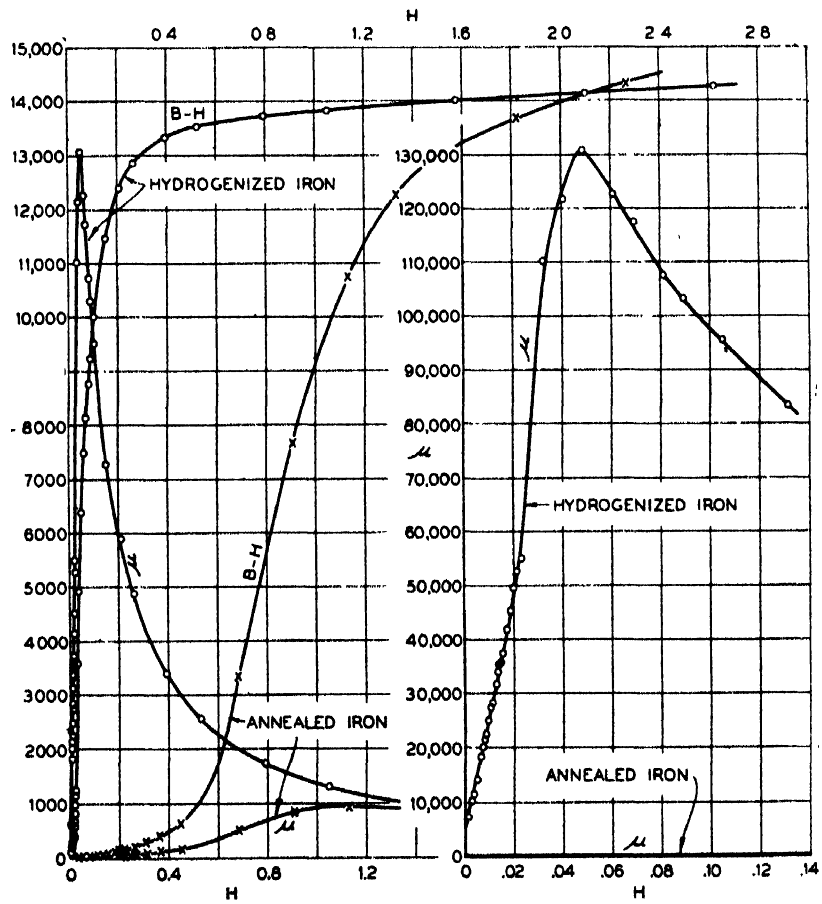


FIG. 1.

been ascribed to the removal of absorbed gases, reduction of the oxides, or decarburisation. Recently Yensen [12] reported high permeability in a specimen of carefully purified and vacuum treated iron. More recently Zeigler [13] reported similar results for a specimen consisting of several large crystals, from which he concludes that high permeability in iron is obtained only in single crystal specimens. Rogers has obtained

higher permeability than Yensen or Zeigler by melting iron in a low pressure carburising atmosphere, but makes no mention of the crystal grain size.[14]

It is believed that the high permeabilities obtained with hydrogenised iron are at least partly due to the absorbed hydrogen. This is shown by the fact that hydrogen treated iron of high permeability, when re-treated at a high temperature and in a good vacuum (about 10^{-8} mm.), assumes the permeability of ordinary iron treated in the high vacuum only. The drop in permeability of the hydrogenised specimen is presumably due to the loss of absorbed hydrogen. In other experiments the gas given off by the hydrogenised specimen was collected and analysed and found to be principally hydrogen. Determinations of the degree of deoxidation and decarburisation in hydrogenised iron are as yet incomplete.

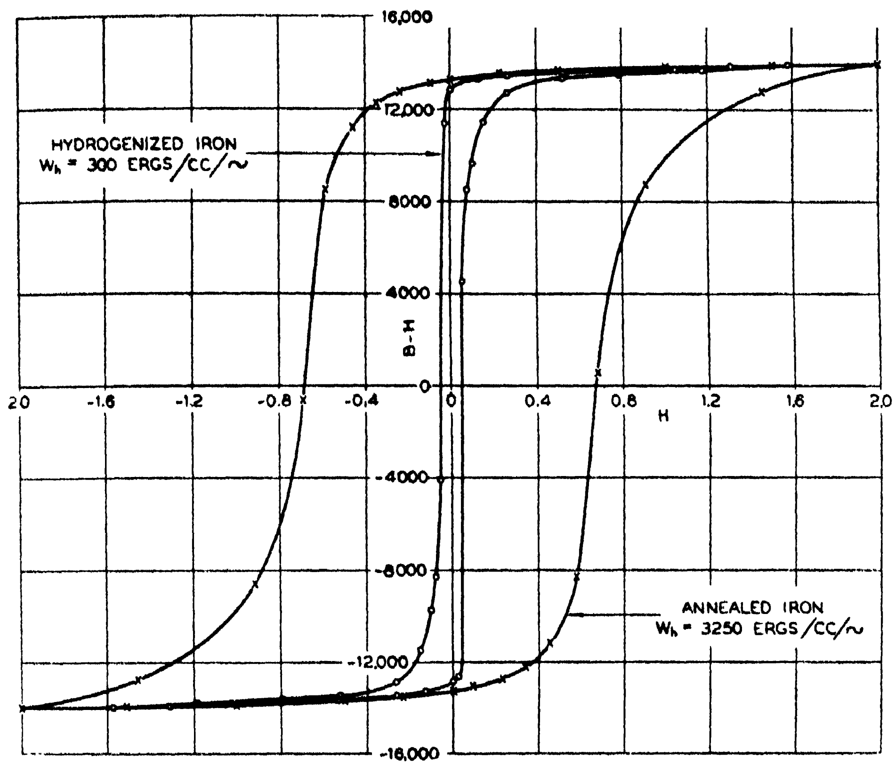


FIG. 2.

The factors which determine the results are temperature and time of treatment, pressure of hydrogen, and thickness of the metal. These are the factors which enter into Richardson's equation for diffusion and absorption of hydrogen by metals.[15] If the large magnetic improvements are dependent upon the absorption of an optimum quantity of hydrogen, it should be possible to obtain the same results by any suitable combination of the factors satisfying Richardson's equation. Experiments indicate that this is so.

P. P. CIOFFI.

Bell Telephone Laboratories, New York, June 16.

[1] L. W. McKeehan: NATURE, **119**, 705-706; 1927.
[2] W. Gerlach: *Zeit. f. Physik*, **38**, 828-840; 1926.
[3] K. Honda and S. Kaya: *Tôhoku Imp. Univ. Sc. Rep.*, **15**, 721-753; 1926.
[4] D. D. Foster: *Phys. Rev.*, **33**, 1071; 1929.
[5] W. E. Ruder; U.S. Patent No. 1,110,010, Sept. 8, 1914.
[6] E. Gumlich: *Electrician*, **83**, 494-495; 1919.
[7] F. P. Wilson, Jr.: *Gen. Elec. Rev.*, **30**, 544-550; 1927.
[8] E. Gumlich: *Stahl u. Eisen*, **41**, 1249-1254; 1921.
[9] T. D. Yensen: *Trans. A.I.E.E.*, **34**, 2455-2495; 1915.
[10] F. S. Tritton and D. Hanson: *Jour. Iron and Steel Inst.*, **110**, 90-121; 1924.
[11] T. D. Yensen: *Trans. A.I.E.E.*, **43**, 558-567; 1924.
[12] T. D. Yensen: *Jour. Frank. Inst.*, **206**, 503-510; 1928.
[13] N. A. Zeigler: A.I.M.E., *Tech. Pub.* No. 273.
[14] This result was reported by Anson Hayes in discussing a paper by T. D. Yensen, *Trans. Am. Electrochem. Soc.*, **56**, 215-229; 1929.
[15] O. W. Richardson, J. Nicol, T. Parnell: *Phil. Mag.*, **8**, 1-29; 1904.

Change of Wave-length of Light due to Elastic Heat Waves at Scattering in Liquids.

SOON after the discovery of the Raman effect, I attempted to find out whether in light scattered in various organic liquids the Raman lines, due to frequencies of the rotation spectrum, are present. These lines should be situated very close (probably within some fraction of an angström) to the incident line. In the course of these experiments a very interesting phenomenon was observed.

When the light λ4358 A. of a mercury lamp scattered at an angle of 90° by the liquids was examined by means of a highly resolving instrument (30 steps echelon grating), it was observed that besides the radiation with a wave-length equal to the incident one there were also other radiations of nearly the same intensity, the wave-lengths of which are symmetrically displaced relatively to the incident wave towards greater as well as smaller wave-lengths by a value depending upon the kind of liquid, but not differing greatly from 0·05 A. for all the liquids studied. The spectrogram of the scattered light has thus the shape of a triplet with a distance between the components of about 0·05 A. In the case of highly scattering liquids, such as toluene and benzene, I observed also some lines displaced by a multiple of this value. In the last-named liquids, up to three displaced lines on each side of the unmodified line, that is, 7 components in all, could be discerned, so that the farthest of them were at a triple distance, namely, c. 0·15 A. (The exposures could be so chosen that the components of hyperfine structure of line 4358 A. did not hinder the observations.)

These results were obtained last summer but their interpretation remained for some time not clear. Some considerations and further experiments (which will be published elsewhere) have led me to the conclusion that it is scarcely possible to regard the displaced components as Raman lines due to the rotational quanta.

Another explanation of the observed splitting of the scattered light is that this splitting is due to acoustic oscillations like those used by P. Debye (*Ann. d. Phys.*, **39**, p. 789; 1912) for explaining the variation of the specific heat of solids at lower temperatures. These elastic heat waves propagate in the medium with the velocity of sound and produce periodical variation of the amplitude of the scattered light, thus giving rise to two new frequencies:

$$\nu = \nu_0 \pm 2\nu_0 \frac{v}{c} \sin \frac{\theta}{2}. \qquad (1)$$

Here ν_0 is the frequency of the incident light, v is velocity of sound and c that of light in the medium, and θ is the angle between incident and the scattered rays.

This equation was given by Brillouin (*Ann. de Phys.*, **17**, p. 88; 1922) and also by Mandelstam

(*Jour. Russ. Phys.-Chem. Soc.*, **58**, p. 831; 1926), who has derived it from somewhat different considerations. The possibility of a change in light frequency according to equation (1) was also pointed out by Bogros and Rocard (*Jour. de Phys. et le Radium*, **10**, p. 72; 1929). However, their conclusion as to the absence of the phenomenon referred to seems to be erroneous.

The observed and calculated values of the splitting of two adjacent components are given in Table 1.

TABLE 1.

	$\Delta\lambda_{obs.}$ in A.	$\Delta\lambda_{calcul.}$ in A.
Aniline . . .	0·050 ± 0·005	0·056
Toluene . . .	0·047 ± 0·003	0·039
Benzene . . .	0·047 ± 0·003	0·036
Water . . .	0·045 ± 0·004	0·040
Ethyl alcohol . .	0·039 ± 0·004	0·033
Ethyl ether . .	0·035 ± 0·004	0·027

The agreement between $\Delta\lambda_{obs.}$ and $\Delta\lambda_{calcul.}$ is surprisingly good, and it remained to verify the existence of the connexion between angle θ and ν predicted by the theory. Such an experiment was necessary because the presence of undisplaced and multiple components seemed to contradict the above interpretation. (The liquids used in the investigation were from the firm of Kahlbaum and I have not purified or distilled them. I think, nevertheless, that the occurrence of the undisplaced component cannot be ascribed exclusively to contamination, dust, or stray light from the arc.)

The experiments with crystalline quartz (to be described in a separate communication) have shown that a crystal, in which the splitting according to equation (1) is mostly probable, gives a splitting of the frequency of scattered light similar to that of liquids.

It was found also that the scattering of a radiation of a mercury lamp λ4047 A. in benzene gives the same splitting as λ4358 A. The dependence of ν on θ was checked with benzene. Light rays scattered at the angles $\theta = 45°$ and $\theta = 135°$ were investigated. With $\theta = 45°$ the displaced components were expected to approach the undisplaced line so closely that under actual experimental conditions they could not be resolved. The spectrogram showed only a broadening of the undisplaced line. But with $\theta = 135°$ not only could the components predicted by equation (1) be observed, but also those displaced at multiple distances. All the components (the undisplaced one included) are equidistant and more separated one from another than at the angle 90°. The position of the undisplaced line remained unaltered at $\theta = 45°$ (the middle of the broadened line) and at $\theta = 135°$.

Table 2 gives averaged experimental values of $\Delta\lambda_{135°}$ and those calculated by equation (1), as well as ratios $\Delta\lambda_{135°}/\Delta\lambda_{90°}$ observed and calculated.

TABLE 2.

θ.	$\Delta\lambda_{obs.}$	$\Delta\lambda_{calcul.}$	$\left[\frac{\Delta\lambda_{135}}{\Delta\lambda_{90}}\right]_{obs.}$	$\left[\frac{\Delta\lambda_{135}}{\Delta\lambda_{90°}}\right]_{calcul.} = \frac{\sin 67° 30'}{\sin 45°}$.
90°	0·047 ± 0·003	0·039	1·32	1·31
135°	0·063 ± 0·002	0·050		

The agreement between observed and calculated values is quite satisfactory.

It may be concluded from the above that a close connexion between the splitting of wave-lengths of the scattered light and the elastic heat waves in the given medium does exist. These results may be regarded as a demonstration of the reality of Debye's waves and at the same time suggest a new 'spectroscopic' method for the determination of the velocity of sound in liquids and solids.

Equation (1) in the case of light scattering in liquids is to be replaced by the equation

$$\nu = \nu_0\left(1 \pm 2n\frac{v}{c}\sin\frac{\theta}{2}\right), \quad \text{where } n = 0, 1, 2, 3, \ldots$$

and the theory of light scattering by elastic waves is to be modified accordingly.

The number of components I could observe with my apparatus corresponded to $n \leq 3$, yet it is probable that components corresponding to $n > 3$ are also present. The broadening of the scattered line observed by Cabannes, Daure et Salvaire (*C. R.* **186**, p. 1533; 1928; **188**, p. 907; 1929), Gerlach (*Ann. d. Phys.*, **5**, p. 301; 1929) and Raman (*Proc. Roy. Soc.*, **122**, p. 23; 1929) can be explained, I think, at least partly by this phenomenon.

The existence of an undisplaced component ($n = 0$) is probably not connected with acoustic oscillations, that is, it is not due to rapid fluctuation of density caused by the propagation of elastic waves, but more likely to some comparatively slow fluctuation, maybe to the orientation fluctuations, the rôle of which in light scattering in liquids has already been discussed (for example, Raman and Krishnan, *Phil. Mag.*, **5**, p. 498; 1928). On the other hand, the occurrence of the undisplaced component may be due to the association of molecules in liquid. In this connexion it is interesting to note that when scattering is produced by a crystal (quartz), where such slow fluctuations cannot take place, an undisplaced component is, as it seems, absent or at least very weak.

The existence of multiple components ($n = 2, 3 \ldots$) may perhaps be ascribed to the scattering from 'elastic gratings' of harmonics.

The phenomenon described, as it seems, may prove of importance for the theory of light scattering as well as for the theory of specific heat of liquids and solids. It may also play an important rôle in Raman effect and probably give, as I believe, some explanation of the observed considerable broadening of Raman lines (Wood, *Phil. Mag.*, **6**, p. 1282; 1928; Langer and Meggers, *Phys. Rev.*, **33**, p. 115; 1929).

In conclusion, I wish to point out that the above experiments may be regarded as an illustration of the change of wave-length of light produced by the modulation of the amplitude of oscillations—a problem which has attracted attention of physicists for a long time (Wood, "Physical Optics", p. 407; 1905; Cotton, *Le Radium*, **8**, p. 404; 1911; Rupp, *Zeit. f. Phys.*, **47**, p. 72; 1928).

E. GROSS.

Optical Institute,
Leningrad, June 20.

Tercentesimal Temperature and the Kelvin Absolute Scale.

IN NATURE of July 19 a review entitled "Discursive Meteorology", meaning as I think 'discursive physics', asks a question to which I ought if possible to find an answer. The reviewer writes: "Some of his own usages arouse criticism, in particular, that of *tt* to denote absolute temperature (not only in the form 300° *tt*, but also in formulæ); why should not meteorologists adopt the now growing physical practice of writing 'K' to denote the Kelvin absolute scale, just as 'C' and 'F' are used for the Centigrade and Fahrenheit scales?"

To begin with, the answer is categorically in the negative.

(1) I have never used *tt* to denote absolute temperature. (2) So far as I know I have never used the form 300° *tt* and never shall; if it is in any one of my volumes it is a misprint; it shocks my æsthetic sense to see

it printed in NATURE. (3) I have never known a meteorologist use the Kelvin absolute scale to express the temperature of the air numerically.

What many of us use is the temperature as read on an ordinary thermometer with 273 added, either by the instrument maker, the observer, or the computer. The result is often loosely called absolute temperature, and may be so called anywhere except at one's writing-table. With rather surprising emphasis, the most incisive of my scientific friends insist upon drawing a very marked distinction between it and the absolute scale, a distinction which I find it impossible to repudiate or ignore though numerically (about a tenth of a degree) it is of no importance.

Equally I find it impossible to regard the so-called absolute temperature as something of the same order as a scale, be it 'C' or 'F' with an arbitrary zero. The one connotes energy; the others connote only the reading on a scale and have no dimension. To my mind there is the same difference betwen the two as there is between volts, amperes, or microfarads and the number of degrees of deflection of a spot of light on the screen of a galvanometer.

I have called the measure of energy by C + 273 the 'tercentesimal temperature'. To-day, for the atmosphere, I would prefer to call it the thermancy and leave temperature to retain its popular usage; but, so far as I am concerned, the opportunity for that has been allowed to go by.

While I was writing discursive meteorology or discursive physics, I came upon a paragraph in a preface by Prof. Ernest Barker of a book on national character which appealed to me so strongly that I may be excused for quoting it.

"It is impossible to think clearly with Protean terms; and the first necessity of argument is the use of clean words which are always used to denote the same things and connote the same attributes. To use a single word when three or four different ideas are in question and to use it now for one and now for another of the ideas, is a confusion of ideas and of argument." From that point of view I was quite pleased with 'tercentesimal temperature' as distinguishing what I was using from veritable absolute temperature as well as from 'C' or 'F'. I thought it a clean, crisp note direct from the International Bank of Scientific Intelligence, Ltd., which still keeps my small account. It never occurred to me to regard it as a bit of old newspaper picked up from the scrapheap of abortive science, and criticism notwithstanding, I do not so regard it even now.

As to *tt* for a symbol of quantity, I have only to say for that, that it is new and crisp and quite useful. So is another piece of apparent duplicity, namely, *bb* for pressure-gradient in absolute units. Any other symbol that is used for either has been overworked for years. If the reviewer or any other of my scientific friends who have to face the terrible discursiveness of the physics of the atmosphere will give such suitable double letters a trial, with the understanding that always and everywhere they will carry exactly the same meaning, he will find them, as I have done, extraordinarily convenient. NAPIER SHAW.

July 21.

Isotope Effect in the Spectrum of Boron Monoxide: Intensity Measurements and Structure of the β-Bands.

MEASUREMENTS of the intensities of the lines in four bands in the β system of boron monoxide excited by active nitrogen have enabled the intensity ratios of the $B^{11}O$ and $B^{10}O$ bands to be determined. Each band has been measured on two plates, and the intensities of the corresponding lines in the two isotopic bands compared. The following table gives the mean ratio of the lines for each of the bands, for each of the two plates:

Band.	$1\rightarrow5$.	$2\rightarrow5$.	$2\rightarrow6$.	$3\rightarrow7$.
Intensity $B^{11}O/B^{10}O$.	3·36	3·34	3·50	4·30
	3·46	3·22	3·17	4·38
Mean . . .	3·41	3·28	3·34	4·34

The first three agree quite well, but differ from the result for $3\rightarrow7$ by an amount considerably greater than the probable error; it is most unlikely that the discrepancy is due to 'blending' with lines of other bands. The result appears to show a real difference in the intensity ratios of the isotopic bands for different vibration transitions. It is possible that the difference is due to some selective excitation properties of active nitrogen.

These results may be compared with the isotope ratio calculated from the atomic weight of boron. Taking 11·0110 and 10·0135 for the atomic masses of B^{11} and B^{10} respectively (F. W. Aston, *Proc. Roy. Soc.*, **115**, 487; 1927), and 10·82 for the atomic weight of boron (German Atomic Weights for 1927), the calculated abundance ratio of the isotopes is 4·22 : 1. There appears to be a possibility that the atomic weight of boron varies according to the source from which it is obtained (H. V. A. Briscoe and P. L. Robinson: *Jour. Chem. Soc.*, **127**, 696; 1925), and since the atomic weight of the boron used in the intensity measurements has not been determined, the calculated isotope ratio must be regarded as uncertain.

It appears from the above measurements that, in this case at least, the intensity ratios of isotopic bands do not give a true measure of the relative abundance of the isotopes as they occur in nature.

STRUCTURE OF THE β-BANDS OF BORON MONOXIDE.

It has been known for some time that only one series of lines occurs in the β bands of boron monoxide excited by active nitrogen, whereas in the same bands excited in the arc, a second series of approximately equal strength appears (R. S. Mulliken, *Phys. Rev.*, **25**, 259; 1925). It was suggested by Mulliken (loc. cit.) that the P branch was missing in both cases, that the two series in the arc were electronic doublets constituting an R branch, and that only one member of the R branch doublet was excited in active nitrogen.

The arc bands have been examined with a Hilger $E1$ quartz spectrograph, and it was found that the lines in both series are very close doublets, the doublet separation increasing with distance from the head. The frequencies of the lines in the $0\rightarrow1$ and $0\rightarrow2$ bands have been measured (neglecting the fine structure), and good agreement of the combination differences for the excited state of the two bands is found, if the two series are assumed to be P and R branches, the P branch being the series which appears only in the arc. The lower state combination differences for the $0\rightarrow2$ band then agree very well with those for the $0\rightarrow2$ band in the α system (W. Scheib, *Zeit. f. Physik*, **60**, 74; 1930), which has the same final state as the β bands.

From these considerations, it appears practically certain that doublet P and R branches of approximately equal strength occur in the arc β bands, whereas (see Mulliken, above reference, for possible exceptions) only the R branch occurs in the bands excited in active nitrogen; it is not known whether this branch is double or not, as the rotation structure is not sufficiently developed in this case to enable the doublets to be resolved with the instrument employed.

From the above measurements, a preliminary value of $B'_0 = 1{\cdot}53$ cm.$^{-1}$ is obtained. The values of B'' are already known from the work of Scheib (loc. cit.), since the α and β bands have the same final state.

A. ELLIOTT.

Physical Laboratory,
University of Utrecht.

Sputtered Nickel Films and the Synthesis of Ammonia.

I HAVE recently found that when a film which has been sputtered from a nickel cathode in an atmosphere of nitrogen is afterwards heated to 150° C. or more in hydrogen, ammonia is produced. The process undoubtedly consists in the reduction of a nitride of nickel formed in sputtering: the quantity of ammonia —10-20 mgm. for a film of perhaps 200 sq. cm.—checks reasonably well with the amount of nitrogen absorbed in sputtering. Heating in a large excess of hydrogen, with added nitrogen, has not as yet been found to increase appreciably the yield of ammonia, so the process does not appear to be catalytic in the ordinary sense—for the pressures and temperatures tried so far.

Of course, the production of ammonia from nitrides is common (cf. the Serpek process), and the nitride of nickel is not unknown (see, for example, Beilby and Henderson, *Jour. Chem. Soc.*, **79**, 1251; 1901: Vournasos, *C.R.*, **168**, 889; 1919). The chief novelty in the present work, aside from the method of production of the nitride, is the comparatively low temperature at which the reaction takes place. This is probably due to the nitride being produced in sputtering in a very finely divided form (although doubtless still crystalline, cf. Ingersoll and Hanawalt, *Phys. Rev.*, **34**, 975; 1929).

It may be pointed out that the sputtering process—when used under conditions such as the present, of relatively high gas pressure and low voltage—offers a method, hitherto little used, for the formation of many unusual compounds or quasi-compounds. With the metal (probably) in the vapour state and the gas largely excited, combinations are certainly to be expected (cf. v. Hippel, *Ann. d. Phys.*, **81**, 1072; 1926), if they are at all possible. Conditions of current density and gas pressure are likely to be somewhat critical. In the present case nitrogen is most rapidly absorbed in sputtering when the pressure is about 0·5 mm., with a current density around half a milliampere per sq. cm. of film surface, at 1500 volts. Too high a current, or insufficient cooling, breaks down the compound as fast as formed. Heating to 300° C. decomposes this nitride, driving off the gas and leaving a crystalline film of metallic nickel. If pure compounds are to be formed in this way, the cathode should be in a thin strip form which can be given a preliminary heating to redness for some time, as otherwise the gas released from the metal in sputtering forms a serious source of contamination.

L. R. INGERSOLL.

Department of Physics,
University of Wisconsin,
July 9.

Spitsbergen Whale Fishery of the Seventeenth Century.

As is well known, in the seventeenth century a right-whale fishery was prosecuted in the inlets of West Spitsbergen, the whales being caught by boats launched from the shore. Were the whales caught at this fishery Greenland whales, as is asserted, or were they, as seems more likely, Atlantic whales?

In 1827, on May 14, Parry [1] found Mauritius Bay, on the shore of which Smeerenberg, the Dutch whaling station, stood, still frozen over, the edge of the land ice or land-floe extending across its mouth from Hakluyt's Headland to Vogel Sang; in 1880, on July 20, the late Mr. Leigh Smith [2] found Fair Haven blocked with ice; and last year in June, according to a Danish Meteorological Office report,[3] Foreland Sound was still frozen over.

Taking the foregoing and certain other facts connected with the ice into consideration, the inshore fishery of the seventeenth century must have been prosecuted in July and August, months in which the inlets of West Spitsbergen are usually free from 'land ice', that is, the ice that forms *in situ* in the winter months. Until this kind of ice breaks and drifts away, the fishery could not be prosecuted by boats launched from the shore.

The Greenland whale is a migratory animal, keeping amongst or in the near vicinity of the polar ice and in water having a temperature never much above its freezing-point. According to the log-books of Scoresby, senior, it was only seen near Spitsbergen in April. In May and June it had to be looked for amongst or near the ice half-way between Spitsbergen and Greenland, and even this situation it usually deserted in the latter month. In July and August it had usually to be looked for in a lower latitude near the Greenland coast, but in that situation it was seldom seen except in limited numbers and only when there was plenty of ice.

The Atlantic whale is also a migratory animal, migrating north in summer and south in winter, but it prefers ice-free waters with a temperature well above their freezing-point. In recent years it has been seen so far north as Iceland and Bear Island; and west of Spitsbergen, where the temperature of the water is unusually high, it may quite well have gone still farther north.

ROBERT W. GRAY.

Exmouth, July 14.

[1] Parry. "Narrative of an Attempt to Reach the North Pole."
[2] Voyage of the *Eira*; *Proc. Roy. Geo. Soc.*, p. 140, 1881.
[3] "The State of the Ice in the Arctic Seas, 1929."

Distribution of the Pigmy Hippopotamus.

UNTIL Major Hans Schomburgk's search in 1911-12 for the headquarters of the pigmy hippopotamus (*Choeropsis liberiensis*), little was known of its distribution except that it hailed from the country to which it owes its specific name. Schomburgk found that it extended from the coastal belt of Liberia back to the boundary of French Sudan, but how far it spread along the coast into Sierra Leone and French Ivory Coast he could not discover ("Distribution and Habits of the Pigmy Hippopotamus", in *17th Ann. Rep. New York Zoo. Soc.*, 1912 (pub. 1913), pp. 113-120). His farthest east record is from Du Queah (Dukwia) River, on the boundary between the Mamba and the Bassa Country, about 10° 15′ W. long.

Two skulls, recently presented to the Royal Scottish Museum by Mr. J. B. I. Mackay, were given to him in 1928 by the chief of Abo. The animals to which these skulls belonged lived in marshy ground of limited area not far from the banks of the Niger and within a hundred miles of its mouth, more than a thousand miles west of previous records. I do not specify the locality more definitely, because, although the animals are sufficiently numerous to warrant the attentions of a professional native hunter who spends most of his time in the dry season hunting them, they might readily be exterminated owing to the circumscribed area inhabited, and in spite of the moderate protection granted by law.

There is a possibility of geographical differentiation in such a colony, especially if it be a very isolated outpost. I add, therefore, the chief dimensions of the skulls, in mm.:

Length along face, premaxilla to occiput, 310, 311; condylobasal length, 297, 299; zygomatic breadth, 185, 196·5; least inter-orbital breadth, 93·5, 96; nasal, 152·5, 147·5; greatest combined breadth of nasals, 38·5, 40; occipital depth (median), 89, 86; mandible, 242; mandibular tooth row, including canine, 180·5; ditto excluding canine 144; maxillary tooth row, including canine, 164, 166·5; ditto excluding canine 136·5, 142; 3rd upper molar, 21, 22; 3rd lower molar, 27.

In the above list the first number refers to skull 1929.176.1, the second to skull 1929.176.2, of which the lower jaw is missing. James Ritchie.

Royal Scottish Museum,
Edinburgh, July 7.

X-Ray Spectra and Chemical Combination.

The element sulphur offers a very interesting case for the effect of chemical combination on X-ray spectra. Lindh has already established remarkable changes in the K-absorption edges of this element with varying valency (see Siegbahn: "Spectroscopy of X-rays", pp. 146-147). The $K\beta$ lines of this element also show peculiar changes, especially regarding relative intensity and structure of β_1 and β_x lines in various chemical compounds of sulphur. In the course of a study of the X-ray spectrum of sulphur and its compounds, I have made the surprising observation that one line, with the wave-length 5043 X.U. (apparently identical with the $K\beta_3$ line listed by Hjalmar), is emitted by certain sulphur compounds, but not by pure sulphur or by certain other chemical compounds of this element.

It has been found that sulphates of lithium, sodium, potassium, rubidium, cæsium, silver, and mercury, as well as the sulphides of sodium, potassium, strontium, barium, and cadmium, give quite an intense $K\beta_3$ line, whereas in the sulphides of copper, silver, magnesium, zinc, mercury, lead, and molybdenum this line is entirely suppressed. For sulphates of copper and magnesium and the sulphide of calcium a faint indication of this line is obtained. In all cases a copper anticathode was used.

The ordinary spectral lines so far known are all of atomic character, that is, they are emitted on transitions between levels belonging to the atom of the free element. In some cases, especially with light elements, an influence on the wave-length and the structure of the lines by adjacent atoms has been found. The observations here reported seem to indicate the existence of a new type of X-ray lines arising from transitions within a *molecule*.

Details of this communication will be published elsewhere. G. B. Deodhar.

Physical Laboratory,
University of Uppsala, July 11.

Mortality amongst Plants and its Bearing on Natural Selection.

In a communication in Nature of May 31, p. 817, Prof. E. J. Salisbury describes some exact quantitative observations on the mortality which takes place in the seedling condition of flowering plants, and he points out the bearing of these facts upon natural selection. The sycamore furnishes another good instance of this high infant mortality, since almost every year the tree produces an abundance of viable seeds. The winged indehiscent fruits provide a very efficient means for seed-dispersal, and seedlings bearing the first pair or two of young foliage leaves are plentiful in almost every situation throughout the summer. It is well known from experience that only a very small fraction of these seedlings will ultimately survive, or even pass beyond the two-leaved stage, and grow into trees.

Some light might be thrown upon the problem as to which, if any, characters possessed by the seedlings are of help in bringing about this apparent survival of the fittest, if observations were made upon the *causes* of this excessive mortality. Is it due, for example, to unfavourable climatic conditions, too much or insufficient light, overcrowding, insect or other animal enemies, fungus pests, etc.? Information upon this point, which so far as I am aware has not previously received attention, cannot fail to be of interest. A. W. Bartlett.

Armstrong College,
Newcastle-upon-Tyne,
July 14.

Simultaneous Electronic Transitions in X-Ray Spectra.

In a letter to Nature of Oct. 26, 1929, by D. Coster and M. Wolf, the results were published of some investigations on the fine structure of X-ray absorption edges of copper and zinc.

Whereas with copper a very complicated fine structure was easily obtained, in the case of zinc, in the beginning, no fine structure at all could be observed. Mr. Suekichi, however, recorded a fine structure of the zinc-K-edge of zincblende when this crystal was used as analysing crystal (Nature, Mar. 29, 1930, p. 509). In the meantime, in continued experiments, I have succeeded at last in observing also a fine structure in the case of zinc, when metallic zinc foil was used as absorbing screen. This fine structure of zinc, however, seemed to be less pronounced than that of copper.

Experiments are in progress to measure the variations in the absorption coefficients in the fine structure range of the K-edges of copper and zinc in order to draw more definite conclusions about the probability of simultaneous electronic transitions in both elements.

M. Wolf.

Natuurkundig Laboratorium der
Rijksuniversiteit,
Groningen.

The Quantum Theory of Chemical Valence.

Dr. J. C. Slater has shown in a most valuable paper (*Phys. Rev.*, Vol. 34, p. 1293; 1929) that one can develop the complete theory of atomic states (multiplets) in a simple way without the application of the methods of the group theory. This is of considerable importance; for the difficulties of these methods interfere greatly with the understanding of the simple relationships which are derived. I should like to point out (no doubt Slater has already done so himself) that one can treat the theory of the interaction of several atoms in the same simple way and indeed more exactly than merely to the first approximation. One obtains the results first obtained by Heitler and London with help of the methods of the group theory and, furthermore, the valence forces between atoms in all various excited states. In the interest of the further propagation of Slater's ideas, I shall in the near future publish these considerations in greater detail in the *Zeitschrift für Physik*.

M. Born.

Institut für theoretische Physik,
Göttingen, July 11.

The Great Barrier Reef of Australia.*

By Dr. C. M. YONGE, Leader, Great Barrier Reef Expedition.

AUSTRALIA possesses in the Great Barrier Reef the largest and most impressive series of coral reefs in the world. The realisation of the unique opportunities so presented for scientific research—geological, geographical, and biological—led in 1922 to the formation of a Great Barrier Reef Committee with headquarters at Brisbane. Its chief promoters were the Right Hon. Sir Matthew Nathan, at that time Governor of Queensland, and Dr. H. C. Richards, professor of geology in the University of Queensland. Valuable work of a geological and geographical nature was carried out, and then, in 1927, following representations by Sir Matthew Nathan on his return to Great Britain, a British Association Committee was formed to organise an expedition for the biological investigation of the Great Barrier. To the expedition, which sailed in May 1928, was attached a geographical section organised and largely financed by the Royal Geographical Society.

The position of the coral reef controversy at that time can best be realised by a study of Prof. W. M. Davis's book, "The Coral Reef Problem", published in 1928. From the time of Darwin it has been regarded as essentially a geographical problem. As a matter of common experience it is known that reef-building corals live only in water 30 fathoms or less in depth and in temperatures at or above 20° C. Although Madreporarian corals flourish even to the fringe of the polar oceans and in the deep seas, they never form true reefs—unless we include the banks of *Lophohelia prolifer* in the deep waters of the Norwegian fjords—except in the tropics. Where in these regions they occur depends on the presence of a suitable substratum, namely, a platform not deeper than 30 fathoms, and where there is never any serious admixture of fresh water or extremely heavy fall of silt. Cold currents from the poles or the upwelling of cold water from the deep seas inhibit their growth and are responsible for the absence of coral reefs from the western coasts of the great continents.

Darwin divided coral formations into fringing reefs, barrier reefs, and atolls. The first develop in the shallow waters round the coasts of continents and continental or volcanic islands, and their origin is clear and undisputed. The others grow up far from land, though in the case of the former in clear connexion with it, and the mystery of the origin of the platform on which they have developed *is* the coral reef problem. Little is known of the biology of corals; few have been examined when alive, and the long-continued and careful investigations necessary for the full elucidation of their life histories, growth, food and manner of functioning, and the numerous factors which control these, have seldom been attempted. It was to fill in some degree this great gap in scientific knowledge that the expedition worked. The results it obtained from investigations into the nature, organisation, and

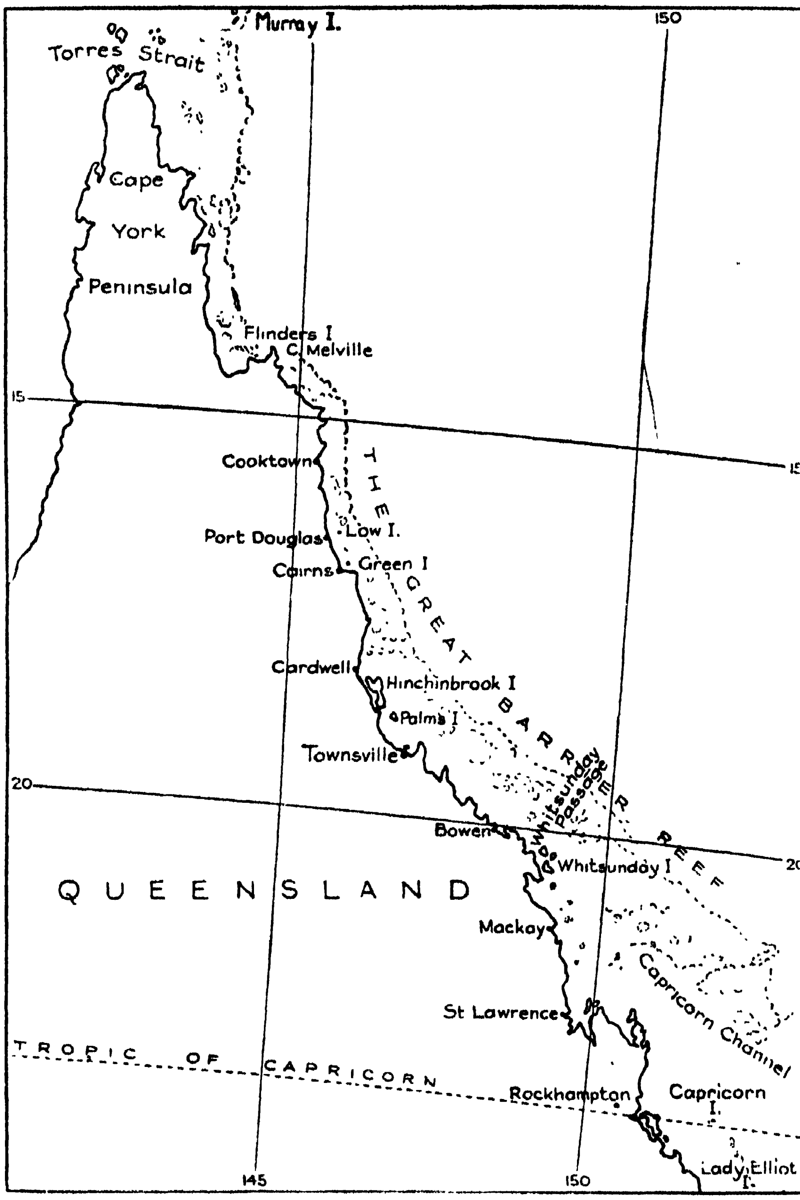


FIG. 1.—Map of the Great Barrier Reef. (Map by Mr. J. A. Steers, by kind permission of *Discovery*.)

* Friday evening discourse delivered at the Royal Institution on May 16.

life of the unique marine communities known as coral reefs will constitute its main contribution to the science of marine biology.

The series of reefs which are grouped together as the Great Barrier Reef of Australia run roughly parallel to the north-east coast and, in the words of Jukes, one of its early investigators, " may be said to commence with Breaksea Spit, in S. lat. 24° 30′, and extend to Bristow Island, on the coast of New Guinea in S. lat. 9° 15′ ". Measured in a straight line, this is 1260 statute miles (Fig. 1). It must clearly be understood that these reefs do not form an unbroken chain, like a gigantic breakwater, although they certainly possess the function of one by sheltering the coastal waters from the Pacific storms. The term Barrier Reef is here one of convenience rather than accurate description. We are dealing with a vast series of reefs which have grown up on a shallow submarine platform of immense length and, in its southern portions, of great width.

The most southern reefs, immediately north of Breaksea Spit, are a series of isolated islands, first Lady Elliot Island and then the Bunker and the Capricorn Groups, all in the region of the Tropic of Capricorn. The reefs are oval in outline, each with a sand cay covered with dense vegetation upon it. Although they extend so much as 60 miles from the coast, none of the islands is on the edge of the platform. The Capricorn Group is separated from the remainder of the Barrier Series by the Capricorn Channel, which is considerably deeper than the waters between the Barrier and the mainland (which seldom exceeds 20 fathoms) and through which vessels pass to enter the steamer channel within the Barrier which leads to Thursday Island and the ports of the Far East.

The Barrier Series proper may be said to begin with Swain Reefs, a confused mass of reefs fifty miles wide and separated by a distance of about one hundred miles from the mainland. These reefs are little known; they are separated from one another by intricate channels, shallow and full of coral patches. They are in no sense barrier reefs. Similar reefs, but not extending over such wide areas and coming gradually closer to the coast, and separated by occasional channels wide and deep enough for ocean-going vessels to negotiate, comprise the southern half of the Great Barrier.

North of Cairns, about latitude 17°, the reefs really do begin to assume the character of a true barrier. The submarine platform becomes narrower and the reefs extend to its outermost margin, so that in places depths of 1000 fathoms are reached only a few miles beyond the reef. This was the region in which the expedition worked, the headquarters, Low Isles, being some fifty miles north of Cairns. The lagoon channel narrows from twenty miles at Cairns to a little more than five opposite Cape Melville, 200 miles farther north, beyond which it becomes much wider owing to the deep inlet of Princess Charlotte Bay. The reefs, however, continue to run roughly parallel to the coast for another 150 miles, but north of Cape Direction the coast runs north-north-west to Cape York, but the reefs almost due north, so that they are separated by a channel eighty miles wide from the far north of Cape York Peninsula.

Within the Torres Strait, itself a shallow water area, the Barrier forms the outer margin of the vast series of reefs which extend between the coasts of Cape York Peninsula and New Guinea.

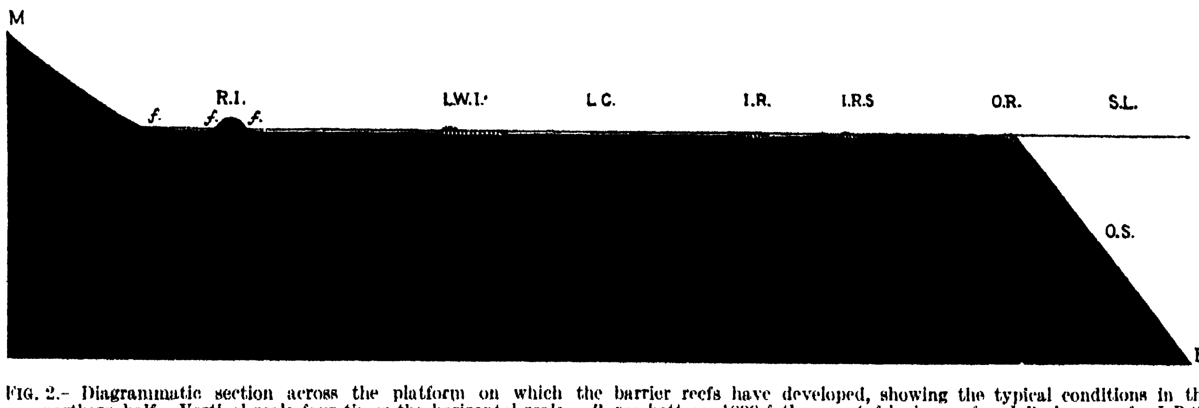


FIG. 2.—Diagrammatic section across the platform on which the barrier reefs have developed, showing the typical conditions in the northern half. Vertical scale four times the horizontal scale. *B*, sea bottom, 1000 fathoms; *f*, fringing reefs; *I.R.*, inner reef; *I.R.S.*, inner reef with sand cay upon it; *L.C.*, lagoon channel 16-20 fathoms; *L.W.I.*, low wooded island with vegetated sand cay; *M.*, mountain, 2500 feet high, on mainland; *O.R.*, outer reef, true barrier; *O.S.*, outer slope of platform; *R.I.*, rocky island, 400 feet high with fringing reefs; *S.L.*, sea level.

Such, then, is the general disposition of the Great Barrier. The origin of the great submarine platform on which it stands is, and is likely to remain so for many years to come, a great geographical problem. Mr. J. A. Steers, the leader of the Geographical section of the expedition, has summarised elsewhere [1] the various opinions that have been held. Some have thought that it has been cut by the seas, possibly when the level of the sea was lowered during the glacial periods, others that it has been formed by a sinking of the land. Upholders of the latter—and more probable—view are divided into those who regard the platform as having been built up by corals, that is, a fringing reef which has grown outwards owing to a sinking of the coast, as Darwin postulated, and others who think that the coral forms only a thin veneer over the surface of a pre-existing platform formed by the submergence of a coastal plain. There are various views as to the manner in which this submergence may have taken place, but Mr. Steers, with the majority of recent workers on the subject, ascribes it to faulting.

The shallow lagoon channel contains innumerable islands. Many of these are rocky, high, richly vegetated, and of great beauty. They show every indication of having originally formed part of the land mass near them and constitute important evidence in favour of land subsidence. Most of them are close to the coast, but Lizard Island, seventy miles north of Cooktown, is sixteen miles from the land. These islands, like the mainland coast wherever suitable, are usually bordered with fringing reefs.

In the far north of the Barrier lies a small group of extinct volcanic cones, the three Murray Islands and Darnley Island. They have no connexion with the continental mass, and in general character and richness of vegetation resemble much more the volcanic islands of the Pacific, such as Samoa, Tahiti, or Hawaii.

The northern half of the lagoon channel is dotted with coral islands, of which Low Isles was a typical example. Trees are abundant and are responsible for the name, Low Wooded Islands, which is given to them in the "Admiralty Pilot". Owing to their protected position and proximity to the land, they have many unique features. The contours of the reefs are influenced by the South-easterly Trade wind which blows with steady force for nine months in the year. They are crescent-shaped with the point of the convexity facing south-east, the reef on this side descending quickly into deep water. On the lee side the water deepens much less quickly. As a result of abrasion by the waves on the weather side, fragments of coral are broken off and carried round the reef to be accumulated in the area of 'dead' water behind it. Here in time a sand cay is formed which, at first entirely at the mercy of any change in winds and currents, gradually becomes consolidated by vegetation and the formation around it about low water mark of a thick zone of beach rock. This is sand cemented together by calcium carbonate precipitated among it when rain water which has fallen on the surface of the cay seeps through it at low tide and is evaporated at its surface.

On the windward side great banks of shingle accumulate and frequently form northward projecting spits. Behind the cover of these shingle banks mangroves have established themselves until, as on Low Isles, an almost impenetrable forest of *Rhizophora mucronata*, fringed at a slightly higher level with *Avicennia officinalis*, is formed. Infrequent openings amongst the tangled mass of strut roots give passage into central lagoons the black mud bottoms of which are exposed at low tide. On the outer side the mangroves are being destroyed by the advancing line of shingle, on the inner side they are advancing over the reef flat towards the sand cay, and in certain islands, notably the Turtle Group, the two seem to have fused, the mangroves growing round the central sand cay.

FIG. 3.—The reef edge at Northwest Island, Capricorn Group, exposed at low water spring tides. The surface of the reef is cemented with *Lithothamnion* and has little living coral, which flourishes on the outer slopes. (Photograph by M. J. Yonge.)

The shallower water on the lee of the reefs is full of coral patches, flat-topped pinnacles of living coral. Sudden storms from the north, sometimes of cyclonic fury, which occur during the summer months, break away this coral and throw great boulders high on to the reef surface, forming a boulder tract along the northern shores. Boulders are also carried on to the south-easterly side of the reef, but not to the same extent. The general

surface of the reef flat, which is some four feet above datum line, is composed for the greater part of dead coral, but there is an abundance of animal and plant life in the numerous pools and particularly in the wide moat which is enclosed by the shingle rampart. Around the sand cay there are wide sand flats, while the mud of the mangrove, which supports a fauna and flora totally different from that of the reef flat proper, extends for some distance westward of the swamp itself.

The Barrier reefs may be divided, in the northern half in particular, into an inner and an outer series. The inner ones are a little higher than the outer reefs and not infrequently have sand cays, smaller and seldom vegetated, upon them. The vegetation consists of coarse grass and creeping convolvulus, and such cays are often the haunt of vast flocks of sea birds, sooty terns, or wide-awakes, and noddies predominating. Even at half-tide the outline of such reefs is frequently indicated by the great boulders which fringe them. These 'nigger' or 'negro heads' have been the subject of much controversy, early workers on the Barrier considering that they have grown *in situ* and were thus the evidence of reef elevation. There can be no doubt, however, that, like the boulders on Low Isles, they have been cast up by cyclones. Although present on the southern and central reefs, they are absent from the reefs about Murray Island, which is north of the cyclone belt.

The outer reefs are exposed to the full force of the Pacific, on which there is usually a great swell even in the calmest weather. Their outer slopes, clothed with living coral for the upper 30 fathoms, descend at a sharp angle to hundreds of fathoms. The reef crest, never exposed except at the lowest spring tides, is cemented by *Lithothamnion*, which always, apparently, flourishes best in regions where the surf breaks, into a solid rampart, on which only a few stunted corals, sessile molluscs and the like, manage to lead a precarious existence. Boulders of a gigantic size are occasionally to be seen; smaller ones will be rolled over the crest into the shallow water in the lee. Here, as in the lee of all reefs, there is a great abundance of coral growth, the size of the coral-covered boulders increasing as the water deepens.

These outer and inner reefs of the Barrier Series all show the same moulding by the South-easterly Trade winds, though in the case of the former it is not so apparent; they frequently stretch almost due north and south along the edge of the submarine platform, sometimes, as in the case of Ribbon Reef, for a length of fourteen miles, with only a curling back at the ends to show the effect of the prevailing wind. The reefs of the Capricorn Group, south of the Trade-wind belt, are not moulded in this way. The occasional deep channels between the outer reefs which give passage for large vessels from the Pacific into the lagoon channel, are kept open by the effect of tidal currents which run in and out with the flood and ebb tides like a mill-race, with a speed of not less than 8 knots.

The accompanying section (Fig. 2) across the platform shows the distribution of the fringing reefs, Low Woody Islands, rocky islands, and inner and outer 'Barrier' reefs, and the sudden descent into deep water off the edge of the platform.

FIG. 4.—Living coral exposed at low water spring tides in the 'anchorage' at Low Isles, showing the wealth of coral which grows in the shallow water in the lee of reefs. (Photograph by M. J. Yonge.)

Between thirty and forty genera of corals and well over one hundred species are concerned with the formation of these reefs. Probably no region in the world is so rich in coral species. They are assisted in their building action by coralline algæ, *Lithothamnia*, and by the minute calcareous skeletons of foraminiferans, and also to a smaller extent by the dead shells of molluscs—foremost amongst which is the giant clam, *Tridacna gigas*, which may attain a length of four and a half feet and a weight of four or five hundredweight. The growth of corals, the study of which formed an important part of the programme of the expedition, is greater than might be expected, certain species doubling their size in six months. Such powers of growth are necessary, however, if the reefs are even to maintain themselves. They are continually being battered by the seas, they are subject to the destructive action of a host of molluscs and worms which bore through their skeletons until these are honeycombed with their tunnels, and even algæ play some part in this destructive process. Exposure during low spring tides invariably kills corals which have grown above a certain height, thus maintaining the level surface of the summit of the reefs. Near the coast the fringing reefs are in constant danger of being destroyed by great floods of fresh water running off from the land during the summer rainy season. A striking example of this was furnished in 1918 when Stone Island Reef near Bowen was completely destroyed after 36 inches of rain had fallen in eight days.

The nature of communities known as coral reefs is too great a subject to discuss here; a detailed census of the population of different reefs and different zones of them was undertaken by the expedition. Corals themselves, it was found after careful studies, live on the minute floating animal life of the seas—the zooplankton—for the capture and digestion of which they are admirably equipped. They contain within their tissues vast numbers of minute algæ, zooxanthellæ, which dispose of the waste products of coral metabolism, and provide, as a result of their photosynthetic activities, abundant supplies of oxygen (possibly of vital importance in view of the density of the population on a typical reef), but do not, as has been thought, play any great part—if any at all, the matter is still *sub judice*—in the nutrition of the coral.

The conditions in the seas which bathe the reefs are of primary importance; they control the food supply and the 'climate'. The changes in the physical condition and in the principal chemical constituents—notably those which can be utilised as food by plant life—are far smaller than occur in temperate seas. The plant and animal plankton is also much poorer and shows fewer fluctuations, but there is no reason to doubt that the latter provide all the food required by the corals, which, in spite of their apparent bulk, are really thin sheets of living matter spread over a great surface of calcareous skeleton. Life on the sea bottom, as revealed by dredging and trawling, is abundant where the bottom is rocky or sandy, but very poor in the inner parts of the platform where it is covered with a soft mud. Fish, not unnaturally, are abundant in the former regions and scarce in the latter.

The reefs are a source of both profit and loss to Australia. They are rich in a number of commercially valuable animals, notably pearl shell—the smaller black-lip (*Pinctada margaratifera*) everywhere and the large gold-lip (*P. maxima*) in the Torres Strait and farther west—the large *Trochus* shell from which pearl buttons are made, edible oysters of various kinds, bêche-de-mer (Holothurians), both edible and tortoise-shell turtles, dugong, many kinds of fish, while sponges of some commercial value are present. In its capacity as a breakwater the Barrier Reef has gained for the enclosed steamer channel the title of Australia's Grand Canal, but it is a canal full of dangers from reefs and, in the summer, from cyclones, and loss from shipwreck forms a very serious item in the debit account.

[1] *Geographical Journal*, vol. 74, Nos. 3 and 4, 1929.

The Discovery of a Second Braincase of *Sinanthropus*.

By Prof. G. ELLIOT SMITH, F.R.S.

AT a meeting of the Geological Society of China in the last week of July, Prof. Davidson Black announced the discovery of another skull of Peking man.

In NATURE of Mar. 22, 1930 (p. 448), an account was given of the discovery of a series of remains of *Sinanthropus* culminating in the recovery of an almost complete braincase by Mr. W. C. Pei on Dec. 2, 1929, while clearing a sheltered recess of the main deposit at Chou Kou Tien. Some days (Oct. 28) before this skull was found, five human teeth were recovered from a spot higher up in the shaft (locus *D* of the excavators' report), where they were associated with the skull of a large deer and some pieces of fossilised bone and blocks of stone, which were brought to the laboratory in Peking for examination.

This material was 'developed' during the third week in June by the technical assistants working under Prof. Davidson Black's supervision, and he found that there were enough fragments, which fitted together, to form the greater part of another uncrushed skull of *Sinanthropus*. He waited until the return to Peking of Dr. Wong (Wong Wen Hao), the Director of the Survey, before making the public announcement of his important discovery.

For reasons which are not yet clear to those who have not seen the actual specimens, Prof. Davidson Black regards the skull found on Dec. 2, 1929, as that of a young woman, and the calvaria the discovery of which is now reported is in his opinion that of a young adult male. It conforms to the same general type as the skull previously found, and its proportions are similar. But the braincase is not so thick and the frontal eminences not so pronounced. The most interesting new fact revealed in this

discovery is the nature of the root of the nose, which is broad and flat and quite unlike that of Piltdown man.

The newly discovered skull was found in association with a number of teeth which can be assumed to have belonged to the same individual. This fact adds to the interest of two mandibles found in 1928 in association with the crushed parts of the respective braincases.

The remains of four skulls of *Sinanthropus* and teeth of at least six other individuals have so far been found. Thus there is available for study in China a much richer material of early Pleistocene man than the fragments of the individual specimens of *Pithecanthropus* and *Eoanthropus* provide. Moreover, the geological age of the Chinese fossils can be established with more certainty than that of the other two primitive genera, which are assumed to be roughly contemporaneous.

The fossils from Java and Sussex were found in gravels, where they had been deposited by running water. Although there is little doubt which of the heterogeneous fossils found in these gravels were contemporaneous with the human remains, in the case of the men of Peking, who left their bones in the cave where they lived, there is less room for doubt that the bones of animals deposited alongside them provide more certain data for the estimation of their geological age. Thus the claim made by Père Teilhard de Chardin and Dr. C. C. Young that *Sinanthropus* lived in Lower Pleistocene times rests upon a surer foundation than the similar claims that have been made in the cases of *Pithecanthropus* and *Eoanthropus*.

Further, the conditions under which the discoveries are being made at Chou Kou Tien hold out a greater promise of further evidence than in the cases where the fossils have been scattered by running water. Thus a series of fragments have already been recovered every autumn since the type tooth was recovered in 1927, and it is not unreasonable to expect that much more still remains to be found in this cave, and possibly in other fossil beds in the neighbourhood. So far no worked tools have been found in the cave; but if such should be recovered, their association with the human remains will be less uncertain than in the case of the other Pleistocene men's implements.

For these reasons, in addition to the intrinsic interest and morphological significance of the skulls of *Sinanthropus*, the discoveries in China have an importance which is unique. It is a matter for congratulation that the investigation of this site should have fallen into such competent hands and that ample facilities and skilled assistance should be available for the work, which is being conducted with great thoroughness and insight.

News and Views.

PROF. ELLIOT SMITH's announcement in another column of this issue that Dr. Davidson Black has reconstructed still another skull of Peking man from material obtained from the now famous cave of Chou Kou Tien is assuredly welcome though perhaps not entirely surprising. Four skulls and teeth belonging to probably six individuals have now been obtained from this source, and it is therefore evident that the fortunate explorers have lighted upon what must have been the final resting place and perhaps the home of a family group or horde of this type of early man. So far, no implements have been found which would determine the cultural horizon of Peking man, but the conditions of discovery are such as to afford grounds for hope. It is at any rate fortunate that the association of the remains with fossilised bones of animals assigned with some confidence to the Lower Pleistocene appears to place the date beyond question. Dr. Davidson Black has pronounced his latest skull to be that of a young adult male, while that found in December last is said to be that of a young woman. Comparative study of the two will no doubt be fruitful of results. A first inspection of the new skull has already yielded a new character of the nose in which it presents a marked difference from the Piltdown skull. A more detailed examination of the two skulls than is yet possible will be necessary before it can be determined what are the precise relationships of Peking man and other early types. It is already clear, however, that these remains will make possible a further advance in the reconstruction of man's ancestral forms. Prof. Elliot Smith is sailing for China on Aug. 14, and in this connexion the results of his personal examination of the material will be awaited with the keenest interest.

IN the interesting little church at Longfield, Kent, close to Fawkham Station, is to be seen the memorial window erected by some members of the University of Cambridge to the memory of Dr. Thomas Plume, the founder of the Plumian professorship of astronomy, of which Sir A. S. Eddington is the present holder. Though never rector of Longfield, Plume for many years lived at Longfield Court, just behind the church, and he died there on Nov. 24, 1704. At his death Plume was seventy-four years of age, having been born just three hundred years ago, in the summer of 1630. The exact date of his birth does not appear to be known, but he was baptised on Aug. 18, 1630, in All Saints' Church, Malden, Essex, of which place his father was an alderman. Educated first at Chelmsford Grammar School, Plume entered Christ's College, Cambridge, and at the age of nineteen took the degree of M.A. Entering the Church, in 1658 he was made vicar of Greenwich, a living then in the gift of Richard Cromwell, and both Pepys and Evelyn speak of his excellent preaching. This important living he held for the remainder of his life, but from 1679 onward was also Archdeacon of Rochester.

LIKE Lucas and Lowndes, the founders of two other famous professorships at Cambridge, Plume did not add to mathematical or astronomical knowledge, but he lived in an age when among men of education

some acquaintance with science was considered a desirable acquisition. Moreover, as vicar of Greenwich when the Royal Observatory was built, he became known to Flamsteed, and it is said that on Flamsteed's recommendation he read Huygens' "Cosmotheoros". It is also said it was the perusal of this work which induced him to leave a part of his fortune to found a professorship and erect an observatory at Cambridge. Newton and Flamsteed were both connected with the arrangements made to carry out Plume's wishes, and when Roger Cotes was appointed to the Plumian professorship in 1707, the King's gate of Trinity College was appropriated to his use, while the observatory erected over the gateway was described by Bentley as "the commodiousest building for that use in Christendom". In spite of the provision of the observatory, little was accomplished in the eighteenth century, and a report of 1792 said that "the professor had neither occupied the said rooms and leads nor fulfilled the conditions for at least fifty years". Instruments and observatory alike had fallen into disrepair, and a few years later the observatory was demolished. A new observatory was built in 1822; with the appointment of Airy as Plumian professor in 1828, astronomical studies at Cambridge were pursued with greater energy, and under his successors much has been done to add prestige to the chair which perpetuates the name of its generous and enlightened founder.

THE Earl of Harewood performed a useful service to the agricultural community by initiating the discussion in the House of Lords on July 22 on the position of the Royal Veterinary College, Camden Town. He pointed out that the position of the College was so desperate that unless further substantial guarantees of capital and income from Government and private sources were immediately forthcoming, the governors would have no alternative but to give notice of their intention to close and to refuse to accept any new students. The annual deficit of the College is a diminishing one owing to the fact that students' fees are increasing year by year and private subscriptions are also bringing in a larger yearly income; but the College buildings are in an irreparable state of disrepair and their entire reconstruction is an imperative necessity. An appeal for the necessary funds to make the College worthy of its cause was made three years ago, but of the £350,000 needed only £30,000 had been raised from those who have most to gain from the maintenance of the supply of adequately trained veterinarians, namely, the great breeders of pedigree cattle, small farmers, sportsmen, and animal lovers generally. The governors of the College had asked the Ministry of Agriculture and Fisheries for advice and a Departmental Committee was appointed. This Committee reported a year ago and recommended that the governors should purchase for £20,000 the freehold of the land in Camden Town from the Ecclesiastical Commissioners, spend £280,000 on new buildings, provide £25,000 for a research laboratory outside London and affiliated to the College, and guarantee an income of £21,000. No reference was made in this report to the financial help the Government might be expected to give, although the offer of £100,000 made by the Government in 1918 presumably still held good, although this offer had been contingent upon the College removing to Cambridge.

A FURTHER appeal for financial assistance was recently made to the Government by the governors of the College, whereupon a further Departmental Committee was appointed which modified the above proposals by suggesting that the purchase of the freehold was unnecessary, that £250,000 instead of £280,000 be spent on new buildings, towards which the Government would be prepared to contribute £70,000 in addition to pound for pound of the subscriptions raised from private sources. Further, the Government was prepared to make a final grant of £50,000 when the sum collected by the governors from all sources had reached £200,000. This offer Lord Harewood, Lord Ernle, and others characterised as not sufficient to justify the governors committing themselves to keep the College open. Lord Ernle suggested that the British Government lagged behind those of other countries in its encouragement of veterinary education, citing the case of Germany, which provides £280,000 a year for this purpose. After Lord Phillimore had pointed out that he had been asked, as the chairman of a veterinary subcommittee on the 'pig', to emphasise the need for more attention to be given by pig-breeders to research, but that it was useless for him to do so unless there were enough veterinary experts adequately trained to make use of the results of such research, Lord De La Warr, on behalf of the Government, invited to a conference those interested in veterinary education and the future of the Royal Veterinary College, in order that the governors of that institution might reconsider the position. Since then, a further powerfully worded appeal has been made to the Government by Sir Merrik Burrell, chairman of the governors of the College, in a letter to the *Times*. Apparently these appeals have not been fruitless, for Lord Harewood, in his address to the eleventh International Veterinary Congress, which he opened on Aug. 4, expressed the hope that the position of the Royal Veterinary College would soon be remedied.

A RECENT Order in Council directs that the Lord President of the Council (Lord Parmoor), the Minister of Agriculture and Fisheries (Dr. Addison), the Home Secretary (Mr. Clynes), the Secretary of State for Scotland (Mr. W. Adamson), and the President of the Board of Education (Sir Charles Trevelyan) shall be a Committee of the Privy Council for the organisation and development of agricultural research. It is also ordered that during His Majesty's pleasure the Lord President of the Council shall be the chairman, and the Minister of Agriculture and Fisheries vice-chairman of the Committee. No information is vouchsafed regarding the relationships between this new body and the Development Commission, the Agricultural Research Council, and the Empire Marketing Board, all of which are concerned with the promotion of agricultural and fisheries research. Presumably this new committee, the personnel of which is exclusively political, will undertake the task of co-

ordinating the efforts of these other important bodies, although the further announcement made in the House of Commons on Aug. 1 by the Chancellor of the Exchequer (Mr. Snowden) creates the impression that it will be concerned mainly with the appointment of *ad hoc* committees for advising the Government on schemes for the prosecution of research on urgent problems confronting the agricultural community. It is to be hoped that the Government will make a further announcement or issue an explanatory memorandum defining more precisely the functions of this new Committee of the Privy Council, and why it differs so radically in constitution from those already in existence for the prosecution of medical research and scientific and industrial research.

THE visit of H.R.H. the Duke of York on July 30 to the works of the British Aluminium Company at Fort William, N.B., may be said to mark in a quasi-formal way the inauguration of the very notable hydro-electric undertaking known as the Lochaber Power Scheme, which has been promoted by the company for the purpose of supplying power to its factory for the production of aluminium. The portion of the undertaking which is so far completed has been in operation for the past few months, but the plant at present installed, with a capacity of 50,000 horse power, represents only about half the energy available when the sources of supply are developed to their full extent. As it stands, however, the installation is of a remarkable character, being the most important of its kind in Great Britain and ranking high among similar undertakings throughout the world. The scheme is designed to utilise the impounded water contained in Loch Laggan and Loch Treig, at a height of about 800 ft. above sea level, to drive turbines in the power house at Fort William a few feet above the same datum. In order to connect the two lochs and convey the water therefrom to Fort William, tunnelling through the intervening mountain rock is necessary for an aggregate distance of 19 miles, and of this, a length of 15 miles, constituting the portion connecting Loch Treig with the Power House, has been completed. The Lochaber Tunnel, as it is designated, is one of the longest tunnels in the world, and far longer than any other in Great Britain. Its nearest rival on the Continent is the Simplon Tunnel between Switzerland and Italy, which is 12¼ miles in length. The Shandaken Tunnel for the water supply of New York is slightly more than 18 miles long, but in cross sectional area it is less than the Lochaber Tunnel, which is approximately circular and 15 ft. in diameter. The Power House at Fort William contains, at present, five main turbo-generator units each of 10,000 horse power. The inception of the Lochaber scheme is due to Mr. Murray Morrison, director and general manager of the British Aluminium Company, which in 1921 obtained powers under the Lochaber Water Power Act for its realisation. The engineers are Messrs. Meik and Halcrow of Westminster.

A CEREMONY of striking appropriateness took place at Inchnadamph, in the wilds of the north-western highlands of Scotland, on July 25, when a memorial to Drs. B. N. Peach and John Horne was unveiled by Sir John Flett. Mr. H. M. Cadell of Grange, who presided over a company which included many well-known Scottish scientific workers, recalled the days when with Peach and Horne he commenced the final survey of the much discussed structure of the Western Highlands, and gave a summary of the dispute which had centred upon that complicated region, and had at length been settled through the labours of his former colleagues. In dedicating the memorial, Sir John Flett described its site as properly selected in the centre of a remarkable area to which the discoveries and interpretations of Peach and Horne had given world-wide fame, a temple of geology to which geologists from all parts of the earth made pilgrimage. He paid a warm tribute to the work of his friends, to their spirit of co-operation and goodwill, and to the single-mindedness of their scientific endeavours. The memorial, a massive pillar of stone set on a height overlooking Loch Assynt, carries a bronze tablet with the inscription : "To Ben N. Peach and John Horne, who played the foremost part in unravelling the geological structure of the North-West Highlands, 1883–1897 : An international tribute. Erected 1930."

UNDER the title of "The Organisation of Mosquito Control Work" Mr. John F. Marshall, Director of the British Mosquito Control Institute, Hayling Island, Hants, has issued a useful practical pamphlet. Its contents formed his presidential address in the Zoology Section of the South-eastern Union of Scientific Societies at the Portsmouth Congress held in May last. The object of this pamphlet is to describe, in simple language, the best methods of suppression of mosquitoes in England. It is pointed out that these insects must be dealt with during the larval or pupal stages of their existence, and that the most satisfactory method is to do away with the water in which such stages are passed. This may be a simple matter in so far as water butts or small ponds are concerned. With ditches, large pools, or marshes, drainage is required, but this procedure, for various reasons, is often quite impracticable ; in such cases the problem is best dealt with by covering the surface of the water with oil, or by mixing chemicals with the water so as to poison the larvæ. In the case of ornamental ponds or lakes, fish, water bugs, and various other creatures which devour the eggs or larvæ are to be encouraged, and the addition of oil or chemicals to the water is then undesirable or harmful.

MR. MARSHALL gives a list of the British mosquitoes grouped according to their habitats or, in other words, according to the nature of the environment in which each species lays its eggs and where, in consequence, its larvæ are to be found. The first step to be taken is to find out what species are present, and when this has been done the anti-larval campaign is simplified. It then becomes possible to seek out their breeding places and take necessary measures at the right time. Indiscriminate oiling of all and sundry collections of water is wasteful and of little use. As an example it is mentioned that at a children's hospital where sleeping out of doors was part of the treatment, mosquitoes rendered this procedure impossible at certain times of the year. All tanks and butts were regularly sprayed

with paraffin in the hospital grounds, without result. Afterwards specimens of the offending insects were sent to the Mosquito Institute, and the species was found to be *Aedes punctor*, which breeds chiefly in pine woods. A number of small pools occurred in the neighbouring woods, and since these have been abolished further annoyance from mosquitoes has been avoided. Methods of identifying mosquitoes either from the larvæ or adults are briefly described. It is further pointed out that adequate control work needs the services of an inspector who, after identifying the species concerned, examines their breeding places and advises whether the collections of infested water shall be oiled, poisoned, or abolished. The pamphlet, it may be added, can be obtained at the British Mosquito Control Institute, price 9*d.*

It is now generally admitted that the radiation of the sun varies when periods of a month or more are considered, and the comparison of data from different stations is justifying Dr. C. G. Abbot's view that there also exist variations from day to day. In a paper entitled "The Atmosphere and the Sun", published as No. 7 of vol. 82 of the Smithsonian Miscellaneous Collections, Mr. Clayton sets out his grounds for adopting two further conclusions, namely, that these solar variations are periodic, and that they provoke definite reactions in terrestrial weather, which behave in a complicated but still predictable manner. The first element of weather to be affected is naturally temperature, but this is complicated by changes of cloudiness, and for the most part the author deals with waves of pressure. As a result of a somewhat superficial discussion, he concludes that there are systematic differences between the pressure distribution over the northern hemisphere associated with high solar radiation and that associated with low radiation, the effects changing from one latitude to another, from season to season, and from land to sea. The differences found are small, however, and as no criteria of reality are given, it is impossible to tell to what extent they are accidental. The disturbances once set up travel like ordinary barometric systems, and since the solar changes which cause them are periodic, the results are series of supposedly regular waves of pressure in all parts of the world. Mr. Clayton thinks that when the sudden changes of phase and amplitude which mar these 'cycles' are understood their use will supplant all other methods of forecasting, but one fears that this day is very distant. Nevertheless, this is an interesting study, which opens out a distinctly promising line of investigation.

Further light has been thrown on the development of the circle in Britain by recent excavations carried out by Captain and Mrs. Cunnington on a site known as "The Sanctuary", on Overton Hill, between Marlborough and Devizes. Stukely records that the double circle on Overton Hill was destroyed in 1724; but nothing was known of it beyond the fact that it had consisted of two circles of sarcens, until Captain and Mrs. Cunnington succeeded in locating its position by ingeniously making use of a clue afforded by Stukely's theory that Avebury and "The Sanctuary" were connected with serpent worship, and that Avebury was the body and Overbury the head of the serpent. An account of their excavations was presented at the annual meeting of the Wiltshire Archæological Society, of which a report appeared in the *Times* of Aug. 1. The excavations revealed not only the position of the stones of the double circle, but also holes in which had stood wooden posts forming six rings concentric with the stone circles. This site, being so closely connected with Avebury, thus links up the latter with "Woodhenge" (Durrington Walls), the forerunner of Stonehenge. One burial only was found. With this was associated a small vessel of 'beaker' type. It is, therefore, suggested that the original construction took place in the early Bronze Age, and that when later—still in the early Bronze Age—Avebury was constructed and the two sites connected by an avenue of standing stones, the wooden posts of "The Sanctuary" were replaced by two circles of standing stones. Captain and Mrs. Cunnington have added further to their great services to British archæology by purchasing the site on Overton Hill, and they now propose to reconstruct the wooden and stone circles by erecting concrete pillars as they have already done on their previously purchased site of Woodhenge.

In an article published in the *Times* for July 31, Dr. C. Davison gives a new estimate of the average annual loss of life by earthquakes. During the last century covered by Milne's great catalogue of destructive earthquakes (1800–99), there are recorded by him 364 earthquakes of the highest degree of intensity and 510 of the second degree those of the lowest degree do not contribute sensibly to the loss of life. From 1601 to 1900, the number of persons killed by the most destructive earthquakes in Italy was 4222 per earthquake, and by those of the second degree 8·3, so that, if the same rates governed all earthquakes, the mean annual loss for the whole world would be 15,410. The stronger Japanese earthquakes of the eighteenth and nineteenth centuries give an average of 3892 deaths per earthquake or of 14,169 every year for the whole world. Dr. Davison thus concludes that, on an average, fourteen or fifteen thousand persons are killed by earthquakes every year, a number that is much less than the number killed by motors annually in the United States, and not much more than twice the number killed in Great Britain.

The three expeditions which Dr. Johs. Schmidt describes in the "Introduction to the Oceanographical Reports" (Danish *Dana* Expeditions, 1920–22, Copenhagen, 1929) were the post-War continuation of the researches on the development and breeding of the European eel begun in 1903 with the *Thor* and *Margrethe*. As soon as possible after the War, three cruises were made to the Sargasso Sea, two of which were undertaken in the auxiliary schooner *Dana I.*, and were confined mainly to the study of pelagic fauna. The third and most extensive voyage was made with the Royal Danish R.S. *Dana*, a steam trawler of the Lord Mersey class, adapted for marine research. The programme on this occasion was

augmented by physical observations, notably hydrographic sections across the North Equatorial Current and the Gulf Stream. Some of the results then obtained in the Gibraltar straits were published in NATURE of Jan. 12, 1922. A seasonal periodicity in the biological phenomena of the Sargasso and Caribbean Seas was demonstrated, and a number of very young larvæ of the European eel (and possibly the ova also) were taken in the Sargasso Sea at between 200 and 500 m. depth, thus completing the series of developmental stages. Dr. Schmidt and his colleagues have now returned from a two years' expedition, the most ambitious so far undertaken with the *Dana*, to the Pacific Ocean, where the breeding habits of the eels common to those waters have been found similar, though with less extensive migrations, to those of the Atlantic forms.

The announcement has just been made that the whole human population of St. Kilda is to be evacuated from the island in September next, 27 to Mull, 8 to Skye, 1 each to Glasgow and Inverness; and thereafter St. Kilda will take its place with North Rona and others of the Scottish isles, which, once inhabited, have become derelict. In this connexion a short article in the *Scottish Naturalist* (p. 69), by Dr. James Ritchie, discusses some of the unique features of the fauna of St. Kilda, its indigenous wren, field-mouse, and house-mouse, and its Soay sheep, the most primitive of surviving races of domesticated sheep. He also endeavours to show how the change in the feeding habits of the human population when it was brought in regular contact with mainland civilisation, first in 1877, affected the numbers of fulmar petrels breeding on the islands. This was ultimately responsible to a great extent for the extraordinary exodus of fulmars which has resulted in the colonising of many of the islands and of the mainland cliffs so far south as Flamborough Head.

SEARCHLIGHTS are usually associated with naval and military operations. It is not generally realised that there is a great demand for them for commercial purposes, such as canal lighting, the flood lighting of buildings, and cinema studios. There are manufacturing firms which are mainly if not solely engaged in making searchlights and projectors of all types and sizes. In the *British Engineers' Home and Export Journal* for July, a description is given of very large searchlights manufactured by the London Electric Firm, Croydon, for a continental government. The candle power of each searchlight was rated by the National Physical Laboratory as 3500 million. This means that if the horizon were sufficiently far away and meteorological conditions were suitable, the lights would be visible for hundreds of miles. These lights are to be used for frontier defence, and although they are seven feet in diameter can easily be controlled electrically by an operator at any distance away. By means of a signalling shutter mechanism, morse signals can be sent by the beam. The same firm has also made searchlights for use in navigating the Suez Canal at night. They send out a divided beam illuminating each side of the canal and leaving a dark patch in the centre so as to avoid dazzling the eyes of the pilot of a ship coming in the opposite direction. The electric carbons burn for 6½ hours, thus obviating the necessity of trimming the lamp when in the canal. The lamps used in cinema studios give either 'spot' or wide angle lighting. Searchlights are also used in aerodromes for fog penetration and for 'writing' on the clouds.

THE "Bulletin de l'Union des Sociétés Savantes Polonaises de Léopol (Lwow)" for 1927–1928 records the successful attempt of a local bureau to bring together the work of the local branches of Polish learned societies. It has been edited by Prof. Sigmond Czerny, (15 rue Tarnowskiego) of the University of Léopol. One hundred pages comprise reports from some three dozen societies. Contacts are maintained with a wider world through Paris and America, by exchanges of periodicals and by representatives to international congresses. The interests of the bureau include much recording of unhappy histories, some care of orphans and widows, cemeteries ancient and modern, excursions to historic monuments, the collection of books and archives into museums and libraries, archæology, jubilees and centenaries of brighter moments, folklore, regional survey, heraldry, classical studies, school geography, local natural history, Slavonic philology and ethnology, the glacial epoch, reorganisation of finances, economic discussions in collaboration with the ministry, publications in Polish with abstracts in French, English, Latin or German, international law in relation to Chorzow and Dantzig, echoes of western science, some medical and mathematical research. The general picture presented by these reports is that of a struggle out of confusion and towards the light. The particular device of a local bureau of local branches of national societies is one that might be useful elsewhere, if only as a clearing-house for harmonising time-tables.

IT is announced in the *Journal of the Society for the Preservation of the Fauna of the Empire* for 1930 that in future the *Journal* will be issued more frequently, and an appeal is made to members for articles on any matter relative to the conservation of wild life. The present number, apart from recording the activities of the Society during the past year, contains some interesting extracts from faunal reports dealing with various parts of the Empire. In Uganda the "astonishingly small number of young gorillas in the troops" is attributed to the attacks of leopards; in Victoria it has been found that the complaints of fishermen regarding the serious menace of seals to fisheries have not been substantiated; and the success of the inoculation of domestic stock in Southern Rhodesia against trypanosomiasis is a matter of first-rate importance to the wild life of the country, as well as to the farmer.

THE Arctic archipelago of Franz Josef Land, now within the realm of Soviet jurisdiction, is seldom visited except by Norwegian walrus and bear hunters, although the scientific knowledge of the group is due chiefly to British, Austrian, Italian, and American expeditions. It is useful to have a summary of what

is known. This has been prepared by Dr. G. Horn and appears as No. 29 of *Skrifter om Svalbard og Ishavet* (Oslo, 1929). The paper includes a fairly complete bibliography and a sketch map showing the routes of the chief expeditions. Dr. Horn antedates the discovery which is generally attributed to J. Payer in 1873 to two Norwegian sealers in 1865. He cannot, however, adduce any written evidence of the discovery of North-East Spitsbergen in that year or proof that the land called by this name was Franz Josef Land, although the identity is not impossible.

THE Medical Research Council has appointed Major A. G. Church, M.P., Col. F. E. Fremantle, M.P., and Sir John H. Parsons to be members of its Industrial Health Research Board.

SIR CHARLES MARTIN, who will shortly retire from the directorship of the Lister Institute, has accepted a pressing invitation from the Commonwealth Council for Scientific and Industrial Research to take charge of its Division of Animal Nutrition for at least two years. This Division was established in 1927 under the late Prof. T. Brailsford Robertson, and has been concerned mainly with problems of wool production. The central laboratory is in the grounds of the University of Adelaide, while there are eight field stations scattered over the more important pastoral areas. Sir Charles Martin will probably leave England towards the end of December and will break his journey at South Africa in order to visit the veterinary research station at Onderstepoort.

THE thirty-sixth annual report of the governing body of the Lister Institute of Preventive Medicine has recently been issued. It contains a brief but useful and interesting survey of the researches which are, or have been, in progress during the year in the various departments of the Institute. Sir Charles Martin, the Director, and Prof. Arthur Harden will be retiring under the age limit towards the end of this year, and the governing body has appointed Prof. J. C. G. Ledingham and Dr. R. Robison to fill the vacancies thus created, the appointments to date from Jan. 1 next.

THE fact that cancer occurs with some frequency in human beings, for example, mule-spinner operatives, as a result of contact with lubricating mineral oils, has caused some alarm among those taking mineral oils for medicinal purposes. We learn from a recent *Science News Bulletin* (Science Service, Washington, D.C.) that Dr. Francis Wood of the Institute for Cancer Research, Columbia University, has tested several makes of medical mineral oil for the presence of carcinogenic properties upon mice, of a strain known to be liable to the development of cancer, by painting the skin and by internal administration. The results were negative, so that mineral oils of the type used for medical treatment may be regarded as being free from any risk of producing cancer.

CATALOGUE No. 13 of second-hand books (543 in number), on mammals, birds, insects, shells, etc., geology, fossil plants, botany, and horticulture, has just been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

THE Cambridge University Press announces the publication in September of vol. 3, in 2 parts, of Prof. Karl Pearson's "Life, Letters and Labours of Francis Galton"; IIIA will deal with "Correlation, Personal Identification and Eugenics", and IIIB with "Characterisation, especially by Letters".

THE latest catalogue (No. 528) of Messrs Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, deals with books, pamphlets, engravings, maps, and original drawings relating to Latin America, the British colonies of the Falkland Islands, Honduras, and Guiana offered for sale by the firm. The catalogue, which is an interesting one, contains upwards of a thousand items.

UNDER the title of "Principles and Practice of Geophysical Prospecting", and edited by Mr. A. Broughton Edge and Prof. T. H. Laby, the Report of the Imperial Geophysical Experimental Survey will be published by the Cambridge University Press in December. The work is in two parts, one dealing with the actual field results obtained in Australia, and the other giving a more theoretical discussion of the subject, which, is is hoped, will be of service to students of practical geophysics in English-speaking countries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Road Experimental Station of the Ministry of Transport Roads Department at Harmondsworth, near Colnbrook, Middlesex—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Aug. 11). An engineer in the Midland Division of the Ministry of Transport Roads Department—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Aug. 11). An assistant lecturer in agricultural biology (bacteriology, botany and zoology), at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the County Council, Shire Hall, Chelmsford (Aug. 12). A lecturer in engineering at the Plymouth and Devonport Technical College—The Secretary for Education, Rowe Street, Plymouth (Aug. 16). Four technical assistants (either sex) at the Manchester Royal Infirmary, for clinical laboratory work—The Chairman of the Medical Board, Royal Infirmary, Manchester (Aug. 16). A horticultural instructor for Norfolk County Council—The Horticultural Superintendent, 30 Cattle Market Street, Norwich (Aug. 21). A professor of physics, and head of the department, in the Muslim University, Aligarh, U.P., India—Vice-Chancellor S. R. Masood, Box 24, c/o NATURE Office (Aug, 23). A general secretary of the Eugenics Society—The Honorary Secretary, Eugenics Society, 20 Grosvenor Gardens, S.W.1 (Sept. 15). A Norwegian professor of marine engineering in the Technical University of Norway—Kirke-og Undervisningsdepartementet, Oslo, Norway (Oct. 1). A medico-physicist to organise and take charge of the Sheffield National Radium Centre—The Secretary, Royal Infirmary, Sheffield.

Research Items.

Composition of Ancient Glassware.—Most people are familiar with Pliny's story of the discovery of glass, but modern researches have shown that it must be regarded as apocryphal, for glass-making has been found to antedate the Phœnicians by many centuries. Glass beads, for example, are plentiful in the excavations of a cemetery of the Third Dynasty of Ur (2450 B.C.). In a discussion of ancient glassware, G. M. Morey shows that the oldest analysed glasses, including specimens from the tombs at Thebes dating from 1500 B.C., have much the same composition as the common glass of to-day (*Art and Archæology*, Dec. 1929). All have silica, lime, and soda as their essential ingredients, and the composition range is remarkably narrow. Only three types of mixtures are known which possess the glass-making property of passing through their freezing points without transformation to crystalline solids; these are characterised by the presence of phosphates, borates, or silicates. Moreover, only the latter can resist successfully the attack of atmospheric agencies. The reason for the restricted composition range is that, of all possible mixtures, only those near the composition represented by $Na_2O \cdot 3CaO \cdot 6SiO_2$ can give a glass with the desired properties. With variation in silica either way the melting-temperature rises and the resulting 'glass' is opaque. Too much lime also gives opaque material; too little makes a readily weathered glass. With too much soda the resulting glass is not durable. In primitive glass-making a low melting-temperature was an important feature and in consequence the older glasses carry more alkali than would to-day be considered good practice.

Transformative Protective Coloration.—Complaint has often been made of the assumptions on which cases of protective coloration are founded, and this complaint would appear to be based on good grounds in the case of the so-called 'transformative protective coloration', described by Karny, by which he means the capacity of an insect or other animal to transform its juvenile protective coloration to a further and different protective coloration in adult life. A searching criticism is made by F. Heikertinger (*Biol. Zentralbl.*, vol. 50, p. 193, 1930) of the work of Karny on transformative protective coloration in the Bornean species of *Asthates*, one of the Longicorn beetles. Karny, he says, founds his work on the uncritical and hypothetical work of Shelford, curator of the Sarawak Museum, on the mimetic insects of Borneo. The latter regards the case of the Asthates as typical protective coloration, the models belonging to the sub-family Galerucinae. Shelford writes with no positive knowledge as to whether Asthates is tasteful or repulsive to its enemies, ignoring the modern biological requirements essential to a discussion of the question, namely, a really exact knowledge of the perceptions, tastes, and food of the enemies against which the animals are supposed to be protected. On the other hand, Heikertinger now contributes practical or positive data relating to the food of local birds, whence it appears that both models and mimics are devoured with equal impartiality. Karny's new case of 'transformative' coloration has therefore no scientific ground, and the author pleads for a more critical treatment of the whole ecological problem of so-called mimicry.

Arctic Birds of Historic Interest.—In the last two numbers of the *Scottish Naturalist*, Admiral J. H. Stenhouse continues his accounts of the birds of historic interest in the Royal Scottish Museum. In the second paper of the series he discusses the birds of Parry's voyages: from the second voyage (1821–23) thirty-five specimens, representing nineteen species, survive, from the third voyage (1824–25) ten, and from the fourth voyage (1827) twelve. The third paper deals with the birds of Franklin's Overland Expeditions, of which the second is best represented by fifty-eight birds, some being type specimens described by Swainston and Sir John Richardson, and the *Tetrao franklinii* of Douglas.

Chromosome Cycle in the Actinomyxidia.—In the epithelium of the intestine of *Tubifex tubifex*, Naville (*Quart. Jour. Micro. Sci.*, May 1930) discovered a new species and genus of an Actinomyxidian which he has named *Guyénotia spherulosa*. It is characterised *inter alia* by the possession of a spheroidal spore with three suture lines 120° apart, three polar capsules, and three digitiform appendages. The female germ line shows a marked meiotic inertia as compared with the male. Each shows three successive divisions in the formation of the gamete; the first is homotypic with four diploid chromosomes; the second is heterotypic reducing the four to two diploid chromosomes; and the third again homotypic. Fertilisation is accompanied by a restoration of the diploid number. The formation of the spore nuclei is somewhat like that in *Triactinomyxon legeri*, but residual nuclei are not formed. It is claimed that the results obtained are homologous with those found by the author in the Myxosporidia. Sex differentiation is more precocious in the Actinomyxidia and leads to the immediate formation of male and female germ lines. It has been shown in the Myxosporidia that increasing precocity in sex differentiation gradually leads to a dioecious condition, although this does not seem to have occured in the Actinomyxidia.

History of the Rhône Delta.—In the *Quart. Jour. Geol. Soc.*, vol. 86, pp. 64-93, 1930, Mr. R. D. Oldham presents the results of his researches into the historic changes of level in the delta of the Rhône. At the opening of the Pleistocene period, the whole area was covered by a deposit of gravel and well-rounded boulders. A period of subsidence then set in and an alluvial delta was built up, the lower part being arenaceous and the upper of finer sand and silt. A period of uplift followed and the land rose not less than 14 metres above the level to which it had previously sunk. The settlements and structures of the Romans were erected on the weathered surface of erosion then developed, but before the Roman occupation a period of intermittent subsidence had already begun. One of the episodes of movement probably occurred between the years 1000 and 1500 B.C. The next change took place in the eighth and ninth centuries A.D. and involved a downward displacement of 5 metres. Lastly, there was a fresh movement of subsidence of about a metre which was practically completed during the latter half of the eighteenth century. Thus, at the present time the total amount of subsidence has reached some 10 metres, so that the land still stands about 4 metres above the lowest level reached before the period of 14 metres uplift set in (see also NATURE, April 19, p. 601).

River Flow Records.—Two Reports on River Flow in the rivers Garry and Morriston, in the Ness Basin, Inverness-shire, which have been received from the offices of River Flow Records (Parliament Mansions, Victoria Street, S.W.1), continue for a further period of three months (that is, from October to December 1929) the observations which were initiated as a private enterprise by Capt. W. N. McClean in the

earlier part of the year. The first instalment of data for the period July to September 1929 was the subject of notice in NATURE of Mar. 1 last; and while this second series is unquestionably helpful in extending the record of exact measurement, and will on that account be cordially welcomed by all who are interested in river development work, it suffers from the disability of its predecessor in that obviously the observations have not yet been carried sufficiently far to render them useful to a higher degree than that of assisting to arrive at approximations of flow of a very general character. Time and continuity will, of course, remedy this deficiency. The fresh records during the three closing months of 1929 are confined to rainfall gauge and water level readings, with calculated deductions therefrom, and no further actual measurements of river flow were made, the hope being expressed in the reports that those may be resumed during the year 1930. The two pamphlets will be valuable for filing and reference. They are further of serviceable interest in indicating how records of river flow may be computed and compiled in an organised manner under some general supervision by a staff of local helpers, aided by occasional expert survey work.

Changes of Rock Temperature.—In the *Proceedings* of the Royal Society of Edinburgh, vol. 50, pp. 153-165, R. W. Wrigley writes "On Changes of Rock Temperatures and Irregularities of the Earth's Rotation". The work is based on the long and unique series of rock temperatures at depths of about 6, 12, and 25 feet made at Calton Hill, Edinburgh, 1838-1876, 1880-1929. These were used by Forbes and Kelvin for the discussion of the downward conduction of heat from the earth's surface; they are here used in a search for any indication of variability in the supply of heat to the earth's crust from below. It is concluded that, when freed from the influence of surface changes, the thermometers show real and distinct fluctuations, accordant with one another, and attributable to deep-seated causes; confirmation of this view is obtained from Greenwich measures of the temperature at 25·6 ft. depth, for the period 1868-1910. The course of these temperature changes is then compared with the 'minor' fluctuations of the moon's motion, according to E. W. Brown; the correlation is thought to be "too close to be the result of mere coincidence", and it is sought to relate both phenomena to crustal movements.

Infra-Red Radiation.—A good survey of the properties and applications of near infra-red radiation, based on two lectures by H. D. Babcock, of the Mt. Wilson Observatory, is given in a *News Service Bulletin* recently issued by the Carnegie Institution of Washington. It appears that the recent developments in the technique of infra-red photography, which have already been of the greatest value in spectroscopy, have come largely from the needs of the motion-picture industry; a daylight photograph taken by infra-red light appears not unlike a night scene, as is shown very well by two mountain photographs in the *Bulletin*. The present limit of sensitivity is put at 11600 A. A remarkable infra-red photograph taken from an aeroplane at an altitude of 17,000 ft., which is also reproduced, shows distinctly the peak of Mt. Rainier (14,400 ft.) at a distance of 227 miles.

Spectroscopy of Soft X-rays.—A spectrograph for the analysis of soft X-rays is described by Prof. M. Siegbahn and T. Magnusson in the *Zeitschrift für Physik* for June 18. It employs a plane grating, ruled with about the same spacing as for optical work, but used at almost grazing incidence. The grating itself, which is ruled only for a width of from one to three millimetres, replaces one slit in the collimating system for the incident beam. The spectra are recorded photographically on ordinary plates. The preparation of the grating is carried out with a new machine, in which the ruling point is brought down so gently at the beginning of each line that the usual pitting of the blank at this point is completely eliminated, and special care is also taken to avoid irregularities elsewhere on the prepared surface. The instrument is designed for use in the difficult region between about 10 A. and 100 A., where neither crystal spectrometers nor the new concave grating vacuum spectrograph—also elaborated at Uppsala—can be applied satisfactorily, so that instruments of good resolving power are now available for the whole of the far ultra-violet and soft X-ray sections of the spectrum.

Tests of Creep Stress.—The June issue of the *Transactions of the Institute of Marine Engineers* contains a reprint of the paper read to the Institute by Mr. S. L. Archbutt, of the National Physical Laboratory, on recent metallurgical research in relation to marine engineering. The reprint is accompanied by a report of the discussion which followed. Restricting his review to work done during the last ten years, Mr. Archbutt dealt in turn with materials for use at high temperatures; light alloys; corrosion; nitrogen case-hardening, and a new cutting tool material. In the design of turbines, boilers, and internal combustion engines there is an ever-increasing demand for materials which will not deteriorate at high temperatures, and one of the most important requirements in this connexion is ability to withstand prolonged loading; as for example in the walls of a steam superheater tube or drum. Extraordinary interest had been aroused by the phenomenon of creep which can occur when material is stressed for a long time at high temperature, the study of which led to the introduction of the term limiting creep stress, which is the upper limit of stress which a material will withstand without ultimate failure. To investigate creep under load, test pieces are hung vertically between shackles and surrounded by an electrically heated furnace. The importance of this study of creep is shown by the fact that, starting in 1921 with four creep furnaces, the number at the National Physical Laboratory has now been increased to twenty-five or more to cope with demands for tests. The report of Mr. Archbutt's paper is accompanied by many illustrations, among which is a view of the creep stress laboratory at Teddington.

Damage by Lightning to Telephone Cables.—In the March number of the *Europäischer Fernsprechdienst*, a journal for European international communication, published in Berlin, there is an interesting account by R. Wicar of damage done by lightning to a telephone cable connected with the Budapest-Vienna line. The lightning struck a large and flourishing acacia tree and severed the trunk completely in a transverse direction. The photograph given shows that the upper portion was partially buried in the ground and was left standing vertically beside the stump of the tree, giving the impression that two trees had been involved. From the trunk the lightning made its way at a depth of about a yard under the surface to the long-distance telephone cable. The path of the lightning was plainly marked by a channel about two square centimetres in cross section and six yards long. Notwithstanding the heavy rain, the earth round the tree was almost as dry as dust. The cable was bent and flattened for a length of about two feet where the lightning entered it. About two yards farther on, the cable sheath had been opened up and

partially deflagrated. During the repair work, it was noticed that the lightning had travelled along the lead sheath for several miles. It is instructive to learn that the insulation of the telephone conductors nearest to the sheath was damaged and even at a distance of more than a mile from the point of entry many broken wires were located. Photographs are shown of the damage done to the cable. Within forty-eight hours of the occurrence, the cable was again working satisfactorily. In 1929, southern Europe had unusually violent thunderstorms.

Efficiency of Telephone Transmitters.—The efficiency of a telephone transmitter varies largely with the distance of the mouth from it and also with the angle at which the air waves impinge on the diaphragm. It is not generally realised, however, that the loss in output for increasing distance between mouth and mouthpiece is greater than that due to the reduction in the air pressure. This is due to the fact that the sensitivity of the carbon granules diminishes rapidly as the amplitude of the vibrations diminishes. In *Electrical Communication* for April, L. C. Pocock gives an interesting account of progress in subscribers' transmission apparatus. He points out that transmitters used in handsets are like other transmitters spoken into from various distances, but are unlike fixed transmitters as this variation is unavoidable. The person using the telephone places the receiver on his ear and the transmitter is then automatically located at some distance from the mouth which depends on the shape and size of the user's head. If the handset is made rather small, people with rather large heads are not able to get the mouthpiece opposite their mouths at all, and so generally place it right underneath their chin, where it gives very bad transmission. On the other hand, if the handset is made larger the transmission will be poor except for the small number of outsize type of users who, owing to the increased length, can bring the transmitter opposite the mouth. To get over this difficulty, the Bell Telephone Laboratories made measurements on the heads of more than four thousand people. The result enabled them to construct a handset which the great majority of people will be able to use with the transmitter in the proper position with regard to the mouth. A description is given in detail of the new modern headset for automatic telephony developed by the International Telephone and Telegraph Corporation. The articulation gain with this instrument over the ordinary fixed set is about fifteen per cent.

Measurement of Interfacial Tension.—The previous measurements of surface tension by determining the pull necessary to detach a ring from the surface of a liquid have given results 30 per cent too high or too low in many cases, and in a paper in the May number of the *Journal of the American Chemical Society*, Harkins and Jordan show that this was due to the use of an inaccurate equation. The correct theory is given in a paper by Freud and Freud in the same journal, in which Laplace's differential equation is used to calculate the shapes of the surfaces upheld by rings. It is shown that the ring process could give results of the degree of accuracy of about 0·25 per cent, and is now an absolute method, since the surface tension can be determined by it without reference to any other method.

Distillation Products of Peat.—The commercial exploitation of peat, apart from its use as a crude fuel, remains as one of the challenging problems of applied chemistry of special interest to Ireland. J. T. Donnelly and J. Reilly have examined the carbonisation of peat at low temperatures (550°) (*Proc. Roy. Dublin Soc.*, February, 365; 1930). By carrying out the distillation in an atmosphere of coal gas, unusually high yields of tar (16·6 per cent) and ammonia (17·4 lb. per ton) were obtained. The peat itself contained 10 per cent of soluble wax and bitumen. Unfortunately, tars of all kinds are at a discount just now, and as these tars have the 'low temperature' character, their value at present is problematical. In the April number of the same publication, C. O'Sullivan and J. Reilly have recorded investigations showing that the yields of tar are increased by distilling separately the wax extractable from the peat.

Low Temperature Carbonisation Tests.—In accordance with the scheme in vogue whereby the Department of Scientific and Industrial Research makes official tests of plants for the low temperature carbonisation of coal, the staff of the Fuel Research Board has carried out a 6-days trial of the 'Babcock' plant installed at the Dunston station of the Newcastle Electric Supply Co. This plant is unusual in that it is specially designed for the pre-carbonisation of boiler fuel and works in conjunction with a power station steam-raising unit. The retort tested was worked at its rated capacity, 30 tons per day of Northumberland coal slack being treated. The coal is first pre-dried by products of combustion and then carbonised by 'internal heat' by a mixture of steam with flue gases containing some oxygen. The coke produced (14·6 cwt. per ton of coal) is led straight on to the chain grate of the boiler stoker while the gas, of very low calorific value, is also consumed under the boiler. Of liquid products the yields were 16·4 gal. of tar and 2·5 gal. of spirit, these being the only by-products. Some of the coke was large enough for use on the domestic grate, for which it was very suitable. The test showed that the plant was technically successful and would eliminate the production of smoke in power-station practice. It should be remembered that the low value of the main product, coke, which must be produced in competition with cheap boiler slacks, makes the economic problem very difficult.

Ekatantalum.—The May number of the *Journal of the American Chemical Society* contains a paper by A. V. Grosse on element 91, or ekatantalum. The existence of such a metal, between thorium and uranium, was predicted by Mendeléeff in 1871, and at present three isotopes of it are known, all radioactive, namely, brevium, protoactinium and uranium *Z*. Of these, protoactinium is most important. It was discovered by Soddy, and independently by Hahn and Meitner, in 1917, and is, as its name indicates, the parent of the actinium series. It occurs in Nature in considerable quantities, uranium ore containing about 0·6 gm. per gm. of radium. Up to the present, all attempts to concentrate and isolate protoactinium have been unsuccessful, and this has been due, according to Grosse, to a mistaken assumption that there would be a similarity in properties between the new element and tantalum. He arrived at the conclusion that it would be more basic than tantalum, and more analogous to thorium and uranium. This prediction has been verified, and Grosse has succeeded in extracting about 40 mgm. of the element. The experiments on its chemical properties were carried out by ordinary chemical methods, using 10 mgm. or more of material. The oxides of ekatantalum and tantalum have only one reaction in common, the solubility in hydrofluoric acid. Attempts by previous experimenters to concentrate protoactinium in tantalum are now known to have had the effect of removing from the tantalum preparations the last traces of protoactinium which they may have adsorbed.

Deep Sea Investigations by Submarine Observation Chamber.

ON June 11, 1930, in lat. 32° 16′ N., long. 64° 39′ W., in the Atlantic Ocean off Bermuda, Dr. William Beebe, accompanied by Mr. Otis Barton, descended to a depth of 1426 feet below the surface of the sea.[1]

This announcement marks a new era in the exploration of the sea. All previous diving records shrink into insignificance compared with this depth; it was with no wish for record-making achievements that the descent was undertaken, but a real explorer's desire to see the animals beneath the waters as they live and not at second-hand from the collections of deep sea nets.

The construction of the chamber was financed by Mr. Barton, and he and Dr. Beebe, working from the New York Zoological Society's Oceanographic Expedition's headquarters at Nonsuch Island, have now made several descents, of which three were to a depth of 800 feet and one to 1426 feet. The chamber is a steel sphere 57·3 in. in outside diameter and 1½ in. thick. Observations could be made through a 6 in. diameter port fitted with a quartz window. Outside the window was hung a bag of decayed fish and some baited hooks, and a strong electric searchlight could be used to illumine the surrounding water. Telephonic communication was maintained with the ship above and a supply of oxygen carried.

One of the most striking phenomena was the " blue brilliance of the watery light to the naked eye, long after every particle of colour had been drained from the spectrum ". The visual degeneration of the spectrum was observed, in connexion with an intensity metre. In Dr. Beebe's own words:[2] "The red had gone completely a few feet down . . . ; orange had been absorbed at sixty feet below the surface and yellow at less than 400. At our depth (800 feet) lavender, too, was non-existent, together with the two opposite ends of the spectrum, infra-red and ultra-violet, while green still persisted, but greatly diluted. All that remained to our straining eyes were violet and blue, but blue such as no living man had ever seen."

It proved quite possible to observe pelagic animals drifting and swimming past the window, such as medusæ, shrimps, and fish, and about a dozen true bathypelagic fish were identified. A very interesting result of these observations was the presence of certain species of fish and invertebrates in water layers well above the depth at which their occurrence is first indicated by net catches in the daytime.

Four descents have also been made in water up to 350 feet in depth along the shelving bottom of the Bermudian insular shelf as the vessel drifted seawards. Such exploration revealed a new fish fauna at these offshore depths, the recognisable shore fish also being of great size.

The observations will be continued another year, and it is to be hoped that this new weapon of marine research has come to stay and that similar submarine observation chambers may be built in time for a study of the floor of shallower seas and the habits of food fishes. Already shallow water diving has proved its scientific value. We shall await Dr. Beebe's and Mr. Barton's full reports with great interest.

[1] *Science*, vol. 72, No. 1854, July 11, 1930, pp. 27-28. "A New Method of Deep Sea Observation First-hand." By Henry Fairfield Osborn.

[2] *New York Times*, June 27, 1930.

The Leakey-Harper Drawing Machine.

IN many branches of science, and more especially in zoology, palæontology, anthropology, and anatomy, it is often necessary to make illustrations of irregular and intricate objects, which must be true to scale and accurate in detail. It has been found that photography does not fulfil the requirements, and the illustrations have in the past been made by accurate freehand drawings. Such drawings require a large number of measurements to be made, and if a high degree of accuracy is required the work entailed is very considerable. If the specimen being drawn is of a fragile nature, considerable risks are involved because of the amount of handling entailed.

The drawing machine illustrated in Fig. 1 has been especially designed by the Cambridge Instrument Co., Ltd., 45 Grosvenor Place, London, S.W.1, to enable true-to-size drawings to be made quickly and conveniently, with the minimum amount of handling. It further makes it possible for drawings to be made of any of the six different views which represent six projections on to the sides of a cube surrounding the object, without moving the specimen after it has been once put into position.

This fact is of special importance in that branch of work for which the instrument was originally suggested by L. S. Leakey, namely, making drawings of human skulls, where it is often necessary to make drawings of the profile, full face, base, etc., with the skull orientated on the Frankfurt plane. The instrument is very easy to use and combines both greater accuracy and greater speed in the drawing of any object. The outline drawing of a skull that is illustrated in Fig. 2, including the teeth, sutures, and orifices, took forty-five minutes. A similar drawing done by the ordinary measurement and freehand method would have taken approximately twelve hours, whilst the degree of accuracy obtained on a complete set of freehand drawings could not equal that obtained by the drawing machine.

The principle of operation of the Leakey-Harper machine (Fig. 1) is as follows: A telescope, *A*, fitted with crosslines and with a horizontal line of sight, is fixed rigidly to a carriage that is capable of horizontal and vertical movement in a plane normal to its axis but so that the line of sight remains accurately parallel to its original direction. The horizontal and vertical movements of the telescope are obtained by rotating two hand wheels, one on the left hand, *B*, effecting the horizontal adjustment and one on the right, *C*, the vertical adjustment. Rigidly attached to the hand wheels, and at right angles to one another, are two long screws, one on the left hand carrying the telescope carriage, so that any rotation of the wheel moves the telescope in a horizontal direction. Rotation of the wheel on the right moves the telescope vertically. Attached to the base of the telescope carriage is a pencil, *D*, that inscribes in one plane on a sheet of paper the horizontal and vertical movements of the telescope.

Attached to the pencil is a circular soft iron plate that is supported above a solenoid by a helical spring; the pencil itself is fed through the solenoid so that the point is supported immediately above the paper; when a current is passed through the solenoid the soft iron plate is magnetically attracted and the pencil pulled down until it is in contact with the paper. When the circuit is broken the pencil is automatically raised from the paper.

The object to be drawn is mounted on a square glass plate on which have been inscribed crosslines intersecting in the centre at angles of 90° to one another; this plate is then placed upon a glass shelf, *E*, similarly ruled, that is fitted in an open frame in a position opposite to the line of sight of the telescope. To obtain an alternative view of the object to the line of sight it is only necessary to rotate the subsidiary glass plate through an angle of 90°, as indicated by the ruled lines, and by rotating the plate in this way through a succession of right angles the four different views necessary for a complete set of drawings may be obtained. The plan views of the top and bottom of the object are obtained by two large plane mirrors, *F*, fixed to the frame at an angle of 45° to the horizontal, one above and the other below the specimen to be drawn. These mirrors reflect the desired images and it is only necessary to raise or lower the frame carrying

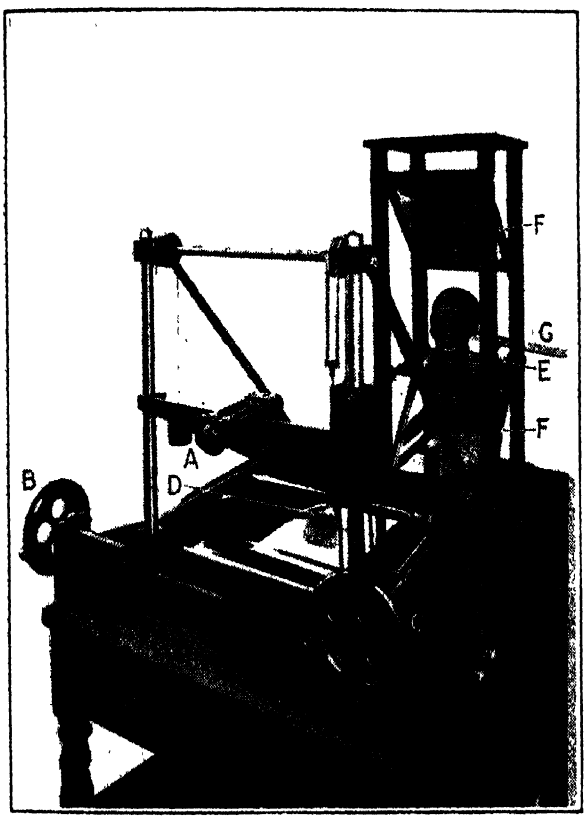


FIG. 1.

the object until the reflected image is in the line of sight of the telescope. The framework carrying the specimen is open, but a suitably coloured curtain may always be hung behind the object to give contrast when drawing edges of white or black objects.

To make a drawing of a skull, the specimen is set up on the glass plate on the Frankfurt or any other desired plane; the skull may be supported by a block and held in position by small pieces of plasticine. Fragile fragmentary specimens may be supported by a moulded block of plasticine, but it will be recognised that this will prevent a detailed drawing of the base view being made without resetting the specimen. The observer sets the telescope so that the intersection of the crosslines in the telescope coincides with the outer extremity of the skull; the right hand wheel controlling the vertical motion should then be rotated through the whole length of adjustment; this will cause a straight line to be drawn by the pencil on a sheet of paper that has been previously fixed to the drawing board. By suitably dividing this line a scale is obtained on which vertical measurements may be made. Similarly, the lowest extremity of the skull may be taken and a line drawn by means of the horizontal adjustment to provide the horizontal scale.

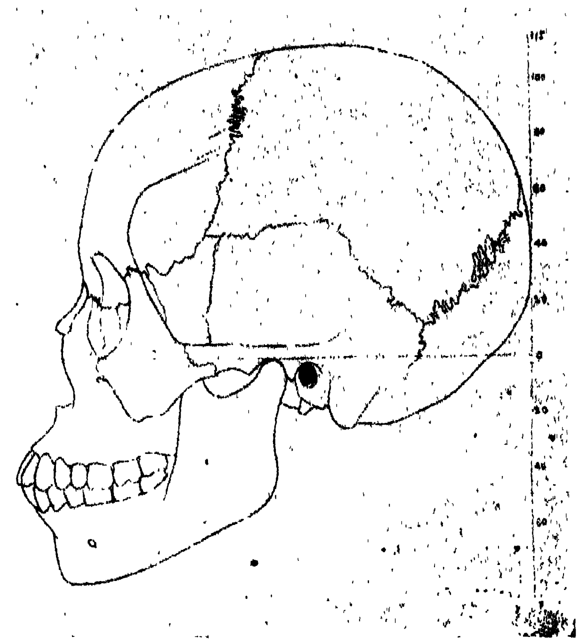


FIG. 2

The telescope is then focused and the crossline intersection made coincident with a point on the main outline of the skull; by rotating the hand wheels the observer may make the telescope traverse the complete outline, and in this way make the pencil draw out the projection of the complete skull in this plane. Similarly the sutures, orbits, teeth, etc. can be drawn in detail.

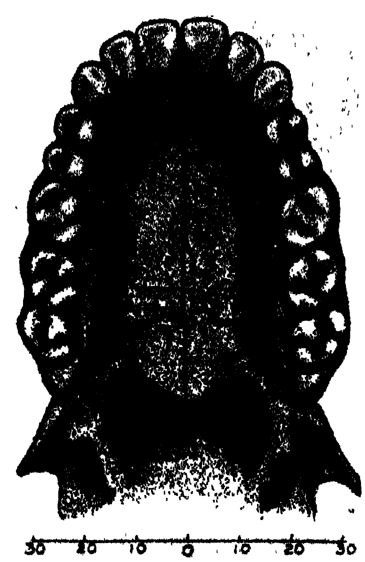


FIG. 3.

A further attachment has been devised by Mr. E. Smith to enable the depths and contours of orifices or cavities in the specimens to be drawn. This is of

great service in connexion with drawings of skulls, as it is often desirable to show on profile drawings the depth and the shape of the orbit, palate, etc. The attachment for this work consists of a U-shaped metal pointer with parallel prongs, *G*, that is capable of horizontal and vertical adjustment and which is carried on an arm that is fixed in a runner at the side of the frame supporting the specimen; this runner is also capable of vertical adjustment. The width between the prongs is such that it is rather larger than half the maximum width of an average skull and the length of each of the prongs is precisely equal, so that the pointed tips are exactly in the same line of sight when viewed by the telescope. It follows that if the posterior prong is placed within a cavity and thereby hidden from view, then the anterior will indicate the actual depth of the cavity and by following the movements of the anterior pointer with the telescope an outline of the cavity may be drawn.

It will be appreciated that all subsequent measurements can be made on the drawings instead of on the object. This is of great convenience, as it enables drawings to be submitted for examination rather than the actual object; in addition, any number of precisely similar drawings may be made.

Although the machine was primarily designed for drawing skulls, it can be used to advantage in making a series of true to size drawings of any object in any plane where accuracy of detail combined with speed are a consideration.

The illustrations show the complete apparatus with a skull mounted in position for drawing, and also two drawings—one of a skull (Fig. 2) and the other of a palate (Fig. 3)—obtained with the instrument.

Recent Work on Vitamin D.

II.

CHEMISTRY.

VARIOUS colour tests have been proposed for the detection of vitamin D, but none of those yet described is specific. Thus W. A. Sexton (*Biochem. J.*, vol. 22, p. 1133; 1928) has investigated the reaction obtained by heating a source of vitamin D with aniline hydrochloride in excess of aniline, when a red colour is produced. It was found that in addition to cod-liver oil and irradiated ergosterol, a similar colour was given also by unsaturated ketones, such as cholestenone, oxycholestenone, oxycholesterylene and carvone: with saturated ketones, such as cholestane-4-one or camphor, only slight darkening of the mixture was observed. The results suggest, however, that the vitamin, or an accompanying irradiation product of ergosterol, is ketonic in character. The phosphomolybdotungstic acid test is even less characteristic; though cod-liver oil gives a positive reaction, irradiated ergosterol is negative. Ergosterol itself, however, shows certain colour reactions which not only are useful for detecting its presence in mixtures, but also throw light upon its chemical structure as well as that of some other sterols.

O. Rosenheim (*ibid.*, vol. 23, p. 47; 1929) has found that when it is warmed with chloral hydrate or its chloroformic solution treated with a concentrated aqueous solution of trichloroacetic acid, an immediate red colour is produced which soon changes to a deep blue (passing through a green in the case of chloral hydrate). So little as 0·005 mgm. can be detected. The red colour is also given by cholesterylene, ψ-cholestene, allocholesterol, and allositosterol, and is therefore dependent upon the presence of the $\Delta^{1,2}$ (or $\Delta^{1,13}$) ethenoid linkage: it is probable that a coloured carbonium salt is formed. The colour is discharged by water or alcohol. The final blue stage observed in the case of ergosterol is presumably due to the presence of the third double bond. Oxycholesterol gives a gentian blue colour with the reagents, which, however, shows only the absorption band of oxycholesterol and not those of the ergosterol blue.

I. M. Heilbron and F. S. Spring (*ibid.*, vol. 24, p. 133; 1930), in further studies of the structure of sterols, have investigated the reaction with bromine: ergosterol and certain hydrogenated derivatives of this substance which do not give the red colour with trichloroacetic acid, when dissolved in glacial acetic acid show a green colour on addition of a solution of bromine in chloroform. It appears that this reaction depends upon the $\Delta^{10,19}$ (or $\Delta^{10,11}$) ethenoid linkage, which is inert to hydrogenation: all cholesterol derivatives, for example, are easily hydrogenated completely; they fail to give the bromine test. Heilbron and Spring also direct attention to the fact that only those sterol compounds show selective absorption which contain the $\Delta^{1,13}$ (or $\Delta^{1,2}$) ethenoid linkage as one of two which are present in the molecule.

Since the discovery that ergosterol shows the highest antirachitic potency of any substance on irradiation with ultra-violet rays, search has been made for other substances which could be activated to a similar degree, but without success. Thus O. Rosenheim and T. A. Webster (*Biochem. J.*, vol. 22, p. 762; 1928) found that naturally occurring saturated sterols and artificially reduced sterols, cholesterol and sitosterol with one double bond, stigmasterol and cholesterylene with two were not activated on irradiation. Again, other unsaturated compounds containing three or more double bonds such as squalene, certain terpenes, sphingosine, and phrenosine were unable to replace ergosterol as precursors of vitamin D. Isomers of ergosterol, fungisterol from ergot and zymosterol from yeast, iso- and neo-ergosterol were equally impotent. The work on zymosterol was carried out by E. M. Hume, H. H. Smith, and I. Smedley-Maclean (*ibid.*, vol. 22, p. 980; 1928) and was complicated by the fact that the sterol still contained, after purification, as much as 5 per cent ergosterol, the impurity being detected by spectroscopic examination, since neither zymosterol nor fungisterol possesses any selective ultra-violet absorption. However, the biological test on rats showed that daily administration of $\frac{1}{20,000}$ mgm. irradiated ergosterol prevented rickets almost entirely, whilst the same slight activity was shown by doses of $\frac{1}{100,000}$ mgm. irradiated ergosterol and $\frac{1}{5000}$ mgm. irradiated zymosterol: hence the effect produced by the latter can be ascribed to its ergosterol content.

In a further communication, Rosenheim and Webster (*ibid.*, vol. 22, p. 1426; 1928) give details of their examination of irradiated fungisterol for antirachitic potency as well as results obtained with two other sterols isolated from ergot. The fungisterol and one of the others contained small amounts of ergosterol as shown by spectroscopic examination and their biological activity after irradiation was low and certainly due to the presence of irradiated ergosterol. The third sterol showed no absorption bands, gave a negative colour test for ergosterol and was completely inactive after irradiation. All the evidence so far obtained, therefore, suggests that ergosterol is the only naturally occurring precursor of vitamin D.

In following the course of the reaction ergosterol→vitamin D, it has been found that other products be-

sides the vitamin are formed: in fact, under conditions of irradiation such as are frequently employed, the latter forms only a small proportion of these products. Observation of the changes in the absorption bands of ergosterol forms a convenient method of following the course of the reaction, but potency tests are necessary before any particular band can be assigned to vitamin D, more especially since the changes vary to some extent according to the conditions of irradiation. By following these changes, Heilbron and his co-workers were first led to suspect that 'pure cholesterol' contained a contaminating provitamin, and finally to suggest that vitamin D was characterised by a band at 2470 A.; the ergosterol bands are at 2935 A., 2815 A., and 2700 A. Irradiation was carried out in alcoholic solution for 60 min. (I. M. Heilbron, E. D. Kamm, and R. A. Morton, *Biochem. J.*, vol. 21, pp. 78 and 1279; 1927; *J. Chem. Soc.*, p. 2000; 1927).

T. A. Webster and R. B. Bourdillon (*Biochem. Jour.*, vol. 22, p. 1223; 1928) found that irradiation with rays of wave-length longer than 2700 A., by the use of a filter of alcoholic cobalt chloride which cuts off the shorter rays, did not alter the equilibrium reached and that exposure of the solution of ergosterol during irradiation to temperatures ranging from - 18° to 77·8° did not alter the potency of the final product, although at temperatures of -183° and -195° the preparations were markedly less active: these results suggest that the temperature coefficients of the changes causing production and destruction of the vitamin are similar and small and that both reactions are directly photochemical in Nature. A highly active preparation was obtained by a short irradiation followed by removal of the bulk of the unchanged ergosterol with digitonin, evaporation to dryness and extraction in ether to remove traces of digitonin and ergosterol digitonide. The product was a glassy solid, melting at about 30° and much more soluble than the original ergosterol in organic solvents. When the absorption spectra of the irradiation products were studied, it was found that the first change was a marked increase in the absorption below 3000 A., especially in the regions 3200-2900 A., 2650-2500 A., and 2900-2700 A. More prolonged irradiation decreased the absorption and, at the same time, the activity. The authors conclude that vitamin D probably has an absorption maximum at 2800 or 2900 A. and from it is formed a secondary product with an absorption maximum at about 2300 A. Still longer irradiation of the products first obtained leads to complete disappearance of both absorption and activity. They point out that the presence of a band together with some activity in a preparation does not indicate that the band is to be attributed to the vitamin, unless a quantitative relation between such absorption and activity can be demonstrated.

Bourdillon and Webster and their co-workers consider the absorption spectrum of vitamin D also in a later paper (*Proc. Roy. Soc.*, B, vol. 104, p. 561; 1929). Their evidence suggests that three substances are formed in succession by the irradiation of ergosterol: the first (which is vitamin D) shows increased absorption as compared with ergosterol in the region 2500-3100 A. with maxima at about 2800 A. and 2700 A. More prolonged irradiation results in decrease in the absorption in this region with a concomitant increase in that between 2300 and 2500 A. and finally in almost complete disappearance of any absorption in the ultra-violet region. Quantitative comparisons of absorption spectra and antirachitic activity showed a roughly linear relation between intensity of absorption at 2700-3100 A. and potency, so that presumably the substance first formed is the vitamin. The other two substances are inactive. When a filter cutting off all radiation below 2650 A. was used, there was a marked decrease in the formation of vitamin D, suggesting that shorter wave-lengths favour its production rather than its destruction.

The irradiation was carried out usually in alcoholic solution in the absence of oxygen: vitamin D was not easily oxidised in alcoholic solution, but very readily when exposed dry to oxygen at 100°. By calculations depending on the rate of destruction of ergosterol (determined gravimetrically) and the rate of production of absorption due to vitamin D, it was found that the purest preparations obtained probably contained about 55 per cent of the vitamin. The minimum dose detectable biologically was about $2·5 \times 10^{-9}$ gm. or, in 14 days, $3·5 \times 10^{-8}$ gm. If only half this was vitamin D, the smallest detectable dose of the pure vitamin would be $1·9 \times 10^{-8}$ gm., a figure which agrees closely with Steenbock's and Coward's estimates.

E. H. Reerink and A. van Wijk (*Biochem. J.*, vol. 23, p. 1294; 1929) irradiated ergosterol in solution in hexane, exposing it to wave-lengths longer than 2750 A. and to the wave-length 2540 A. by interposing between the mercury arc and the solution filters of benzene solution or chlorine gas and potassium nitrate solution, respectively. Oxygen was rigidly excluded. With the long wave irradiation it was found that the absorption increased at first over the whole range, diminishing as irradiation proceeded in the long wave range. At 2820 A., absorption decreased from the beginning, but at 2715 A. it at first increased. It was possible to calculate that for the first 15 min. the conversion of ergosterol into vitamin D was the only reaction taking place and that in this time about half the ergosterol was converted. More prolonged irradiation resulted in slow destruction of the vitamin and disappearance of the above bands with the development of an ill-defined band at 2400-2500 A. The product of a short irradiation was highly active and was obtained in the crystalline state, free from ergosterol, provided that oxygen was rigidly excluded during all manipulations: the crystals had a melting point below 0°.

Irradiation at 2540 A. resulted in an increase in absorption over the whole range, including 2800 A., the increase being much more marked than with the long wave irradiation: the absorption at 2930 A. and 2820 A. increased much more than that at 2715 A.: further irradiation resulted in almost complete disappearance of the absorption. The vitamin was formed only during the first few minutes and was then rapidly destroyed: the most potent preparation had an activity of only about a tenth of that of the material obtained by long wave irradiation. In certain respects these results do not agree with those obtained by Bourdillon and Webster *et al.*, and it is obvious that further work is required before agreement is reached on the absorption spectrum of vitamin D, but the preparation of pure specimens appears now to be assured.*

It may be pointed out that the stability of the vitamin may be influenced by the presence of accompanying compounds in a similar manner to the parent substance ergosterol. H. King, O. Rosenheim, and T. A. Webster (*Biochem. Jour.*, vol. 23, p. 166; 1929) point out that although ergosterol itself is labile, as a contaminant of cholesterol it appears stable: they have, in fact, found it present in the cholesterol esters isolated from the brain of a mummy 1400 years old, both by colour test and also by obtaining an antirachitic product of the same order of potency as irradiated 'cholesterol', by its irradiation.

* In a recent note in our columns (NATURE, vol. 125, p. 635; 1930), Bourdillon, Jenkins, and Webster state that they have now come to the conclusion that the absorption band at 2800 A. is not that of vitamin D, but of a decomposition product: the vitamin shows low absorption at this wave-length.

University and Educational Intelligence.

CAMBRIDGE.—The electors to the Woodwardian professorship of geology have elected Prof. O. T. Jones, professor of geology and mineralogy at the University of Manchester, to succeed Prof. J. E. Marr, who will vacate the post on Sept. 30 next. Prof. Jones, who was educated at Pencader Grammar School and the University College of Wales, Aberystwyth, took first class honours in both parts of the Natural Sciences Tripos at Cambridge, where he also gained the Wiltshire prize, the Harkness prize, and the Sedgwick essay prize. He has been professor of geology at Manchester since 1910.

The Vice-Chancellor announces that the annual Treasury grant payable to the University as from the beginning of the academic year 1930–31 will be £107,500, an increase of £14,000.

Dr. G. H. F. Nuttall has been re-elected into the Quick professorship of biology.

The Appointments Committee of the Faculty of Agriculture and Forestry has appointed H. E. Woodward to be University lecturer in agricultural chemistry, W. K. Hubble to be University demonstrator in agriculture, and Dr. Marshall to be director of the Animal Nutrition Institute. This Committee will shortly proceed to appoint a University lecturer in agricultural chemistry to give instruction in soil science. Particulars as to stipend and duties may be obtained from the Secretary, Appointments Committee, Department of Agriculture, University of Cambridge.

The Vice-Chancellor has appointed Sir Arthur Evans to the Frazer lectureship in social anthropology for the academical year 1930–31. The Managers of the Benn W. Levy Research Studentship in Biochemistry have elected L. H. Strickland, Christ's College, to the studentship.

LONDON.—Dr. J. M. W. Morison, lecturer in radiology at the University of Edinburgh, has been appointed to the University chair of radiology tenable at the Cancer Hospital (Free). Dr. H. D. K. Drew, lecturer in the Department of Chemistry at the University of Birmingham, has been appointed to the University readership in organic chemistry tenable at East London College.

The following appointments have been made to the staff of Birkbeck College: Mr. H. C. K. Henderson to be lecturer in geography; Mr. C. E. M. Joad to be lecturer in philosophy and psychology, and Mrs. M. E. Robinson to be lecturer in economics.

At a meeting of the Court of the University held on July 30, it was announced that the London County Council will, subject to certain conditions, make a total capital grant of £250,000 towards the erection and equipment of buildings on the Bloomsbury site, and a capital grant for the quinquennium 1930–35 of £150,000 towards the capital requirements of schools not connected with the Bloomsbury site.

MANCHESTER.—The Council, at a recent meeting, unanimously adopted a resolution expressing to Prof. F. E. Weiss its very deep regret on his retirement from the George Harrison chair of botany, which he has held since 1892. "During his tenure of the Chair, he has built up a great School of Botany, which bears a distinguished name both at home and abroad. It is renowned for the researches which have been carried out by the members of the School and for the unusually large number of men and women it has trained who now occupy positions of influence in many spheres of botanical work. . . . His singleness of purpose, inspiration, and exceptional abilities as a leader and administrator have been a constant source of strength, and have done much to place the University of Manchester in the position it now occupies."

Historic Natural Events.

Aug. 10, 1591. Atlantic Gales.—A fleet of 77 sail, which left Havana for Spain on July 17, encountered a terrible gale on Aug. 10, and the commander of the fleet with 500 men perished. Three or four days later, in another gale, five or six of the largest ships with all their crews and the vice-admiral were lost. About the end of August, in lat. 38° N., they experienced a third gale in which 22 sail perished. Finally, within sight of Flores, the survivors were scattered by a fourth gale on Sept. 6; very few reached Spain.

Aug. 10, 1893. Heavy Rain at Preston.—At Preston, Lancashire, 2·09 in. of rain fell in 35 minutes, but the observer was of opinion that 1·25 in. of rain and hail fell in five minutes. This storm did a great amount of damage.

Aug. 10, 1901. Hailstorm.—A series of very violent thunderstorms brought terrific falls of hail during the morning in Derbyshire, Yorkshire, and the south-east of Scotland. Great damage was caused to crops, especially near Galashiels, and thousands of panes of glass were broken. The violent storm was very brief, but the hail blocked up the drains and caused flooding.

Aug. 10-16, 1924. Aberrant Typhoon in the Pacific.—A typhoon which originated in the western Pacific, near the Marianna Islands, on Aug. 5, followed a most unusual track. The majority of these disturbances either travel steadily towards the west or north-west until they strike the mainland of Asia, when they fill up, or else follow a simple parabolic path, travelling first towards the west-north-west, then turning north and finally north-east. This particular example, however, a well-developed, violent typhoon, followed a looped track south-west of Japan, travelling south-west on Aug. 10, south and south-east on Aug. 11, and very slowly eastwards on Aug. 12-16. Finally on Aug. 17 it resumed its normal track and continued across the Sea of Japan. So unusual was the looped track that a steamer was wrecked because its captain believed that a typhoon could not possibly advance towards the south-west, and neglected to take the necessary precautions.

Aug. 12, 1582. Storm in Norfolk.—There was a great thunderstorm and whirlwind, with hailstones shaped like rowels of spurs, two or three inches in circumference. On the same night arose the greatest storm since the "Calais" storm on Jan. 7, 1558. Many houses, barns, and gates were blown down, and many vessels were lost.

Aug. 12, 1891. Record Rainfall.—At Campo, San Diego, Calif., on Aug. 12, 1891, a total of 11·50 in. of rain fell in one hour. This is the world's record for one hour's precipitation.

Aug. 13, 1868. Peruvian Earthquake Sea-waves.—The epicentre of the earthquake was near Arica on the coast of Peru. The resulting sea-waves were observed along the South American coast from the Chincha Islands on the north to near Valdivia on the south, places that are 2000 miles apart. They were also recorded in the Hawaiian Islands (6218 miles), Samoa (6633 miles), New Zealand (7047 miles), and New South Wales (8500 miles).

Aug. 14-27, 1873. Nova Scotia Cyclone.—A violent storm, after traversing the West Indies, travelled northward off the east coast of the United States, causing an immense amount of damage. It is said that 1223 vessels were wrecked, and at least 223 lives were lost. The storm played havoc with the fishing fleets of Canada and the United States, and was long remembered as the 'Nova Scotia Cyclone'.

Aug. 15, 1537. Hailstones in Central Europe.—At Gottwick, Austria, men and beasts were killed by hail. At Bologna the hailstones were said to have weighed 28 pounds. As this weight would give them a diameter of more than nine inches, it must be regarded as greatly exaggerated.

Aug. 15, 1905. Thunderstorm over the West of England.—A thunderstorm of exceptional violence occurred over Devon and Somerset during the evening, accompanied by heavy rain. There was much damage by lightning, buildings being set on fire and many cattle killed, but there is no record of the loss of human life.

Aug. 16, 1664. Thunderstorm.—Pepys wrote under this date: "Wakened about two o'clock this morning with the sound of thunder, which lasted for an hour, with such continued lightnings, not flashes, but flames, that all the sky and ayre was light; and that for a great while, not a minute's space between new flames all the time; such a thing as I never did see nor could have believed had ever been in nature. . . . And that accompanied by such a storm of rain as I never heard in my life; . . . it seems it has been here and all up and down the countrie hereabouts the like tempest, Sir W. Batten saying much of the greatness thereof at Epsum."

Societies and Academies.

PARIS.

Academy of Sciences, June 11.—**P. Villard**: The reduction of soda by hydrogen. Caustic soda, heated in a current of hydrogen at 800°-900° C., gives sufficient sodium vapour to reverse the sodium lines and to cut off all the light from a sodium flame. This result cannot be due to dissociation, since at the same temperature the replacement of the hydrogen by nitrogen causes the sodium vapour to disappear.—**Louis Roy**: The propagation of waves on elastic surfaces with three parameters.—**Paul Vuillemin**: A new species, *Corethropsis Puntonii*.—**O. Borůvka**: The surfaces represented by spherical functions of the first species.—**Ch. Sadron**: The ferromagnetism of the alloys of nickel and chromium. The study of the magnetic properties of nichrome alloys has been made by Safranek. On the same specimens the author has studied the saturations at the absolute zero and the ferromagnetic Curie points.—**Léon Bertrand**: The Trias of the neighbourhood of Betchat and of Salies-du-Salat.

June 16.—**Léon Lecornu**: Funicular surfaces.—**V. Grignard** and **J. Colonge**: The condensation of ketones. Extension of the classical method. The substitution of hydrochloric acid by hydrobromic and hydriodic acids gives higher yields, and some ketones which resist the condensing action of hydrochloric acid suffer condensation in the presence of hydrobromic acid.—**Léon Guillet** and **Marcel Ballay**: The influence of tempering on the electrical resistance and resistance to shearing of the silicon-aluminium alloys. The electrical resistance of pure aluminium.—**Jean Rey** was elected a member of the division of the applications of science to industry.—**L. Abélès**: The nomographic representation of analytical functions. Application to complex trigonometry.—**Mme. Julie Różańska**: The continued decompositions of surfaces into Cantorian curves.—**André Roussel**: Functions the infinitesimal increase of which has a given expression.—**Marcel Winants**: Linear differential equation of the third order and the integral curve passing through three given points.—**M. Fekete**: The changes of sign of a continuous function in an interval.—**Vignaux**: A method of summation of divergent integrals.—**H. E. Bray**: Functions with finite deviation.—**P. J. Myrberg**: The existence of Green's function for a given plane domain.—**G. Maneff**: Gravitation and the energy at the zero.—**Al. Proca**: Dirac's equation.—**N. Stoyko**: The influence of the terms of the third and fourth orders in the use of E. Esclangon's method for the determination of the orbit of a star. Application to the trans-Neptunian body.—**Ernest Esclangon**: Remarks on the preceding note.—**Fernand Baldet**: The nucleus of the Schwassmann-Wachmann comet (1930*d*). The nucleus does not appear to have had a diameter much greater than 400 metres, and is at least as small as that of the Pons-Winnecke comet.—**L. Décombe**: The undulatory theory of quantic phenomena. New results.—**F. Holweck** and **P. Lejay**: A portable instrument for the rapid determination of gravity.—**H. Muraour** and **G. Aunis**: The agreement between calculated explosion pressures and experimental explosion pressures. The calculated explosion pressures, starting with the new specific heats of Nernst and Wohl, for the gaseous mixture obtained in the experiments, are in complete agreement with the experimental pressures corrected for cooling.—**R. Forrer** and **J. Schneider**: The production by annealing of two states of pure iron, stable at the ordinary temperature.—**Armand de Gramont** and **George Mabboux**: The comparison of piezoelectric quartz oscillating at slightly differing frequencies.—**L. Abonnenc**: The measurement of the magnetisation coefficient of aqueous solutions by the method of falling drops. The method has been applied to measure the diamagnetism of the halogen ions. The results are in good agreement with the values obtained by Hocart by a different method.—**A. Turpain** and **R. de Bony de Lavergne**: An ultramicroscope permitting the direct projection of ultramicroscopic tests and the Brownian motion.—**V. Fock**: The mechanics of the photons.—**F. Prevet**: The mode of action of boric acid on the phosphorescence of sulphides of zinc prepared by the explosion method. The use of boric acid in the preparation of phosphorescent zinc sulphide is known to increase the intensity and persistence of the phosphorescence. Attempts to replace boric acid by other substances have proved unsuccessful, and it is concluded that the boric anhydride acts by influencing the crystalline medium necessary for phosphorescence.—**R. Coustal**: Poisons and phosphorogens for phosphorescent zinc sulphide.—**E. Estanave**: Integral photographs obtained without objectives.—**Hubert Garrigue**: The passage of the continuous current in acetone.—**Georges Fournier**: A relation between the filiation capacity of radioactive atoms and the velocity of the α-rays which they emit.—**Augustin Boutaric** and **Mlle. Madeleine Roy**: The radioactivity of materials arising from old roofs. The radioactivity of substances exposed to the open air is not due to exposure to sun, but to contact with rain water. Rain water was collected on a roof and passed into a cistern containing a filter of sand and charcoal, the filtering material not being exposed to the sun: both the charcoal and the sand were clearly radioactive.—**W. Broniewski** and **J. Strasburger**: The structure of the copper-zinc alloys. The brasses were examined after long periods of annealing at 400° C. Curves are given showing the electrical conductivity, the temperature coefficient of the electrical resistance, the thermoelectric power with reference to lead and other physical properties. The compound CuZn appears on all the curves and there are indications of $CuZn_2$ and $CuZn_6$.—**H. Colin** and **A. Chaudun**: The complex between the enzyme and the products of hydrolysis during the diastatic inversion of sugar.—

Guichard, Clausmann, Billon and Lanthony: The hardness of cold-hardened and electrolytic nickel.—**G. Dupont and J. Allard**: The mechanism of the antoxygen action.—**H. Forestier**: The action of the magnetic field on the velocity of solution of iron in a solution of cupric chloride. The velocity increases rapidly with an increase in the strength of the magnetic field; with fields between 500 gauss and 4000 gauss the increase of velocity of solution is proportional to the strength of field. Above 4500 gauss the velocity of solution is independent of the magnetic field.—**Alfred Molnar**: New researches on the cold hardening of lead, tin, cadmium and zinc at different temperatures. A comparison of the hardening effects produced by slow and rapid extension. The latter presents all the characteristics of a cold-hardened metal.—**Jean Cournot and Jean Bary**: The treatment of siderurgical alloys with solutions of some metallic phosphates. A study of the effects of mixtures of various phosphates as regards the protection of mild steel against corrosion. Protection by phosphate of iron alone was unsatisfactory, the best results being obtained by using solutions of mixed phosphates, iron and zinc, or zinc and manganese.—**F. Taboury**: The action of sulphuric acid on mercury at the ordinary temperature. Sulphur dioxide is the only gaseous product and crystals of acid mercurous sulphate, Hg_2SO_4, H_2SO_4.—**Picon**: Mercury camphocarbonate and some derived mercurial products.—**Charles Combaluzier**: The limits of the Burdigalian deposits in Lower Provence.—**H. Derville**: Henriette marble, a reef constructed by calcareous Algæ.—**Yves Milon**: The presence of Globigerina limestones in the Bartonian of Sarthe.—**E. Huguenard, A. Magnan, and A. Planiol**: A method of measuring the turbulence of the atmosphere.—**Guilliermond, Dufrenoy, and Labrousse**: The germination of tobacco seeds in media containing neutral red: the coloration of the vacuome during the development of the seedlings.—**Mlle. Eudoxie Bachrach and Mme. Pillet**: The micro-incineration of diatoms without carapace.—**Aug. Chevalier**: The three periods of renewal of vegetation in Senegal.—**G. Nicolas and Mlle. Aggery**: A third example of generalised bacterial infection in plants.—**Marcel Chopin**: The additive mechanical properties of dough made of wheat flour.—**C. Vaney and A. Bonnet**: The phenomena of autotomy in *Spirographis Spallanzanii*.—**Jean Régnier and Guillaume Valette**: A study of the mode of fixation of cocaine hydrochloride on the nerve fibres. A comparison of the absorption of cocaine by animal charcoal and by nerve substance showed a close similarity as regards rapidity of fixation and shape of curves. These results indicate that cocaine is fixed on the nerve fibre by a normal process of adsorption.—**L. Lutz**: The soluble ferments secreted by the Hymenomycete fungi. The degradation of the ligneous material.—**M. Lemoigne and P. Monguillon**: The presence of acetylmethylcarbinol and of 2.3. butylene glycol in the higher plants. Formation during germination.—**Claude Fromageot and Mlle. M. Watremez**: Comparison between the buffering powers of glycocoll and glycylglycine.—**Radu Codreanu**: The nutrition and action on the host of *Symbiocladius rhithrogenæ*.

GENEVA.

Society of Physics and Natural History, June 19.—**Leon W. Collet**: Preliminary report on the geological expedition of Harvard University in the Canadian Rockies (1929). The Canadian Rockies, from their eastern border to Yellow Head Pass, are made up of seven 'blocks' thrust one over the other from west to east, and separated by 'clean cut thrusts' of the type of the Northwest Highlands of Scotland. The Athabasca valley, from the town of Jasper to the eastern border of the Rockies, follows an axis depression of the thrust masses. The quartzites forming the mountains to the west of Maligne lake, as far as the Tonkin valley, are of Lower Cambrian age and not of Mesozoic age. Ammonites found in the Jurassic black shales show that upper Lias and Bajocian are present in the interior of the Canadian Rockies in Jasper National Park.—**L. Reverdin**: The neolithic fauna of the station of Port Conty (St. Aubin, Neuchâtel) from material collected from 1928 to 1930. Two groups of deposits belonging to the old and middle neolithic yielded 273 and 73 specimens. These proved, from one group to the other, a variation from 70 to 50·8 per cent for the domestic species and from 30 to 49·2 per cent for the wild species.—**G. Tiercy**: The gravitational derivation of the solar rays and the thermal regime of the high plateaux. The author proposes a new theory capable of explaining the thermal advantage enjoyed by the high plateaux, especially the Asiatic plateau, as compared with other regions of the same latitude. The calculation allows the estimation of the order of magnitude of the age of the Asiatic protuberance, or 1400 millions, figures which agree with those based on radioactivity and relative to the time necessary for the terrestrial crust to have acquired its present chemical constitution starting with uranium and thorium.—**N. Danoz**: The free surface of the fluid stars. The author has applied Wavro's method to the study of the internal movements of the fluid stars, and has been able to establish the following: if the equator rotates more rapidly than the pole caps, the free surface is an ellipsoid compressed between the pole and the equator. In the contrary case, it will be an expanded ellipsoid.

ROME.

Royal National Academy of the Lincei, Mar. 16.—**A. Angeli**: Certain relationships between constitution and odour. Unlike the artificial musks (aromatic nitro-compounds) and violet ketones (ionone, etc.), the cyclic polymethylene carbonylic compounds described by Ruzicka, although having similar odours, are free from methyl groups. It is suggested that the presence in the molecules of these compounds of a large number of methylene groups may render possible deformations of the ring so as to produce lateral nodes able to act like methyl groups. Certain evidence in support of this view is advanced. **A. Angeli and A. Polverini**: The oxidising power of diazohydrates and their analogies with nitrous acid. Reactions are described which justify the argument that the three molecules, $O:O$, $(HON):O$, and $(C_6H_5 \cdot N_2H):O$, are analogous in structure and behaviour.—**A. Terracini**: The projective quasi-applicability of a surface on a plane.—**Luisa Pelosi**: Generalisation of a theorem of F. Neumann on the calculation of certain integrals.—**M. Calonghi**: The mean curvature of surfaces. It is shown how the consideration of geometric elements connected with a surface along an infinitesimal cycle leads naturally to the notion of mean curvature of the surface itself. The procedure approximates the mean curvature to the total curvature, the rigid connexion of which with the properties of the infinitesimal cycles traced in the surface is rendered evident by the theory of surface parallelism.—**G. Pfeiffer**: The integrals of S. Lie.—**G. Krall**: Point loads for rods with moment of inertia variable with discontinuity.—**W. Kusnetzoff**. The regularisation of the general problem of three bodies.—**G. Bargellini and Lydia Monti**: 2:6-Dibromophenetidine and 3:5-dibromophenetidine. Various derivatives of these two compounds have been prepared and compared.—**A. Baroni**: Diphenyl

polysulphides, sulphodiselenide, and selenodisulphide. The melting-points and densities (at 20° : 4°) of the various compounds described are: $(C_6H_5)_2S$, 62°, 1·353; $(C_6H_5)_2S_3$, 30°, 1·418; $(C_6H_5)_2Se_2$, 59°, 1·743; $(C_6H_5)_2S_2Se$, 50°-51°, 1·593; $(C_6H_5)_2Se_2S$, 55°, 1·873.—**S. Visco** : Hysteresis of electrical conductivity in colloidal solutions. The electrical conductivity of solutions of granular gelatine of various concentrations exhibits distinct hysteresis.—**Mario Betti** : Optical resolution of racemic aldehydes (1). By means of β-hydroxy-naphthylphenylaminomethane, which combines readily with aldehydes to form highly stable, crystalline compounds, the racemic form of *p*-methoxyhydratropic aldehyde has been resolved into the two optical isomerides. Other aldehydes may be similarly resolved.—**G. Bini** : A new method for the identification and determination of nitrates in waters. Quinosulphonic acid gives with NO_3 ions a coloration varying from pale green to brown according to the concentration of the ions, and serves as a satisfactory reagent for the detection and determination of nitrates in water. It is less sensitive than, and hence preferable to, pyrogallolsulphonic acid.—**G. Checchia-Rispoli** : A case of metamerism in an exocystic echinoid.—**Fausta Bertolini** : Regeneration of the digestive apparatus in holothurians. The emission of the whole of the intestinal tube, leaving in position the first tract of the œsophagus and the last part of the rectum, united by the thin mesenteric lamina, with subsequent regeneration of the digestive system, has been observed in *Stichopus regalis*, and appears to be relatively more frequent with this species than with the genus *Holothuria*.—**G. Cannicci** : Contribution to the study of glutathione in Teleostei (2). The proportions and variations of glutathione in various species are described.—**G. Brunelli and N. Apolloni** : Certain characteristics of Mediterranean lagoon associations.—**V. Rivera** : The biological action of penetrating radiation (cosmic or ultra-γ rays) on the development of seeds of land vegetables. Penetrating radiation has not only no positive influence on the germination of the seeds of land plants, but even exerts a slight depressive action, retarding the onset of germination or slowing the growth of seedlings.—**Silvia Colla** : Variations in the oxygen content of the hydrostatic bladders of certain brown algæ. The results of experiments on *Fucus serratus L.* show that oxygen is accumulated in these bladders on exposure to light and is consumed or eliminated in the dark, so that the accumulation of oxygen is to be regarded as a photosynthetic effect. A parallel phenomenon was noted by Stiles and Langdon with a species of *Neurocystis*.

VIENNA.

Academy of Sciences, May 8.—**L. Haberlandt** : Researches on the heart-hormone in invertebrates. Experiments were made on the excised hearts of snails, of *Helix pomatia* in Innsbruck, of *Aplysia* in Naples. Isolated hearts were put into Ringer's solution and kept until spontaneous or mechanically excitable pulsations ceased in a time which varied from some hours to three days. Extract of muscle from the foot (with Ringer) produced no pulsation when added; extract of heart muscle proved a stimulant. Heart-hormone preparation from vertebrates also proved exciting even in extreme dilutions. Also adrenalin stimulated *Helix* hearts, and extract of heart from cattle stimulated *Aplysia*.—**F. Wessely and G. H. Moser** : Synthesis and constitution of scutellarine.—**L. Kober** : Structural elements of the Apennines in Calabria and Sicily and of the Atlas in Algeria.—**H. Gräven** : A method for determining uranium, thorium and potassium in hand specimens of minerals and rocks.

May 15.—**W. Knapp** : The action of *o*-phthalyl-chloride on the methyl ethers of *p*-bromo-phenol and of *p*-bromo-thio-phenol.—**C. Mayr and G. Burger** : Potentiometric titration using mercurous nitrate and sodium oxalate as titration solutions.—**P. Goldmark and F. Kammer** : Methods for measuring the mobilities of ions in gases.—**H. P. Cornelius and M. Furlani-Cornelius** : The Insubric line from Tessin to the Tonale pass.—**M. Radakovic** : Determinants that can be made symmetrical.—**F. Halla and E. Mehl** : Fibrous structure of plastic sulphur.—**F. Witt** : The distribution of radium emanation between the liquid and solid phases of water and of benzol. Radium emanation is occluded not absorbed by ice.—**J. Hoffmann** : Coloration of glasses and some minerals by β- and γ-rays. Lead glasses are recognisable by characteristic fluorescence in ultra-violet light. Neutral atoms of the alkalis, also Pb, Ba and Zn may be causes of colour.—**K. Marbach** : The disturbance of the equilibrium of radium B and radium C in preparations freed from traces of emanation.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 4, April 15).—**Jan Schilt** : The velocities of *B*-type stars.—**C. R. Burnham** : Genetical and cytological studies of semisterility and related phenomena in maize. Two new types of semisterile maize have been found and examined.—**H. J. Muller and L. M. Mott-Smith** : Evidence that natural radioactivity is inadequate to explain the frequency of 'natural' mutations. As measure of the intensity of radiation, the ionisation per cubic centimetre per second in air was used. The mutation rate in untreated *Drosophila* is about 1 : 150 of the highest rate artificially induced, whereas the intensities of natural and artificial radiations are in the ratio of 1 : 200,000. Thus the natural mutation frequency is at least 1300 times as high as it would be if caused by radiation normally received by the flies.—**J. H. Hildebrand and J. M. Carter** : The influence on the ideal solution laws of the distribution of polarity within the molecule. Using the data for benzene with nitrobenzene, the three dinitrobenzenes and 1-3-5 trinitrobenzene, it appears that it is the number and polarity of the substituent groups rather than the electric moment of the whole molecule which determine deviations from Raoult's law.—**Wilder D. Bancroft and C. E. Barnett** : Pentavalent nitrogen in organic compounds. The conditions under which organic nitrogen will add on hydrogen chloride stoichiometrically are brought together in eight generalisations.—**Wilder D. Bancroft and Herbert L. Davis** : The tautomeric form of malic acid. Changes in optical rotation and anomalous dispersion of *l*-malic acid in solution are due to two tautomeric forms in dynamic equilibrium; the lævo-acid is ordinary malic acid and the dextro-acid contains an ethylene oxide oxygen linkage and two hydroxyl groups attached to the same carbon.—**J. L. Walsh** : On the overconvergence of sequences of polynomials of best approximation.—**H. S. Vandiver** : Summary of results and proofs on Fermat's last theorem (fifth paper).—**G. A. Miller** : Groups generated by two given groups.—**A. Adrian Albert** : (1) On the structure of pure Riemann matrices with non-commutative multiplication algebras.—(2) On direct products, cyclic division algebras, and pure Riemann matrices.—**Joseph W. Ellis** : The near infra-red absorption spectrum of calcite. Three new bands with wave-lengths shorter than 1·7μ are reported and doublet structure has been observed in most of the bands in this region.—**Richard C. Tolman** : The effect of the annihilation of matter on the wave-length of light from the nebulæ. It is assumed that there is a general

transformation of matter taking place throughout the universe at a rate necessary to account for the radiation from stellar objects; a non-static line element for the universe is derived mathematically and its implications examined.

Official Publications Received.

British.

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 22, 1929. Prepared under Instructions from the Minister of State for Home Affairs by Chas. H. Wickens. Editor: John Stonham. Pp. xxxii+1074. (Melbourne: H. J. Green.) 5s.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Grazing and Manurial Trials on Permanent and Prepared Swards: and Factors affecting Seed Production of Red Clover. (Series H, No. 11, Seasons 1921-1929.) Pp. iii+91. (Aberystwyth.) 3s. 6d.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 403, July. Pp. 801-944+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1929 May 19-1930 May 18. Pp. 8. (Cambridge.)

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 2, July. Pp. 59-82. (London: Dulau and Co.) 10s. net.

The National Physical Laboratory. Report on the Physics Department for the Year 1929. (From the Report of the Laboratory for the Year 1929.) Pp. 58-94. (London: H.M. Stationery Office.) 2s. net.

Leeds University: Department of Pathology and Bacteriology. Annual Report by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research by Prof. R. D. Passey. Pp. 15. (Leeds.)

Research Council of Alberta. Report No. 23: Preliminary Soil Survey adjacent to the Peace River, Alberta, West of Dunvegan. Pp. iv+83+6 plates. (Edmonton: W. D. McLean.) 50 cents.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1929. Pp. 16. (Hong Kong.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1930. Pp. xii+58. (Aberdeen.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 24: The Carboniferous Sediments of Kintyre. By Dr. William J. M'Callien and Robert B. Anderson. Pp. 599-619+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3s. 6d.

Transactions of the Optical Society. Vol. 31, No. 2, 1929-30. Pp. v+53-112. (London.) 10s.

University of Reading: the National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1929. Pp. 87. (Reading.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 6, June. Abstracts Nos. 1122-1290. Pp. 197-235. (London: H.M. Stationery Office.) 9d. net.

Indian Journal of Physics, Vol. 4, Part 7, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 7. Conducted by Sir C. V. Raman. Pp. 541-589. (Calcutta.) 12 annas; 1s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1290 (Ae. 439): The Equations of Motion of a Viscous Fluid in Tensor Notation. By C. N. H. Lock. (T. 2798, revd.) Pp. 28. 1s. 6d. net. No. 1306 (Ae. 446): Lateral Stability Calculations for the Bristol Fighter Aeroplane. By Dr. A. S. Halliday and C. H. Burge. (T. 2905.) Pp. 13+17 plates. 1s. net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 40: The Nitration of Substituted Diaryl Ethers:- Phenyl-p-tolyl Ether. By Joseph Reilly, P. J. Drumm and T. Gray. Pp. 461-465. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

Foreign.

R. Osservatorio Astrofisico di Catania. Annuario 1930. Pp. iv+50. (Catania.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 106a; Ergebnisse aerologischer Beobachtungen, 17, 1928. Pp. iv+41. 2.50 f. No. 108: Seismische Registrierungen in De Bilt, 15, 1927. Pp. ix+63. 1.00 f. (Amsterdam: Seyffardt's Boekhandel.)

Ministerio de Agricultura de la Nación, República Argentina. Memoria: correspondiente al ejercicio de 1928 presentada al Congreso de la Nación por el Ministro de Agricultura, Doctor Juan B. Fleitas. Pp. 105. (Buenos Aires.)

U.S. Department of Agriculture. Leaflet No. 61: English Sparrow Control. By E. R. Kalmbach. Pp. 8. 5 cents. Circular No. 117: The Asiatic Beetle, a Serious Pest in Lawns. By H. C. Hallock. Pp. 8. 5 cents. Circular No. 118: Calculating Waterfowl Abundance on the Basis of Banding Returns. By Frederick C. Lincoln. Pp. 4. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Leeches (Hirudinea) from China, with Descriptions of New Species. By J. Percy Moore. Pp. 169-192+plates 7-8. (Philadelphia.)

Bulletin of the National Research Council. No. 75: Weather and Health; a Study of Daily Mortality in New York City. Prepared under the direction and with the advice of the Committee on the Atmosphere and Man, Division of Biology and Agriculture, National Research Council, by Ellsworth Huntington. Pp. 161. (Washington, D.C.: National Academy of Sciences.) 2 dollars.

Reprint and Circular Series of the National Research Council. No. 92: Report of the Committee on Sedimentation, 1928-1929. Pp. ii+122. 1 dollar. No. 93: Guide Leaflet for Amateur Archaeologists. Pp. 11. 25 cents. (Washington, D.C.: National Academy of Sciences.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 4, No. 6, June. (R.P. Nos. 176-182.) Pp. 737-874. (Washington, D.C.: Government Printing Office.) 40 cents.

Smithsonian Institution: United States National Museum. Bulletin 76: Asteroidea of the North Pacific and adjacent Waters. By Prof. Walter Kenrick Fisher. Part 3: Forcipulata (concluded). Pp. iii+356+93 plates. (Washington, D.C.: Government Printing Office.) 1.40 dollars.

United States Department of the Interior: Geological Survey. Bulletin 813-B: The Chakachamna-Stony Region, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1928.) Pp. ii+97-123+2 plates. 10 cents. Water-Supply Paper 618: The Green River and its Utilization. By Ralf R. Woolley. Pp. xv+456+35 plates. 1.25 dollars. Water-Supply Paper 621: Surface Water Supply of the United States, 1926. Part 1: North Atlantic Slope Drainage Basins. Pp. vi+274. 30 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 8, Part 2, June. Pp. 91-319+11 plates. (Tokyo: Iwanami Shoten.) 2.70 yen.

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 10, No. 5, March 31st. Pp. 329-388. (Tokyo: Maruzen Co., Ltd.) 2.00 yen.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 9, 1927. iv, Meteorologiska iakttagelser i Sverige, Band 69. Pp. x+177. 7.00 kr. Årsbok, 11, 1929. ii: Nederbörden i Sverige. Pp. 160. 5.00 kr. (Stockholm.)

Jahresbericht der Hamburger Sternwarte in Bergedorf fur das Jahr 1929. Pp. 30+8 Tafeln. (Bergedorf.)

Catalogue.

South and Central America: a Catalogue of Books, Pamphlets, Engravings, Maps and Original Drawings relating to Latin America with the British Colonies of Falkland Is., Honduras and Guiana. (Catalogue 528.) Pp. 80. (London: Francis Edwards, Ltd.)

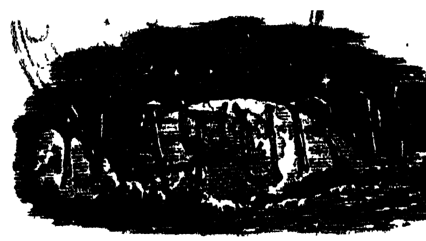
Diary of Societies.

CONGRESS.

AUGUST 7 TO 15.

INTERNATIONAL HORTICULTURAL CONGRESS (in London).—*Papers to be read on Aug. 8, 11, and 13*:—

Prof. Priestley: Vegetative Reproduction from the Standpoint of Plant Anatomy.
Dr. Van der Lek: Anatomical Structure of Woody Plants in Relation to Vegetative Propagation.
Dr. R. Salaman: Vegetative Mutations.
Prof. E. Baur: Production of Mutations by External Stimulus.
Dr. F. E. Denny: The Excitation of Dormant Buds under External Influence.
John Innes Horticultural Institution: Graft Hybrids.
John Innes Horticultural Institution: Vegetative Production of Polyploids.
John Innes Horticultural Institution: Sterility.
G. E. Yerkes: Raising Root Stocks from Seed.
Dr. C. G. Dahl: Root Stocks from Seeds of known Parents.
Dr. R. J. D. Graham and L. B. Stewart: Special Methods of Practical Utility in the Vegetative Propagation of Plants.
Miss Mary E. Reid: The Influence of the Nutrient Conditions of Seeds and Cuttings upon the Development of Roots.
Prof. P. W. Zimmerman: Factors influencing Root Growth of Cuttings.
Dr. A. B. Stout: The Inter-relations between Vegetative Propagation and Seed Reproduction.
N. Esbjerg: Varieties grown on own Roots.
Prof. N. I. Vavilov: The Wild Progenitors of Fruit Trees in Turkestan and in the Caucasus.
R. G. Hatton: The Development of a Research Programme around the 'Build Up' of a Fruit Plant.
Dr. H. Faes: Vine Propagation.
L. Ravaz: The Influence of American Stock on French Vines.
W. G. Freeman: Vegetative Propagation of Cacao and the West Indies Citrus.
Prof. T. Tanaka and Y. Tanaka: Propagation of Citrus Fruits in Japan.
Prof. H. J. Webber: Studies on Rootstock Reactions in Citrus.
Dr. F. F. Halma: The Propagation of Citrus by Cuttings.
Dr. H. P. Traub: The Ripening Process in Fruits, with special reference to the Fig and the Grapefruit.
Prof. B. T. P. Barker: The Fruit Tree Complex in Relation to Environment: Some current Investigations at Long Ashton.
Prof. N. E. Hansen: Fruit Stocks where Mercury Freezes.
Prof. E. C. Auchter: American Experiments in Propagating Deciduous Fruit Trees by Stem and Root Cuttings.
W. T. Macoun: National Tastes in Apples.
Dr. L. Filewicz: The Frost Injuries of Fruit Trees in Poland in 1928-29, with special reference to the Influence of the Stock and Scion upon the Resistance of the Apple-trees against the Frost.
Dr. P. J. S. Cramer: Rubber Budding.
W. A. Orton: Propagation in Tropical Countries.
Prof. P. Work: Some Scientific Problems in connexion with Vegetable Seeds.
Eng. G. Jacobsen: Electric Heating of Soil in Hotbeds and Hot houses.
Prof. B. Fedtschenko: The Horticultural Work of Russian Botanical Gardens.
Prof. C. Regel: The Botanical Garden of the Present Day.
H. J. Rumsey: Horticultural Progress in Australia.



SATURDAY, AUGUST 16, 1930.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The Imperial Conference and Science.

IN the House of Commons on July 30, the Prime Minister, Mr. Ramsay MacDonald, stated that the Imperial Conference, which is to be held in the autumn, will afford an opportunity for the Home Government and representatives from the various parts of the British Empire to make a general survey and discuss all matters, both in the political and economic spheres, of common interest to the members of the British Commonwealth. These matters will be dealt with under three headings: (1) inter-imperial relations; (2) foreign policy and defence; (3) economic questions. As regards inter-imperial relations, particular questions for consideration will be the recommendations of the recent conference on the operation of Dominion legislation and other matters of a constitutional character cognate to and arising from those discussed in the Report of the Inter-Imperial Relations Committee of the Imperial Conference of 1926.

As regards foreign policy and defence, the agenda will cover the further development of peace and arbitration policy, and will include the question of the reduction and limitation of armaments. Obviously, any consideration of the problems arising out of the effort made by the constituent parts of the British Commonwealth to reduce and limit armaments must include in its scope the bearing of scientific research on the materials for defence. But even more obvious is the ultimate connexion between science and the economic questions to be considered by the Conference. These questions include the general one of the trade of the Empire, the effect of successive tariff changes, and the extent and effect of inter-imperial tariff preferences; bulk purchase and price stabilisation; oversea settlement; the past and future work of the Imperial Economic Committee, the Empire Marketing Board, and the Imperial Institute; co-operation in agricultural research (including cotton-growing), forestry, and minerals; special meetings of experts on industrial research and standardisation; transport and communications, including review of the work of the Imperial Shipping Committee and the Oversea Mechanical Transport Council, survey of steamship services and development of civil aviation, cable, radio, broadcasting, postal and news services.

The programme is certainly comprehensive. It includes consideration of a number of subjects around which the fiercest political controversy has raged for many years past in every part of the Commonwealth. The only grave omission is a

reference to any discussion on the effect of the return to the Gold Standard in 1925 on trade and industry, a subject which has lately become one of most serious concern to economists, industrialists, and financiers. But the programme will commend itself as an honest attempt to project into the field of discussion almost every subject worthy of consideration, however unpalatable some of them may be to certain members of His Majesty's Government, charged as they are with potentialities for exhibiting marked differences of opinion, not merely between the oversea members of the Commonwealth and the Home Government, but also between those representing the Home Government itself. It demonstrates, moreover, that since 1926 the emphasis of the Conference has been shifted from constitutional to economic questions, the basis of which must in future be free co-operation, each Dominion being the sole judge of the nature and extent of its co-operation.

It is interesting to compare the subjects for discussion at the Imperial Conference with those which engaged the attention of representatives from the non-self-governing dependencies of the Crown and Mandated Territories at the recent Colonial Office Conference. At that conference discussion ranged mainly around the methods by which the potential resources of the Colonial Empire could best be developed. The report of that Conference has already been issued,* and more than half of it is devoted to subjects of direct interest to scientific workers. It surveys in broad outline the administration of the scientific and technical departments of the Colonial Empire, with special reference to the possibilities of creating a unified agricultural service, the Imperial College of Agriculture, veterinary services and research, the organisation of work on animal husbandry, medical services and research and their bearing on the recent report of the Colonial Development Public Health Committee, the place of the biologist in the education services, and forest services and research. The work of the Empire Marketing Board in fostering general research and assisting various colonies to undertake *ad hoc* investigations into problems of special interest was reviewed, and consideration was given to the development of fisheries, the extension of cable and wireless communications, civil aviation, transport services, and the function of the Imperial Institute. No questions relating to tariffs were discussed, with the result that full time was given to and due emphasis laid on considerations of the place of science in the life of the subject races of the British Empire.

We do not suggest that consideration of tariffs and imperial preferences, or what has come to be regarded as the alternative, bulk purchase and stabilisation of prices, should not be adequately discussed by the assembly of imperial statesmen. Everything is to be gained by the ventilation of these subjects, more particularly if the protagonists of these economic dogmas will provide the Conference with adequate statistical data bearing on their convictions. But there is a danger that most of the plenary sessions of the Conference may be taken up by such discussions, and those questions dealing with the bearing of science and co-operation in scientific research upon the development of the resources of the Dominions will be relegated to sub-committees consisting solely of experts. The inevitable consequence will be that the proceedings of these sub-committees will receive scant attention from the popular organs of the Press, wedded as these are to acutely controversial matter which the Conference will provide in abundance, and their reports will be presented at the end of the Conference and hurriedly adopted without comment or discussion.

It may be urged that the prominence given at the Imperial Conference in 1926 to the need for the encouragement of scientific research is a guarantee that there will be the same interest in science at this one. We trust this may prove to be the case, but there is reason to doubt it. It has to be remembered that the late Lord Balfour presided over the Research Sub-Committee appointed by the last Imperial Conference. He presented its report to a plenary session. His was a personality which commanded attention. He added to political renown an intimate knowledge of the subject-matter he presented and an unrivalled capacity in a statesman for presenting the facts and the outlook of science to the uninitiated. Unfortunately, none of the statesmen at the forthcoming conference possesses this unique combination of qualities. It does not follow, of course, that the reports of the sub-committees of experts presented to the Conference will not be of the greatest importance, or that lack of publicity in the Press or adequate discussion at a plenary session necessarily means that their recommendations will not eventually be put into effect. But it does mean that a restatement of the claims of science to the attention of the civilised world and the bearing of science on world progress, as well as the re-emphasis of the place of science in education, must be made without rather than within the Conference,

* Colonial Office Conference, 1930. Summary of Proceedings (Cmd. 3628.) (London: H.M. Stationery Office.) 2*s*. net.

What is wanted is a mobilisation of the supporters of science to take part in a preliminary educative campaign. Help can be expected from certain statesmen no longer in office, of whom the most prominent in England are Mr. Amery, Mr. Ormsby-Gore, and Major Walter Elliott. They have already done much to awaken their political colleagues at home and in the Dominions and Colonies to the need for more earnest encouragement of scientific research, and they have in their recent Empire travels done much also to spread the gospel of science among the unofficial classes in the various countries which they have visited. But the task is primarily one for scientific workers themselves. They should not ignobly depend upon others to interpret their work for them. It is a confession of impotence. It is their obvious duty to the peoples of the Empire to make unmistakably clear the problems which confront them, what new problems the application of science has created for the civilised world, and what hope there is of their solution.

The next few weeks will provide scientific workers with their opportunity to take part in this useful and necessary form of propaganda. A splendid lead has been given them by Dr. A. C. D. Rivett, deputy chairman of the Australian Council for Scientific and Industrial Research. In an article which appeared in the *Times* of Aug. 7 he pointed out that the coming Imperial Conference, in exploring the possibilities of closer economic co-operation, would do well to realise the fact " that before political and administrative measures can attain full success in dealing with the interchange of products it is essential to reach as high a degree of efficiency as possible in methods of production in both primary and secondary industries ". He adds that it will not " be without significance politically if, by improved methods, Empire goods are able to compete in British markets with a smaller measure of artificial aid than is deemed by some to be necessary at present ". These improved methods, he suggests, must be based on scientific experiment and reasoning, so that " it becomes of major importance to ensure that the growing scientific powers of the Empire shall be strengthened by union and made available, in the full force so attained, for the solution of problems of production and marketing ".

Much of Dr. Rivett's article is devoted to a survey of the problems confronting pastoralists and agriculturists in Australia. The diseases which ravage their sheep, blow-fly, foot-rot, braxy-like diseases, internal parasitic troubles, caseous lymphadenitis, are all preventable, he avers. The beef industry in North and North-West Australia is threatened by the rapidly spreading buffalo-fly pest. The prickly-pear has more or less ruined 60,000,000 acres of valuable stock-raising land in Queensland. Ignorance of soil science has been responsible for the economic ruin of many agriculturists and the failure of settlement schemes.

Fortunately, Australian statesmen of all parties realise that it is wise economy to spend money, even at a time of acute financial depression, on those services to which alone they can look for a solution of such problems, and it is equally fortunate that those in control of their scientific services realise the importance of co-operation and the pooling of knowledge through the medium of the various imperial bureaux and imperial research institutions which now exist in the different countries of the Empire. What is true of Australia is also true of every British Dominion, and Great Britain can be proud to have created the institutions which have served as models for them all.

Nevertheless, it is not enough to have persuaded governments that production and distribution are best improved by the assiduous prosecution of scientific research and its application. Science has a greater and nobler rôle to play than that in world affairs. Science, in fact, cannot be dissociated from any aspect of policy which seeks to determine the future course of the form of civilisation for which science itself is mainly responsible.

The Wider Biochemistry.

Outlines of Biochemistry: the Organic Chemistry and the Physico-Chemical Reactions of Biologically Important Compounds and Systems. By Prof. Ross Aiken Gortner. Pp. xv + 793. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 30*s*. net.

IT will be generally agreed that, up to the present time, the development of biochemistry has been most active in those aspects of the science which are associated with medicine in general and with animal physiology in particular. Such, according to Prof. Gortner, has been the case in most of the universities of America, and such, most of us will agree, has likewise been the case in Great Britain. Biochemistry has not on that account suffered any undue restriction of its activities. The reviewer feels personally that the future development of biochemistry can best be secured by retaining and even widening the administrative contacts with physiology and especially with

animal physiology. But such a viewpoint in no sense implies a denial of the necessity for developing biochemistry as an independent science incorporating within its wide bounds the methods of any sister science which give promise of elucidating the mechanisms of the living plant or animal.

It is clear that during the last two decades the younger science has found increasing utility for the techniques of the older physico-chemical sciences, and this ever-widening scope of biochemistry is very well brought before us in " Outlines of Biochemistry ", which collates and amplifies the lecture material used in Prof. Gortner's classes in agricultural chemistry in the University of Minnesota. It must be made clear, however, that this is not a text-book of agricultural chemistry in the strict sense. It is much more. Thus it devotes ten chapters and 277 pages to a consideration of physico-chemical problems intimately associated with cellular chemistry. Some may regard this as an undue allowance in a book of this size, but they are adequately answered by the originality of selection and the freshness of treatment of the matter embodied in these chapters, much of it distinctly unusual in biochemical text-books. Prof. Gortner is certainly to be congratulated on his breadth of vision in the more physical fields of biochemistry. The remainder of the book covers the proteins, nitrogen bases and alkaloids, carbohydrates and allied compounds, tannins, plant pigments, lipides, essential oils, and, finally, the ' biocatalysts '—the vitamins and enzymes.

The proteins are very fully treated, and special mention may be made of Chapter xiv. on protein structure and isomerism, and of Chapter xix. on the biological reactions of the proteins. The latter is perhaps unduly brief, but the matter of both chapters is presented in a most stimulating manner. In the section on nitrogenous bases the newer work on thyroxine, ergothioneine, and spermine is included, but the references to glutathione will require alteration in later editions. The carbohydrates are well treated, and in all cases the pyranoside and furanoside formulæ are used for the stable and reactive isomers respectively of the monosaccharide components. There is a mistake in the formula of gentiobiose on page 543, the reducing glucose component being represented as glucofuranose instead of glucopyranose. Glucofuranose has not yet been found in any natural source, either free or in combination. There is some confusion on pp. 549 and 550 regarding the individual monosaccharide components of some of the lesser known tri- and tetra-saccharides. Moreover, the α-configuration is given to the glucosidic linkage in sucrose. The reviewer is not aware of the evidence upon which this is based. All these are minor slips and can readily be rectified in a later edition. In the section dealing with the polysaccharides there is included the extremely interesting work of Heidelberger and his associates on specific immunological carbohydrates, whilst the nature of the problems to be considered in relation to the internal structure of cellulose is well illustrated by diagrams from the papers of Sponsler and Dore on X-ray analysis of ramie fibres—both very welcome features in a text-book of biochemistry. The chapters on fats and oils, sterols, and lipides are perhaps less satisfactory than those already reviewed; the treatment, though efficient, strikes one as being somewhat less original and lacking a little in enthusiasm.

There are certain omissions which are perhaps explained by the circumstance that the book is based on courses of lectures to students of agricultural chemistry. This notwithstanding, one feels that the important field of biological oxidations and reductions—including some reference to that fundamental plant product, cytochrome—might well have been included in a comprehensive work of this type. Moreover, although melanin and its formation are referred to in various parts of the book, no mention is made of the important work of Raper in this field. The rôle of hexose phosphates in fermentation is dismissed in two lines, and no reference is made to the parallel phenomena of muscle chemistry.

The reviewer is well aware of the impossibility of the author's anticipating all the strictures of the critic determined to be critical, and the above remarks are advanced, not with the intention of casting any reflection upon Prof. Gortner's noteworthy contribution to the literature of biochemistry, but rather that they may serve as a guide to the reader as to what fields he may expect to find covered, and what omitted, in the impressive mass of well-ordered information embraced within the covers of this work. Textual references to the original literature are ample, and are extended in a series of general references at the end of the volume. " Outlines of Biochemistry " will be deservedly popular on both sides of the Atlantic, and it is the certainty of the demand for further editions that encourages the reviewer to stress his personal regrets regarding what is omitted. In no sense does it lessen his enthusiasm for what is included and treated so admirably.

J. P.

A Biologist in the New Hebrides.

Man and Animals in the New Hebrides. By Dr. John R. Baker. Pp. xiv + 200 + 17 plates. (London: George Routledge and Sons, Ltd., 1929.) 12*s*. 6*d*. net.

On two occasions, in 1922 and 1927, Dr. Baker spent five and seven months in the New Hebrides, bent on scientific pursuits. No one will read in his account of these explorations vivid or wordy descriptions of tropical scenery and tropical mankind; the style is matter of fact, rather abrupt, sometimes a little careless, but no one will gainsay the importance of the facts themselves, or but admire the pains taken by the author to make his investigations as thorough as difficult conditions would allow.

The rapid depopulation of Melanesia has exercised the minds of many travellers, and various recent writers have attributed it to a score of different causes. Dr. Baker makes his own contribution. In Espiritu Santo, where the expedition was based, relics of villages the inhabitants of which had died off were frequent amidst the dense forests of the interior, and an estimate made by an English resident of some twenty-five years' standing placed the population then at ten times its present numbers. A census of a considerable number of the villages brought out the striking fact that for each 100 females there were 159 males, the second highest male/female ratio recorded of any people in the world at the present day. While Dr. Baker admits that introduced diseases and abortion are the chief causes of depopulation, he agrees with Buxton in regarding this abnormal sex-ratio as a factor of great importance. Unless the birth-rate were very high, and here it is the reverse, no race could fail to decline under such conditions.

To our knowledge of the fauna of the islands Dr. Baker made very considerable additions, as witness his list of some 29 new species (mostly Arthropoda). Undoubtedly his most interesting faunistic survey was that of the almost hitherto unknown "Steaming Hill Lake" in the hollow of the ancient crater of Santa Maria. Of thirty species, ten are probably new to science, a large proportion; but we are not prepared to agree with the author when he suggests that the specific differences cannot possibly be regarded as "of use" to their possessors. The physical conditions of the lake are so peculiar, its altitude, relatively high temperature, and curious temperature gradient, that who is to say what variations they may induce?

On the sea-shore of the island of Gaua some excellent ecological observations were made. A study of the coral reef in the mass suggested a modification of the gradual subsidence theory of fringing reef formation. The new idea is that a relatively slight sinking, which need not be continued, may offer conditions suitable for a gradually broadening fringe of coral, since even in the presence of the reef the coast-line itself recedes before the erosive action of shore breakers. Instead, therefore, of expanding outwards from the original shore-line, the reef expands inwards over erosion-submerged coast. Detailed examination of the half-mile of reef brought to light a fairly definite zoning of coral genera, and even more definite was the zonal arrangement of holothurian genera and species revealed by a count of individuals from the shore to the edge of the reef, an observation which fits in with recent work on the zoning of mollusca on Scottish shores.

Finally, reference must be made to the scientific use to which the extraordinary abundance of intersexual pigs was put. The abnormality elsewhere is extremely rare amongst mammals, but in these islands, where pigs are the most highly valued of possessions, between ten and twenty intersexes occurred to every hundred normal males. The type is quite distinct from those known in Europe, and its abundance and variety have led the natives to classify the intersexes into seven recognisable groups. Dr. Baker traces the probable development of these different stages, and suggests a convincing theory of their origin and of their genetics.

This is an interesting book, because, touching upon many different subjects, it sees all from the point of view of the scientific student. J. R.

Infra-Red Spectroscopy.

Das ultrarote Spektrum. Von Prof. Dr. Clemens Schaefer und Dr. Frank Matossi. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 10.) Pp. vi + 400. (Berlin: Julius Springer, 1930.) 28 gold marks.

The remark has not infrequently been made that progress in scientific knowledge depends ultimately upon the discovery of new methods of technique and the perfection of older ones. However much one may wish to uphold the claims of pure theory, there remains the conviction that, broadly speaking, it is the experimentalists who set the pace, either in providing trustworthy data or, for various reasons, failing to do so. In few branches of physics has this been more obvious

than in research upon infra-red radiation and its reactions with matter. As the authors of the book now under review remind us, it was Herschel who discovered the existence of these radiations so long ago as 1800; yet other parts of the spectrum—X-rays, for example—came to light decades later and grew in importance far more rapidly. The reason is to be sought in the exceedingly difficult nature of experimentation in the infra-red. It is not too much to say that the conquests of the last few years have reduced many of the technical rebels to a satisfactory degree of subordination: a few, however, still offer stout resistance, and against them a war of attrition is probably the only course.

Prof. Schaefer is not only a pioneer in infra-red spectroscopy and the founder of an enthusiastic school of disciples which includes Dr. Matossi, but it has also come his way to hold chairs of both theoretical and experimental physics at various times. The book now before us is the work of labourers in a vineyard who take no delight in picking to bareness for the say-so of it, but who have garnered judiciously, assessing almost to perfection the value of the crop. It is this that has made the laboratories at Marburg and at Breslau institutions whereunto seekers may resort, and be certain that they will come away humbler and wiser.

After a short historical introduction, the reader is asked to face some seventy pages devoted to experimental affairs. It is all very valuable, and the fact that it comes first serves to stress the hardly won battle for technical supremacy. The only drawback is that it might give the impression that the subject is little beyond the sum of its inherent difficulties. The next chapter is more encouraging, and deals adequately with the questions of heat radiation and their theoretical significance. A brief but sufficient treatment of the general Maxwellian relations follows, together with the work of Rubens on optical constants. The reader may now pause and take breath, for it is here that the book changes its outlook.

So far, infra-red rays have done all that electromagnetic waves of such a range of frequencies should, they have fitted reasonably well into the classical scheme and have provided a host of traps for the unwary observer. The authors, however, are not amongst those who ruminate on past victories: they are about to show how this region of the spectrum is of the first importance as the means whereby the physicist probes into the nature of the molecule. Theoretically, in this the chemist should rejoice (though in practice he usually does no such thing), and the X-ray worker will benefit from evidence on crystal structure from directions whence he least expected it.

Chap. iv. is devoted to the infra-red spectra of gases and liquids. After a general treatment along what must now be called classical quantum lines, the authors expound such portions of the new mechanics as are directly applicable. One wonders whether so much space need have been given to the Hamiltonian and the correspondence principle: they are discussed at length in countless text-books, while it seems unlikely that anybody would embark upon such a special study as that of infra-red spectra without a working knowledge of such matters. On the other hand, the recent verifications for polyatomic gases and the finer points of molecular structure provide very welcome reading; they are presented with a generosity to workers outside Germany which is a pleasure to record.

Solids next receive attention. Here, too, there is a good deal that one is accustomed to find elsewhere, included no doubt for completeness and the reader's convenience, but the story of the gradual unravelling of crystal spectra and the fitting together of fundamentals, overtones, combination tones, and inactive vibrations into a consistent whole is told as only those can tell it who have kept many a night vigil watching the excursions of the spot of light on the scale. The value of the results is great, both for crystal dynamics and sometimes even for the revelation (from the character of the absorption bands) of subtle niceties in crystal structure.

In spite of the high price, spectroscopists and physical chemists should strive to add this volume to their library: they will find in it not only enlightenment but also a certain majesty as of those who return from the harvest, bringing their sheaves with them. F. Ian G. Rawlins.

The Older Rocks and Physiography of Scotland.

Chapters on the Geology of Scotland. By the late Dr. Benjamin Neeve Peach and the late Dr. John Horne. Pp. xvi + 232 + 18 plates. (London: Oxford University Press, 1930.) 10*s*. 6*d*. net.

THE late Dr. B. N. Peach, of the Scottish Geological Survey, is well known to have advocated the view that the Moine gneiss, the most extensive formation in Scotland, is the metamorphosed eastern extension of the Torridon Sandstone. His remarkable personal influence gave that conclusion long currency among his colleagues and inspired a series of ingenious hypotheses to reconcile

it with the facts. This view was, however, never adequately explained in print and remained generally unintelligible. One of its unfortunate consequences was that it prevented the preparation of the work on the geology of Scotland which had been planned by Peach and Horne; for Horne rejected this view of the relation of the Moine and Torridonian rocks and the two authors could not complete their account of the first section of Scottish geology.

After Peach's death Horne resumed work on the book, and prepared five chapters, which give a valuable account of Scottish physiography, and of the petrography, distribution, and history of the investigation of the older rocks. These chapters contain so much inconsistent with Peach's opinions that they are clearly the work of Horne. The sixth and seventh chapters with the accompanying illustrations, Fig. 27 and Plate XVIII., are the work of Peach, and their publication is of importance as they record opinions which have had a great influence on Scottish geology. The arguments for Peach's conclusion that the Moine gneiss is altered Torridon Sandstone are clearly stated by Horne on pp. 199-200 ; and they are followed by three objections which appear unanswerable. In the text (p. 76) reference is made to the occurrence of Moine pebbles in the Torridon conglomerates of Loch Broom; if those pebbles are Moine they are an absolute objection to the Moine and Torridonian being of the same age. The text quotes Teall to the effect that the five pebbles from the Torridonian submitted to him could all be matched by rocks mapped by the Survey as Moine; and a footnote adds that Dr. Horne was of the opinion that they are typical Moine granulites.

In Peach's chapter on Islay some of the sandstones are represented as Torridonian, as if there were no doubt of the fact ; and on the map and the section (Plate XVIII. f. 3) those rocks are marked as Torridonian without the query which Horne insisted on inserting in the Survey maps. The note of interrogation is retained in the block reproduced on p. 204. The identification of these rocks as Torridonian is said on p. 205 to be convincing ; but it has been emphatically rejected by Mr. J. F. N. Green and the reviewer. The upper quartzites of Islay are identified as Cambrian on evidence that appears quite inadequate. Dr. Peach's general views are clearly shown by the Plate XVIII. and are bewildering. The succession includes neither Moine nor Dalradian. The Loch Tay Limestone is represented as the equivalent of the limestone in the slates of Toward, of the Margie Limestone of the Highland Border series and of the fossiliferous Stinchar Limestone (Llandeilo, or Middle Ordovician) near Girvan. The Ben Ledi Grits are claimed as Silurian ; the bulk of the Dalradian as Cambrian, and the Islay Limestone as Torridonian. Dr. Peach expressed such views in conversation, but they appeared vague and variable, and it was difficult to see how they could be reconciled with the general evidence. They are now published explicitly in Plate XVIII.

This definite statement of the opinions which Peach advocated so persuasively renders the volume of historic importance, though the sections which explain his views will probably be regarded ultimately as one of the curiosities of Scottish geology.

J. W. G.

Bibliographical Guides.

Reference Books : a Classified and Annotated Guide to the Principal Works of Reference. Compiled by John Minto. Pp. vii + 356. (London : The Library Association, 1929.) 21*s*.

THE need for a new guide to the literature of books of reference compiled from the point of view of the requirements of the larger libraries in Great Britain is undoubted, and no better choice could have been made in the selection of an editor-in-chief than Mr. Minto, the learned librarian of the Signet Library in Edinburgh. The Brussels decimal system of classification has been adopted as a basis for the classification of the entries. Strict adherence to any system of classification leads to unsatisfactory results, for while a work can be placed only in one class its contents may justify duplication or multiple entry in several. For example, the most complete bibliography of American literature is Sabin's " Bibliotheca Americana ", but it does not appear in this class, though it does elsewhere under works relating to America. This is a case where repetition is justifiable ; but when need for repetition arises from defects in the classification, the better course is to modify the classification by amending the class definition or by transferring the class elsewhere. For example, alchemy is treated in the Brussels classification as a branch of occult philosophy and only one entry appears relating to alchemical MSS. This is a case for class transference—for the bibliography of alchemy and chemistry are often combined. It cannot be too strongly stressed that in preparing guides of the character of this work great freedom is permissible in amending a classification if such amendment tends to clarify the results for the users of the book.

The classes most fully dealt with in the guide are "General Reference", Social Sciences", and "History and Geography". These classes go to confirm Mr. Minto's reputation for solid and scholarly workmanship; but in the classes "Natural Science" and "Useful Arts" Mr. Minto and his coadjutors are clearly out of their depth. The nature of the omissions may be gathered from the following examples. In the class "Chemistry" there is no reference to any of the chemical abstracts or under "Chemical Technology" to the annual reports of the Chemical Society. Under "Mining Engineering" "The Mineral Industry" is omitted, and there are only two entries under the "Bibliography of Agriculture"—one a 44-page pamphlet which is described as representing an important collection! The agriculturists' Bible, "The Experiment Station Record", is not recorded. In turning to the list of contributors mentioned in the preface we see that the advice of librarians of scientific institutions was not thought worth securing. It is regrettable that the Library Association did not insist upon a proper representation of scientific bibliographers upon the advisory panel. The neglect of scientific advice has rendered an otherwise valuable work useless for scientific and technical workers.

Our Bookshelf.

Geologische Karte der Erde. Von Franz Beyschlag. Bearbeitet mit Unterstützung durch die Preussische Geologische Landesanstalt. 1 : 15,000,000. Lieferung 2, enthaltend die Blätter 5, 6, 9, 10. (Berlin: Gebrüder Borntraeger, 1929.) Gesamt-Subskriptionspreis 150 gold marks.

THE second section of this map on the scale of 1 to 15 million, which is being issued by the Prussian Geological Institute under the supervision of Prof. Beyschlag, includes the four sheets of the southern part of the New World. Two of them were easily prepared, for one covers the Central Pacific with part of California, and another the south Pacific and New Zealand. The islands are too small to show their composition by colour, but initials might have been used for the purpose. As it is, islands such as Barbados and those off Brazil are left without any indication of their geology.

The most important of the new sheets is one covering Central and most of South America, and another of Patagonia and the South Atlantic Islands. These two sheets are especially useful. It is not easy to read them fully without the index of colours, which is to be issued with the last section; but they give a clear view of the general structure of South America. South Georgia is unfortunately coloured as Archean, and that mistake is the more remarkable since the fossil which most clearly proves that at least part of the slates in the island are Mesozoic was found by a German doctor, was determined by Pompeckj, and is in the collection of the University of Heidelberg. The uncertainty as to the geology of South America may be realised by comparison of this map with that compiled by Du Toit in 1927. Prof. Beyschlag greatly reduces the area of Lower Mesozoic volcanic rocks in the Upper Parana basin and south-western Brazil, but includes in the lavas a large area near Ascension which Du Toit marks as Devonian, Carboniferous, and Archean. The composition of the Sierra de Tanjil and range to the south of it are also different from Du Toit's map. The maps are an example of clear and beautiful colour printing.

Les Étapes de la physique. Par H. Volkringer. (Encyclopédie Gauthier-Villars.) Pp. ix + 217. (Paris: Gauthier-Villars et Cie, 1929.) 20 francs.

THIS little book of 200 pages is such a good example of the specially French art of popularisation that it is worth examining how the success is obtained. The first point is obvious and clearly attained in the case of M. Volkringer: the author must be a master of his subject. Wherever he gives details of any particular conclusion or experiment, he speaks clearly, as one who has been through that stage and knows it. In the second place, he must be able to select with judgment. This book, slight as it is, gives some enlightening illustrations of all the main stages from Archimedes to Planck and Rutherford. The third point is one on which the French are nearly always more successful than others, one on which the English populariser is apt to feel shy and open to comment. The successful author of such a book must give a certain amount of moralising and what may be thought commonplace generalisation. In this matter M. Volkringer is particularly good; he gives it and it does not appear cheap. Not only his own remarks but apt quotations from greater men punctuate and enliven especially the later pages. "Le succès est le plus puissant toxique." "Le but essentiel de l'industrie est l'adaptation des richesses à la satisfaction les besoins humains." "Tout le secret de sa valeur et son influence [that is, of physics] est dans le fait qu'elle est la science de la mesure."

The book concludes with two short but sufficient chapters on the place of theory in science and the nature of scientific law. The reader gets a glimpse of the philosophy of the subject, but is not immersed in it.

F. S. M.

An Introduction to Organic Chemistry. By Dr. Eric John Holmyard. Pp. xi + 282 + 10 plates. (London: Edward Arnold and Co., 1930.) 4*s.* 6*d.*

DR. HOLMYARD has attempted to arouse interest in organic chemistry among boys and girls in upper forms who have already passed the school certificate examination, by describing the structure and chemical properties of some of the simpler compounds in both the aliphatic and the aromatic series. Stress is laid upon methods used in the purification and analysis of compounds and upon the development of structural formulæ in order to

familiarise the student in the first place with the kind of reasoning by means of which a knowledge of molecular structure may be acquired, and, secondly, with the general properties associated with particular groupings. To each chapter is appended a list of questions to be answered, but no practical details are given for the guidance of beginners. The illustrations include ten full-page plates, six of which are portraits of eminent chemists. The descriptive narrative is occasionally relieved by the introduction of chemical theories, such as Baeyer's strain theory, the theory devised by Le Bel and van't Hoff to interpret the existence of optical isomerism, the polymerisation of formaldehyde to account for the photosynthesis of carbohydrates, and the discussion of the orientation of derivatives of benzene. Notes are also given upon modern commercial processes. The style is clear and the text is not overloaded with detail.

The Art and Religion of Fossil Man. By Prof. G.-H. Luquet. Translated by J. Townsend Russell, Jr. Pp. xiv + 213. (New Haven: Yale University Press; London: Oxford University Press, 1930.) 23*s*. net.

THIS volume is a translation—and it may be said an excellent translation—by Mr. Townsend Russell, of the American School of Archæology in France, of Prof. Luquet's "L'Art et la Religion des Hommes fossiles". M. Luquet is the author of a considerable number of works on the psychology of primitive and prehistoric art; but a wise choice was made in selecting this particular volume for translation into English. Not only is it a valuable description and analysis of the various classes of Palæolithic art, but it is one of the most important contributions to be made by French archæologists to the discussion of the meaning and purpose of that art. M. Luquet is a strong supporter of the view which holds to the disinterested origin of the art of Palæolithic man, though it is recognised that in certain cases a magical element must be admitted. The evidence for a belief in some sort of life after death to be deduced from the burial customs of Palæolithic man is here well marshalled and thoroughly sifted. The illustrations are excellent; they have been selected with discrimination, but at the same time without undue partiality to the line of argument followed by the author.

A Dictionary of Scientific Terms: Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology. By I. F. Henderson and Dr. W. D. Henderson. Second edition, revised. Pp. xi + 352. (Edinburgh and London: Oliver and Boyd, 1929.) 16*s*. net.

THE first edition of this dictionary was published in 1920. Nine years later a second edition appears. Clearly the scientific workers for whom it was compiled have found the book useful.

The present-day student of science is usually ill-educated on the classical side. He often employs the commonest terms in vogue without any serious reflection as to their literal meaning, and his mispronunciations must appal the scholar of Latin and Greek. But if he possess this dictionary and consult it faithfully, there will be less excuse for his blunders.

The second edition contains fifteen hundred new terms, but is no bulkier than its predecessor. Much care and thought must have gone to the recompilation, and the publishers are to be congratulated on their wise decision to allow the whole book to be reset. The authors offer their thanks to those colleagues who have suggested new terms that might be included, and they hope that further suggestions will be forthcoming for future editions.

D. L. M.

The Wilderness of Denali: Explorations of a Hunter-Naturalist in Northern Alaska. By Charles Sheldon. Pp. xxv + 412 + 63 plates. (New York and London: Charles Scribner's Sons, 1930.) 21*s*. net.

THE late Charles Sheldon was a great hunter, and this posthumous work describes the last of his hunting trips, amongst the snows of Denali or Mt. M'Kinley in Alaska. But Sheldon was also a sound observer of Nature, and while the sportsman will be thrilled by his descriptions of difficult stalks after bighorn, moose, and reindeer, the naturalist turns, with some relief, from the tales and pictures of slaughter, to his comments upon the lives of these and other wild animals. Colour protection attracted his attention: snowy owls hunting for mice in the snow were inconspicuous, and motionless ptarmigan were invisible; the markings and coloration of the lynx blended with the rocks; but the colour of the moose rather revealed than concealed it, and the white bighorns were sometimes visible three or four miles away. A sudden plague of field mice and lemmings sprang up in 1907, where none had been seen before; marsh-hawks increased in numbers, and by May of the following year mice were scarce again. There are many such notes scattered throughout the text, but the book is primarily a hunter's account of the pursuit of big game and the habits which had to be explored to make the pursuit fruitful.

The Physiology of Love. By Dr. George M. Katsainos. Pp. vi + 326. (Boston, Mass.: The Author, 176 Huntington Avenue, 1929.) 4 dollars.

DR. KATSAINOS cannot be said to have contributed any great advance to our knowledge in the work under notice. He is somewhat intolerant of the views of others and shows a lack of the critical faculty in his discussion, allowing his emotions to run away with him. To attribute homosexuality to satiety with heterodox sex cravings shows a very superficial knowledge of up-to-date psychopathology, and this is confirmed when we find him attributing *Psychopathia Sexualis* to Freud! One would hesitate to compare dyspepsia to what the author pleases to call dyseros—surely this is a travesty of physiological principles. The book leaves a feeling of dissatisfaction.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Stellar Structure and the Origin of Stellar Energy.

THE generally accepted theory of the internal conditions in stars, due to Sir A. S. Eddington, depends largely on a special solution of the fundamental equations, and according to this a definite calculable luminosity is associated with a given mass. If this were the only solution of the equations it would conflict, as I have repeatedly shown in recent papers, with the obvious physical considerations which show that we can build up a given mass in equilibrium so as to have an *arbitrary* luminosity (not too large) whatever the assumed physical properties of the material. I have recently noticed that the fundamental equations possess a whole family of solutions, corresponding to arbitrarily assigned luminosity for given mass. These solutions show immediately that Eddington's solution is a special solution and corresponds to an unstable distribution of mass. In the stable distributions the density and temperature tend to very high values as the centre is approached, theoretically becoming infinite if the classical gas laws held to unlimited compressibility.

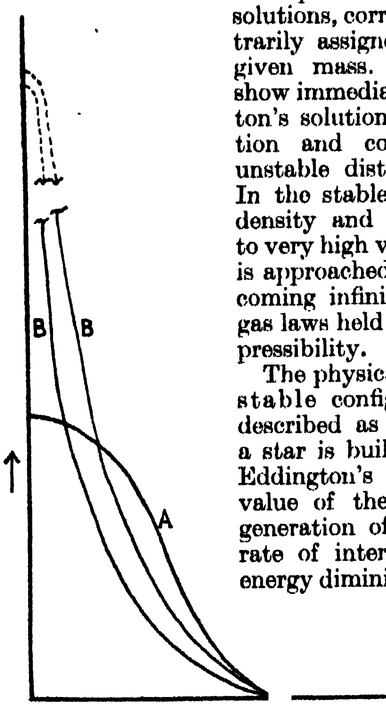


FIG. 1.

The physical properties of the stable configurations can be described as follows. Suppose a star is built up according to Eddington's solution with his value of the rate of internal generation of energy. Let the rate of internal generation of energy diminish ever so slightly. Then the density distribution suffers a remarkable change. The mass suffers an intense concentration towards its centre, the external radius not necessarily being changed. The star tends to precipitate itself at its centre, to crystallise out so to speak, forming a core or nucleus of very dense material. The star tends to generate a kind of ' white-dwarf ' at its centre, surrounded of course by a gaseous distribution of more familiar type; the star is like a yolk in an egg. In this configuration the density and temperature are prevented from assuming infinite values by the failure of the classical gas laws, but they reach values incomparably higher than current estimates. For example, it seems probable (though the following estimates are subject to revision) that the central temperature exceeds 10^{11} degrees, in comparison with the current estimates of the order of 10^7 degrees; and the density may run up to the maximum density of which ionised matter is capable.

The unstable density distribution of Eddington's model (curve A) and the stable density distribution of actual stars (curves B) are indicated roughly in Fig. 1, which is not drawn to scale. It may be mentioned that the instability is of a radically different kind from that discussed by Sir James Jeans. He concluded that perfect-gas stars of Eddington's model were *vibrationally* unstable. In my investigations, the instability of Eddington's model arises from any slight departure of the rate of generation of energy below the critical value found by Eddington. The perfect-gas distribution of my solutions is perfectly stable, but the density necessarily increases until degeneracy or imperfect compressibility takes control.

The consequences amount to a complete revolution in our picture of the internal constitution of the stars. In the intensely hot, intensely dense nucleus, the temperatures and densities are high enough for the transformation of matter into radiation to take place with ease. It is to this nucleus that we must look for the origin of stellar energy, a nucleus the existence of which has previously been unsuspected. The difficulties previously felt as to stellar conditions being sufficiently drastic to permit the evolution of energy largely disappear. Many of the cherished results of current investigations of the interiors of stars must be abandoned; current estimates of central temperature, central density, the current theory of pulsating stars, the current view that high mass necessarily implies high radiation pressure, the supposed method of deducing opacity of stellar material from observed masses and luminosities, the supposed proof of the observed mass-luminosity correlation—all these require serious modification.

The new results are not a speculation. They are derived by taking the observed mass and luminosity of a star, and finding the restrictions these impose on the possible density distributions compatible with this mass and luminosity. By integrating the fundamental equations from the boundary inwards, we are inevitably led to high central temperatures and densities. So long as the classical gas laws persist, the solution is one of the family with a central singularity (infinities in ρ and T), and it is only the ultimate failure of the gas laws which rounds off the distribution with a finite though very large central ρ and T.

E. A. MILNE.

Wadham College, Oxford,
July 29.

Structure of Carbohydrates and their Optical Rotatory Power.

IT would appear from two recent publications by Dr. C. S. Hudson of New York (*J. Amer. Chem. Soc.*, **52**, pp. 1680, 1707; 1930) that the classification of the ring structure of sugars can be decided upon little more evidence than that of the optical rotations which these substances display in a single solvent and for light of one selected wave-length. If this claim could be substantiated, the method might be usefully extended to other groups of compounds and the labours of organic and bio-chemists would be immeasurably simplified.

Dr. Hudson is satisfied, however, with a standard of constitutional proof for the carbohydrates which will not find general acceptance. In no case does he advance evidence which is unequivocal for any sugar, although he attempts to apply definitive formulæ to many. His scheme finds its origin in the assumption that optical rotation is an additive property. At the same time that he is seeking to test this hypothesis he assigns differing structural formulæ to explain the anomalies that arise from it. These are at variance with many of the constitutional formulæ which my co-workers and I have established from a fundamental

study of the behaviour of sugars, although now, after some years of disagreement, he accepts my formula for glucose (NATURE, **116**, 430, Sept. 10, 1925).

Dr. C. S. Hudson has not utilised the means which were open to him to test the validity of his views by direct chemical experiments. The basis on which he develops his argument is the presumed existence, which his statistical methods enable him to detect, of the residue of a new form of mannose (calculated $[\alpha]_D + 77°$) in acetobromo-, chloro-, etc., derivatives of 4-glucosido-mannose, obtainable from cellobiose through cellobial. All the calculations leading to the allocations of structure for the remaining sugars are made to rest upon the assumption that the mannose occurring in the ordinary known form of α-methylmannoside is not present as a residue in this biose. If this foundation for his scheme fails, then the entire superstructure of rival formulæ which he has raised upon it must collapse.

A survey of Dr. Hudson's two recent papers (*v. supra*) has led me to select for this critical test an experimental method which he has tacitly approved: he has accepted and utilised the observation of Fischer that β-methylmaltoside gives rise by enzyme hydrolysis to β-methylglucoside without ring change. Implicit in Dr. Hudson's scheme, therefore, is the expectation that 4-glucosido-α-methylmannoside will yield by enzyme cleavage his hypothetical α-methylmannoside ($[\alpha]_D + 125°$), inasmuch as this is the glycoside of the unknown form of mannose to which he has assigned the 1 : 5-ring.

With my colleague Dr. E. L. Hirst and other co-workers (R. J. W. Reynolds, H. R. L. Streight, H. A. Thomas, J. I. Webb, and Miss M. Plant) I have prepared and investigated the chemical behaviour of both 4-glucosido-α-methylmannoside and 4-galactosido-α-methylmannoside to which the 1 : 4-ring for the mannosido residue cannot apply, since the 4-position in this residue is occupied by the biose link. We have found that these substances are hydrolysed by *emulsin* and yield the ordinary known form of α-methylmannoside ($[\alpha]_D + 79°$) which is the pyranoside (1 : 5-ring). To this pivotal compound Dr. Hudson has assigned the furanoside (1 : 4-ring) structure. It follows that the whole of his rival formulæ for mono- and disaccharides become meaningless.

The above biosides are prepared in the same way as the bioses, namely, from cellobial and lactal by the action of perbenzoic acid, but in the presence of methyl alcohol instead of water. The same 4-glucosido-α-methylmannoside has also been obtained from acetobromo-glucosido-mannose, the reference compound quoted in the statistical scheme.

Had Dr. Hudson tried these experiments it is difficult to see how he could have committed himself to speculations that are at variance with this and with much more chemical evidence which is on record. Moreover, should it be the case that rotational values only are considered the relevant factors, then one may add that the rotations of these biosides and of the corresponding bioses are widely divergent from those required by his system of classification based on epimeric differences with cellobiosides and lactosides and the free sugars. From the optical rotations of these new compounds in the series upon which his case is based, he could have confuted his own thesis and demonstrated by statistical methods the presence of a residue of the ordinary known form, and not the hypothetical form, of methylmannoside or mannose. We showed two years ago that the 'principle of optical superposition' does not apply uniformly throughout the sugar group and that in the mannose, lyxose, rhamnose series the failure was conspicuously evident. The results now summarised are in complete agreement with the sugar formulæ we have established over many years by methylation studies, lactone formation and degradation, and by a comparison of the reaction velocities of glycosides under hydrolysis, and by other direct chemical methods.

W. N. HAWORTH.

University, Edgbaston,
Birmingham,
July 24.

Predissociation of the Phosphorus (P_2) Molecule.

IN a recent letter to NATURE, H. H. Van Iddekinge (NATURE, **125**, 858; 1930) communicated the observation that in the emission spectrum of S_2 the same bands occurred as in the absorption spectrum with the exception of those bands which are diffuse in the absorption spectrum (Henri and Teves, NATURE, **114**, 894; 1924; and Rosen, *Z. f. Phys.*, **52**, 16; 1928). According to Van Iddekinge (see also Kronig, *Z. f. Phys.*, **62**, 300; 1930), this is readily explained by the fact that the diffuseness of the band lines is due to a spontaneous dissociation of the molecule in the upper state of these diffuse absorption bands (predissociation) which occurs before radiation can take place; emission of these bands cannot therefore be observed.

When investigating the emission band spectra of the phosphorus (P_2) molecule, I found, about six months ago, an extended band system from 3500 A. to the far ultra-violet, the longer wave-length part of which has already been measured by Geuter (*Z. f. wiss. Phot.*, **5**, 1; 1907). The vibrational structure of this part was easily analysed, whereas the shorter wave-length part is rather difficult because of overlapping of the bands and vibrational perturbations, and has not been yet completely analysed. The analysis of the short wave-length part showed that those bands are present, the ν' of which is below a certain value, say a.[1] In that region there are five strong bands with $\nu' = a$, but no bands at all with $\nu' = a+1$, $a+2$, etc. What is even more significant is that the band lines of the bands with $\nu' = a$ suddenly stop at a certain low value of the rotational quantum number, the last line being very intense; whereas the lines of the bands with $\nu' = a - 1$ stop at a certain higher value of the rotational quantum number, no fall of intensity being evident for lower values of ν'.

The explanation of this phenomenon was rather obvious, and is the same as that independently obtained by Van Iddekinge and Kronig in the case of S_2. Though the absorption spectrum of P_2 vapour has not yet been investigated, it may be assumed as certain that the sudden stop of the bands at the value $\nu' = a$ corresponds to the beginning of bands with diffuse lines in the absorption spectrum at the value $\nu' = a+1$. These absorption bands, however, lie in the far ultra-violet, because, as always for absorption bands, ν'' will be small, whereas the emission bands in question lie on the other branch of the Franck-Condon parabola, that is, high values of ν'', and therefore at longer wave-length.

In all cases of diffuse molecular *absorption* spectra observed hitherto, diffuseness sets in at a certain band, but it has not been previously observed that it sets in at a certain line of a band. It seems, however, to be so in the case of P_2 as shown by the fact of the drop of intensity in the *emission* bands discussed above. This sharpness of the limit of predissociation seems to be rather significant. Therefore, it would be highly interesting to investigate the absorption spectrum of the P_2 molecule, and it is hoped to do that later.

Recently Grundström and Hulthén (NATURE, **125**, 634; 1930), Stenvinkel (*Z. f. Phys.*, **62**, 201; 1930) and Kronig (*Z. f. Phys.*, **62**, 300; 1930) have tried to explain several examples of the breaking off of emission bands of hydride molecules by predissociation. It seems to me, however, that in most of these cases the available data are not sufficient definitely to exclude Oldenberg's explanation by rotational instability (*Z. f. Phys.*, **56**, 563; 1929), because the energies of dissociation of all electronic states involved are very small and, as nearly always in hydride spectra, cannot be determined accurately, if at all. In the case of P_2, however, which seems to be the first molecule other than a hydride showing this breaking off of band lines, Oldenberg's explanation can be definitely excluded, because the last observed vibrational frequency is 424·5 cm.$^{-1}$ and the decrease for successive vibrational quantums is 4·7 cm.$^{-1}$ as shown by more than six definitely located levels.

The absolute value of the predissociation limit thus found cannot be given very accurately for the moment, because the origin of the band system has not yet been found. A rough value of 45,000 cm.[1] (5·5 volts) may, however, be given. This represents an upper limit for the heat of dissociation of the P_2 molecule (cf. G. Herzberg, *Z. f. Phys.*, **61**, 604; 1930).

G. HERZBERG.

H. H. Wills Physical Laboratory,
University of Bristol,
July 10.

[1] The absolute value of *a* cannot be given, because the origin of the band system has not yet been found.

Distribution of Growth Activity in *Eupagurus*.

INVESTIGATIONS on the relative growth of parts in the common hermit crab, *Eupagurus prideauxi*, which will shortly be published *in extenso* in *Roux's Archiv*, reveal some interesting facts of general significance.

In previous communications [1] it has been pointed out that when organs or regions are growing at rates different from that of the body as a whole, there exists in them a *gradient* of growth-activity, with a maximum point (*growth-centre*) from which the intensity of growth decreases in both directions. In the case of markedly heterogonic crustacean limbs, this growth-centre has always been the penultimate segment (propus). This is confirmed for the male right chela of *Eupagurus*, which is heterogonic in later stages. But in earlier life this limb is growing only slightly faster than the body; and in this phase the growth-centre is two segments more proximal, in the merus.

The following table gives the percentage increases of the various segments of the right chela, and that of the thorax-length as standard for the body, in young and old males.

	Thorax.	Ischius.	Merus.	Carpus.	Propus.	Dactylus.
Small males (thorax length, 9·0-11·36 mm.)	26·6	28·5	*40·0*	35·0	30·0	27·5
Large males (thorax length, 12·2-13·3 mm.)	0·5	13·0	16·4	16·3	*16·6*	14·5

The interesting point is that the slower-growing left chela and the two long walking legs (pereiopods 2 and 3) show, throughout the size-range examined, a gradient similar to that of the right chela in its early stages, with high point in the merus. Thus different constructions and different rates of relative growth of appendages demand that the main increase of growth shall be in different regions; but in both cases increased growth proceeds by means of growth-gradients culminating in a high point or growth-centre.

It then appears that we can extend this conception of growth-gradients from the growth of single appendages to that of the body as a whole. Fig. 1 shows the percentage increase in length of the various appendages (or conveniently measurable portions thereof) in both males and females, for a percentage increase in thorax-length of 48·2 per cent, for specimens between 9 and 12 mm. thorax-length. The graded effect is well shown on the left side of the male curve. Small eyestalks and maxillipeds, lengthy 2nd and 3rd pereiopods, short 4th and 5th pereiopods —all, when considered in regard to their growth-

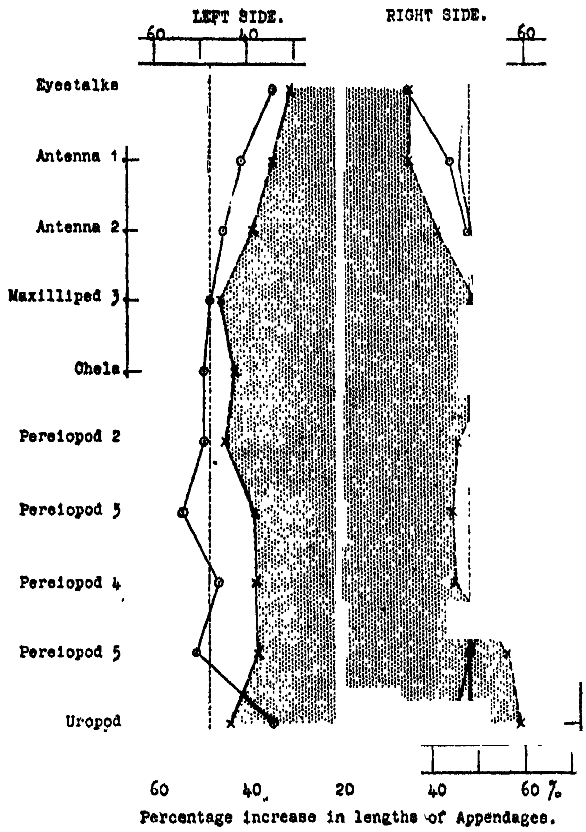


FIG. 1.—⊙——⊙, male; ×----×, female (stippled). Vertical dotted line represents percentage increase of thorax length.

rate instead of their absolute size, fall into a single gradient-system with high point at pereiopod 3. The male right side shows a similar gradient, but interrupted locally by the strong heterogony of the right chela. The female appendages show a different distribution of growth-intensity—everywhere save posteriorly this is less than the male's, and has two high points, one between maxilliped and 2nd pereiopod, the other in the abdomen.

The graded effect is shown also as regards the degree of asymmetry, which may be measured as the percentage ratio of the lengths of left-hand to right-hand appendages. Fig. 2, which illustrates this, requires little comment. Note that the greater right-handedness of the male thorax, culminating in the chela, causes males to remain predominantly right-handed for a third of a segment farther down the body than is the case in females.

These facts would indicate that what we may loosely call 'growth-potential' is distributed in an orderly fashion through the animal body, in a series

of growth-gradients, which are of varying shape and steepness, and apparently interact with one another as illustrated by the fact (*loc. cit.* p. 910) that an active

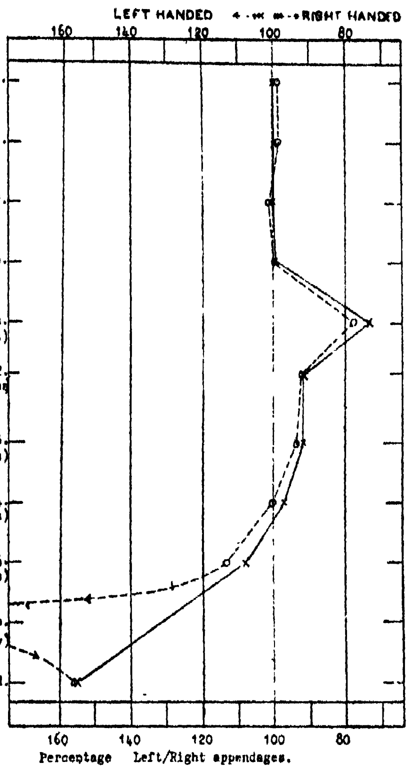


FIG. 2 — ×——×, male; ⊙- - - -⊙, female.

growth-centre in one appendage is correlated with increased growth-activity in limbs immediately posterior to it, decreased growth-activity in those immediately anterior.

S. F. BUSH.
J. S. HUXLEY.

King's College, London, W.C.2.,
July 28.

[1] Huxley and Tazelaar, NATURE, June 15, 1929, p. 910; Huxley, *ib.* April 13, 1929, p. 563.

Virus Disease of the Potato: Streak.

THE term 'streak' has been applied to a diseased condition of the potato in which the leaf and stem tissues become to a greater or lesser extent involved in a necrotic process. The condition was first described as a separate disease by Atanasoff under the name of 'stipple streak', and has since received considerable attention from the clinical point of view from Quanjer and others. In this Institute I have shown how 'streak' may be but an alternative symptom of another disease, namely, crinkle *A*; and my colleague, Dr. Kenneth Smith, that it may assume a somewhat similar relation to ringspot disease of tobacco. In the former, the change from crinkle to streak is induced by varietal susceptibility; in the latter, by *passage* of an original potato mosaic virus through tobacco before being used as an inoculum to reinfect the healthy potato. Streak is clearly a clinical picture which may be reproduced by different agents.

In pursuance of the task of obtaining virus-free stocks, I have frequently been brought up against the problem of the apparently healthy virus carrier, and have dealt with the question in some detail in two recent papers.[1] This year's work has given me good reason to believe that there may be at least two distinct viruses which produce streak, and, as in the case of the two distinct crinkles, namely, crinkle *A* and paracrinkle, they are to be distinguished by their varietal reactions.

The variety Di Vernon is only with some difficulty to be obtained free from all external signs of virus disease. Two out of three such apparently healthy and very vigorous stocks in my possession, when grafted to healthy Arran Victory plants, produced in them but a mild mosaic, but when grafted to healthy President plants, a violent and lethal streak. Further, if the mosaic-affected Arran Victory be grafted to President, the latter succumbs to acute streak in the same way as did those grafted directly from the Di Vernon.

Uptodate has long been known to carry a latent streak, though it itself may appear to be in the best of health. I have tested out a great many units of Uptodate from the very best stocks obtainable in Scotland and Ireland, and have, with one doubtful exception, found them all to be carriers of virus disease. Now the streak which Uptodate may carry reacts differently from that carried by Di Vernon: here both healthy test plants, Arran Victory and President, develop a moderate and generally non-lethal streak. However, the Arran Victory usually suffers more severely than does the President—the reverse of what was found with Di Vernon streak.

To the Uptodate class of streak reaction belongs that found in two more carriers, namely, Kerr's Pink and Majestic. In the latter variety, streak carriers seem rather rare; in the former the matter is complicated by the fact that whilst all Kerr's Pink stocks (in my opinion) are carriers, the virus they carry is clearly depressed in virulence by its sojourn in Kerr's Pink, and it is only rarely that its reaction on grafting to other varieties is in terms of streak.

A corresponding difference of reaction is found when Daturas are inoculated with the two types of streak. The Di Vernon carriers produce no reaction in Datura; the Uptodate and Kerr's Pink carriers, on the other hand, cause a reaction identical with that following inoculation with crinkle *A*.

As it seems wisest to discriminate between the viruses of the potato by their reaction in standard healthy varieties rather than by their clinical appearance in any one variety, I would suggest that the virus which produces streak in both healthy Arran Victory and President and may be latent in Uptodate, Kerr's Pink, and Majestic, be termed streak *A*; and that which may be latent in Di Vernon, produces a streak in healthy President but fails to do so in healthy Arran Victory, be called streak *B*. Such a system of nomenclature leaves room for the identification of other streaks, evidence for which is now accumulating in our Institute.

REDCLIFFE N. SALAMAN (Director).

Potato Virus Research Institute,
Cambridge, July 30.

[1] "Crinkle 'A'; an Infectious Disease of the Potato," and "Paracrinkle; a Potato Disease of the Virus Group." *Proc. Roy. Soc.* B, vol. 106, 1930.

Transmission of Potato Leaf Roll.

IN his letter in NATURE of July 19, p. 96, Dr. Kenneth Smith appears to be under the impression that I 'deplore' the importance attached by virus workers to *Myzus persicæ* as a vector of potato leaf roll. The importance of this insect in this respect was not called into question in my letter in NATURE of June 28, but rather "the growing tendency . . . to regard the relation of *M. persicæ* to leaf roll transmission as specific and unique". Dr. Smith reminds me that in May 1929 he expressed the opinion that *M. persicæ* is probably not the only carrier of leaf roll.

In his latest publication, however, (*Jour. Min. Agric.*, June 1930, p. 227) he emphasises the similarity between leaf roll transmission by *M. persicæ* and other plant virus diseases in which it is said that one, and only one, insect is capable of carrying the virus. *M. persicæ*, he states, has a marked affinity for several potato viruses, especially for the leaf roll virus, whilst "other insects such as capsid bugs, leaf-hoppers, and the *remaining species of aphides*, have failed to transmit the diseases". Here is evidence of the growing tendency referred to in the mind of at least one virus worker. Although proof is lacking, I think it quite probable that *M. persicæ* bears a more subtle relationship to leaf roll transmission than that of a mere mechanical agent, but this relationship, whatever it may be, would appear to be shared to some extent by *M. circumflexus*. So far from minimising the importance of *M. persicæ* in leaf roll transmission, in my letter I attributed little or no importance to *M. circumflexus* as an active agent in spreading virus diseases.

Dr. Smith disagrees with my suggestion that *M. circumflexus* should prove of value in virus transmission studies, apparently because (1) it is not uncommon for the characteristic dorsal markings to be absent from specimens of *M. circumflexus*, and (2) this species is stated to be a poor transmitter of mosaic and to possess, in its saliva, a toxin which produces a 'false mosaic' in Solanaceous plants, including the potato. With regard to the first objection, it is obvious that the absence of the dorsal bands in occasional adults makes the task of detecting such apterous females of this species uncertain, but surely not more so than in other unmarked species, for example, *M. persicæ*. Exceptional individuals need not be selected for use in artificial infestations, and any initial error in diagnosis can thus be obviated. The appearance of unmarked adults in the cages will, at least, raise a suspicion of admixture of species in the mind of the worker and will induce caution in interpreting results.

The suggestion that *M. circumflexus* possesses a toxin in its saliva is, if substantiated, of great importance and marks a definite advance in our knowledge of viruses. It will of course restrict the use of this species to special aspects of mosaic transmission, but it is difficult to see in what way the power to produce a false mosaic will impair the value of *M. circumflexus* in *leaf roll* transmission studies; and these studies, after all, formed the subject matter of my first letter. T. WHITEHEAD.

University College of North Wales,
Bangor, July 28.

Flint Implements of Upper Palæolithic Age from Yorkshire.

IN regard to Mr. Bromehead's objection (NATURE, July 5, p. 13) to my letter in the issue of June 7, p. 858, it might perhaps dispel any misunderstanding that may have arisen in connexion with the same if I say that Messrs. Dewey and Bromehead, after they had investigated the sites under consideration last May, were unanimous in relegating Lamplugh's "Late Glacial Boulder Clay" deposit of Danes' Dyke to Late Pleistocene times, though, I was given to understand, they regarded it as a hill-wash formed under cold conditions rather than a boulder clay. In accordance with these opinions, Mr. Dewey afterwards supplied me with the wording for par. 2 of my letter in NATURE of June 7 as representing both his and Mr. Bromehead's views concerning the age of the deposit they had been asked to examine.

As space cannot be spared in NATURE for a full statement of the facts, I have given the details in a letter which I am circulating privately, and I am content to leave these to speak for themselves.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2, July 7.

IN answer to Mr. Burchell, it is inaccurate to say that I relegated Lamplugh's "Late Glacial Boulder Clay" deposit to Late Pleistocene times, since Lamplugh nowhere described the flint-bearing deposit by those words. In his paper on the Drifts of Flamborough Head (*Quart. Jour. Geol. Soc.*, vol. 47, pp. 384-431; 1891) he shows the deposit in question in only one of his fifteen sections, that at Danes' Dyke; he describes it as "a few feet of loamy stuff resembling a weathered Boulder Clay" and as "stony earth like weathered Boulder Clay", and in a generalised table includes it under the heading "Late Glacial Gravels, Brickearth, and Boulder Clay". In all other sections Lamplugh ignores this deposit; he also omits to show any soil or subsoil. I personally am convinced that if Lamplugh were with us to-day he would class Mr. Burchell's deposit under some such heading, or use the more expressive Yorkshire term, 'muck'. In the memoir on Holderness, Clement Reid definitely classes the bed at Kelsey Hill, Burstwick, as Post-Glacial.

The report by Mr. Dewey and myself to the Director of the Geological Survey was made as favourable to Mr. Burchell's views as our opinions allowed. In his letter published in NATURE of June 7, Mr. Burchell anticipated this report; he quoted the only words in any way favourable to his view and omitted to say that on the main question, whether the 'implements' are overlain by Boulder Clay, our decision was unfavourable. In his present letter he takes a similar course with regard to Lamplugh's published paper. I am therefore glad to know that his "full statement of the facts" has been circulated privately.

C. N. BROMEHEAD.

Geological Survey Office,
14A Parliament Street, York.

The Second World Power Conference at Berlin.

IN his article in NATURE of July 19 on the Second Plenary World Power Conference in Berlin, Mr. H. Quigley has presented the results of the meeting in a somewhat wrong perspective. As a matter of fact, the constitution of the World Power Conference renders it almost impossible for immediate action to be taken such as he would suggest. The position is really as follows: a number of resolutions, some of which bear very directly upon the work of the Conference as a permanent organisation, were passed during the technical sessions, but in accordance with our unvarying practice, none of these resolutions was endorsed by the International Executive Council this year. They will be circulated to all the national committees, will be examined by a special sub-committee, and will come up for consideration and appropriate action at the next meeting of the Council, to be held in London at the time of the Faraday celebrations in September 1931. In other words, no exceptional treatment was accorded to the resolutions passed during the technical sessions this year.

On the other hand, the International Executive Council, of its own motion, took a number of decisions of first-rate importance concerning the future "work of the Conference". Specific proposals were put forward by the Central Office or by national com-

mittees for issuing a statistical year book based upon standard forms for the collection of data relating to the power resources of the world upon a comparative basis, in connexion with which a mass of preliminary work has been accomplished during the past three years. Arrangements were made for the publication of selected annotated bibliographies upon a uniform system. The possibility of issuing a periodical Central Office bulletin was explored. Lastly, a special sub-committee was appointed for the very purpose or re-examining the activities and organisation of the World Power Conference. The following passage occurs in the Report presented on behalf of the International Executive Council at the closing meeting of the Berlin Conference: "The International Executive Council has set up on the basis of some definite proposals put before it, a Sub-Committee which is to submit to its next meeting in 1931, after consultation with the National Committees, certain proposals promoting the rational development and increasing the usefulness of the World Power Conference".

C. H. GRAY
(Secretary, International Executive Council).

Central Office,
World Power Conference,
63 Lincoln's Inn Fields,
London, W.C.2.
July 24.

Ultra-Violet Light and Atmospheric Pollution.

THERE are so few manufacturing towns where observations have been taken of the incidence of ultra-violet light that Mr. Bower's results which are given in a letter to NATURE of July 12, p. 59, are very welcome. On the average of three years he finds that Sunday is a day with 12 per cent more ultra-violet light than the average of all days of the week. In Rochdale, observations in 1929 show Sunday also to be a day of more ultra-violet light than the average of all days of the week, and the excess is 12 per cent, which is in exact agreement with Mr. Bower's results for Huddersfield.

Now in Rochdale a daily record has been kept of the soot-fall, and it is found that the number of particles deposited on Sundays is 29 per cent *less* than the average of all days, and there is therefore direct evidence that reduction in soot-fall and increase of ultra-violet radiation occur together. The falling off of deposited particles concurrently with the increase of ultra-violet rays which is found on passing from town to country is evidence in the same direction. There can be little doubt that factory smoke in manufacturing towns cuts off much of the valuable light of the sun.

By the kindness of Sir Leonard Hill I have been supplied with the daily observations of ultra-violet light in 1929 at London, Cardiff, Lowestoft, and Ventnor, and I have worked out the Sunday and week-day values. Confining attention to Lowestoft and Ventnor, two seaside resorts free from factory smoke, we have as the combined percentage result:

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average.
97	100	104	100	104	101	94	100

Here Saturday and Sunday have less ultra-violet light than week-days. Contrast with this the combined result for Huddersfield and Rochdale, which is as follows:

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average.
112	99	99	94	94	99	103	100

It seems reasonable to suppose that at the seaside resorts the week-end activities increase the pollution of the air, and this is the more probable as the diminution on Saturday and Sunday of ultra-violet radiation is mainly in evidence in the summer—the holiday time.

Thus the measurement of ultra-violet light, in addition to the value attached to it by medical men, will probably provide a new and it may be a delicate test for atmospheric pollution.

J. R. ASHWORTH.

Rochdale, July 22.

Atomic Diameters of the Rare Gases.

IN our note on the crystal structure of krypton in NATURE of June 14, p. 889, we gave the ratios of the distance of nearest neighbours in the crystal lattice to the atomic diameter deduced from viscosity measurements for neon, argon, krypton, and xenon, as 1·35, 1·29, 1·22, and 1·23 respectively.

We took the values of the atomic diameters calculated by Herzfeld from measurements by Rankine ("Handbuch der Physik", vol. 22). We owe to Prof. Rankine himself the information that these values must be considered to be too large, as Herzfeld made use of the value of Sutherland's constant given in the Landolt-Börnstein Tables of 1923, which value is too low (cf. Rankine and Smith, *Phil. Mag.*, **42**, 601; 1921). Using the values of the atomic diameters 2·30, 2·87, 3·10, and 3·41 A. calculated by Prof. Rankine, the ratios become 1·39, 1·34, 1·28, and 1·28.

The value for krypton is lower than would be expected; this may perhaps be explained by the fact that its structure was investigated by us at a relatively much lower temperature compared with the Debye characteristic temperature than was the case for the others. Indeed, Natta and Nasini's value of the distance of nearest neighbours at the temperature of liquid nitrogen leads to 1·32 for krypton.

W. H. KEESOM.
H. H. MOOY.

Leyden.

Gamma Rays of Potassium.

Two years ago W. Kolhörster published a short paper [1] on the gamma rays of potassium, which he ascertained partly by measurements in the Stassfurt mines and partly by analysing the radiation of a greater quantity of sylvin supplied by Messrs. C. A. F. Kahlbaum.

In our Institute ionisation measurements have been carried out using a large ionisation chamber of a capacity of 125 litres and about 120 kgm. of chloride of potassium. Kolhörster's results have been confirmed so far that chloride of potassium really emits penetrating radiation, the intensity of which is proportional to the quantity of potassium. The radiation is complex and consists of at least two groups of gamma rays. By absorption of these rays in lead 0·5-4·0 cm. thick an absorption coefficient for the first group of rays has been found of approximately the same order as in the case of the gamma rays of radium, whereas the second group is about twice as penetrating as the gamma rays of radium. On the other hand, the intensity of the gamma rays of potassium is much lower than that which would correspond to its period of $T = 10^{12}$ years, if we assume that every beta ray of potassium is followed by one gamma ray. A detailed description of the work done will be published next autumn.

F. BĚHOUNEK.

State Radiological Institute,
Prague-Podoli,
July 3.

[1] W. Kolhörster, *Die Naturwissenschaften*, **16**, 28; 1928.

Some Scientific Instrument Makers of the 18th Century.*

By Robert S. Whipple.

Although numerous references are found in early British manuscripts to instruments of an elementary kind, chiefly for the determination of time or position, there is little evidence that before the sixteenth century scientific instrument making as a craft had obtained a position of any importance in Great Britain. The demand for instruments to assist navigation became more insistent as new lands were discovered and the length of the voyages increased.

Gradually the professional scientific instrument maker came into existence, two of the more distinguished being Humphrey Cole, the maker of the astrolabe used by Sir Francis Drake, and Elias Allen, the maker of Oughtred's double horizontal dial. In a book by Oughtred dated 1632 describing the double horizontal dial it is stated that it is printed for Elias Allen, "Maker of these and all other Mathematical Instruments and are to be sold at his Shop over against St. Clements Church without Temple-barr".

With the discovery of the telescope in 1608, and its development by Galileo in the following years, a great impetus was given to the instrument-making industry. Although Gregory and Newton propounded the reflecting telescopes known by their names in 1663 and 1666, they were unable to find makers capable of developing their ideas. Newton made his own instruments, but it was not until about 1730 that John Short of Edinburgh succeeded in making a Gregorian telescope.

The latter half of the seventeenth century was a great period of scientific development. Experimental science, under its leaders Boyle, Hooke, Newton, and others, created a demand for scientific instruments which could only be satisfied by skilled craftsmen. The work of Hooke and Leeuwenhoek did much to develop the microscope and to direct attention to the possibilities of the instrument. Fortunately an instrument made about 1670 and somewhat similar in its details to that described and illustrated in Hooke's "Micrographia" (1665) has been preserved. The evidence is, I think, convincing that this instrument was made by Christopher Cocks, the well-known telescope maker, who lived in Long Acre, and of whose telescopes there are at least three in existence. It is known that in March 1672 Cocks was ordered to make a four or five foot Newtonian reflecting telescope, but the instrument was not successful. About 1680 he was admitted a freeman of the Spectacle Makers' Company.

Owing to the publication of the "Micrographia", with its description of Hooke's microscope, great interest was created in microscopical work, and a demand arose for microscopes. Owing to the high quality of the optical and mechanical work the English microscope won a high reputation.

The greatest of the English instrument makers who bridge the seventeenth and eighteenth Centuries is undoubtedly John Marshall. Nothing is known of his early life, but part of a diary recently discovered in the British Museum by Mr. H. W. Robinson, by whose courtesy I am able to publish an extract, has thrown an interesting sidelight upon Marshall's career. The record covers five years of Hooke's life, 1688 to 1693—with the exception of some few months—and was thought to be the diary of James Pettiver, an apothecary friend of Hooke. Mr. Robinson has been able to prove that it was written by Hooke. The following is an extract, December 14, 1688: "One John Marshall who told me he was Dunning apprentice and now worked at turning at the 3 keys in Ivy Lane came to shew me some microscopes of his own making he told me Mr. Boyle had bought such of him". He appears to have set up later at the sign of the Gun as a maker of spectacles and microscopes, and there is little doubt that the microscopes were of the Hooke type. By 1690 he had built up a large business, and had introduced a new method of grinding lenses on brass tools. Marshall's double microscope was undoubtedly the greatest advance made in microscope construction for many years. The instrument was fitted with coarse and fine focusing adjustments, and for the first time the limb which carried the eyepiece, the object glass, and the object, formed one complete system which could be inclined as one unit. All the features are retained in the modern instrument.

The first outstanding English instrument maker in the eighteenth century is undoubtedly Benjamin Martin, a man who, so far as is known, was not apprenticed to the trade. He was born at Worplesdon, Surrey, in 1704, and began life as a ploughboy, later becoming a teacher of the 'three R's' at Guildford. He devoted his spare time to the study of mathematics. A legacy of £500 relieved him from the necessity of teaching, and enabled him to travel and lecture. He appears to have assisted at the lectures given by Dr. J. T. Desaguliers, which were eagerly attended by the fashionable world and were illustrated by experiments. Horne, afterwards president of Magdalen College, Oxford, sarcastically remarked that Ben Martin "who having attended Dr. Desaguliers' fine raree gallantry show for some years in the capacity of a turnspit, has it seems, taken it into his head to set up for a philosopher". This is a hit at Martin's literary efforts, because he proceeded to publish a large number of text-books dealing with a great range of subjects. When it is considered that Martin was a self-educated man, the extent and thoroughness of his knowledge, as shown in his publications, are remarkable. He appears to have lived for some time at Chichester, where he kept a school, and also wrote several elementary text-books and pamphlets describing scientific instruments. There is little doubt that he commenced to make scientific

* From a Friday evening discourse delivered at the Royal Institution on May 23.

instruments in Chichester, not improbably being asked by the readers of his books where it would be possible to obtain the instruments mentioned.

About 1750 Martin moved to London to a house in Fleet Street, three doors below Crane Court, where he became famous as a scientific instrument and spectacle maker at the sign of "Hadley's Quadrant and Visual Glasses". Martin was essentially a teacher, and continued to write after he had made his home in London. The books impress one with the care he takes to make every individual step in an explanation clear, and with the detailed drawings and references with which he explains the construction and use of an instrument. This is strikingly illustrated in his description of the various orreries he constructed. The orrery was almost the latest scientific novelty, and Martin appears to have been much impressed with the educational possibilities of the instrument. In his "Young Gentleman and Lady's Philosophy in a continued survey of the works of Nature and Art"—a book which had a great vogue—he uses planetaria to describe the difference between the Ptolemaic and Copernican systems, and the phenomena of eclipses, etc. He was evidently prepared to supply either form of planetarium to suit his customers' wishes. In one of his tracts published in 1771, "The Description and Use of an Orrery of a new Construction", he gives full details of the capabilities of the instrument, and also "the theory of calculations for the wheel-work of an orrery to the most extreme Degree of Accuracy". The prices of the instruments ranged from £12 12*s.* upwards, depending on the number of bodies demonstrated, and the accuracy of their movements, or as Martin himself states "proportional to the work". That Martin must have continued to lecture until late in life is shown by the fact that the apparatus made is adapted to show "all the Phaenomena [*sic*] of the Transits of Mercury and Venus over the Face of the Sun such as I shewed in Public to Thousands on the late memorable instance of 1769".

In 1740 Martin published a useful text-book on optics, "A New and Compendious System of Optics", and in many other writings took immense trouble to explain optical systems and instruments. His microscopes and especially his cabinets containing two or three instruments of various types were much sought after, and still remain as examples of first-class workmanship and ingenuity. There is little doubt that he invented the drum type of microscope (see Fig. 1) which had a great vogue and is still made in large numbers on the Continent. If the invention of the glass micrometer as applied to a microscope was not actually due to him he was undoubtedly one of the first to employ it. He was also one of the first to apply rack and pinion focusing adjustments to the compound microscope, and to fit inclining movements to the pillar carrying the stage and mirror.

It is a cause of wonder to me how Martin was able to produce such a large number of books. The "Dictionary of National Biography" mentions thirty-one, although some of them are only leaflets. Many of his books passed through several editions, and at least one was translated into French. They undoubtedly helped to popularise science and to create an interest in scientific instruments. Shortly before his death at the age of seventy-seven, he took his son into partnership, and unaware of the state of his affairs was adjudged bankrupt. He thereupon attempted suicide, and the wound hastened his death. His valuable collection of fossils and curiosities was sold by public auction

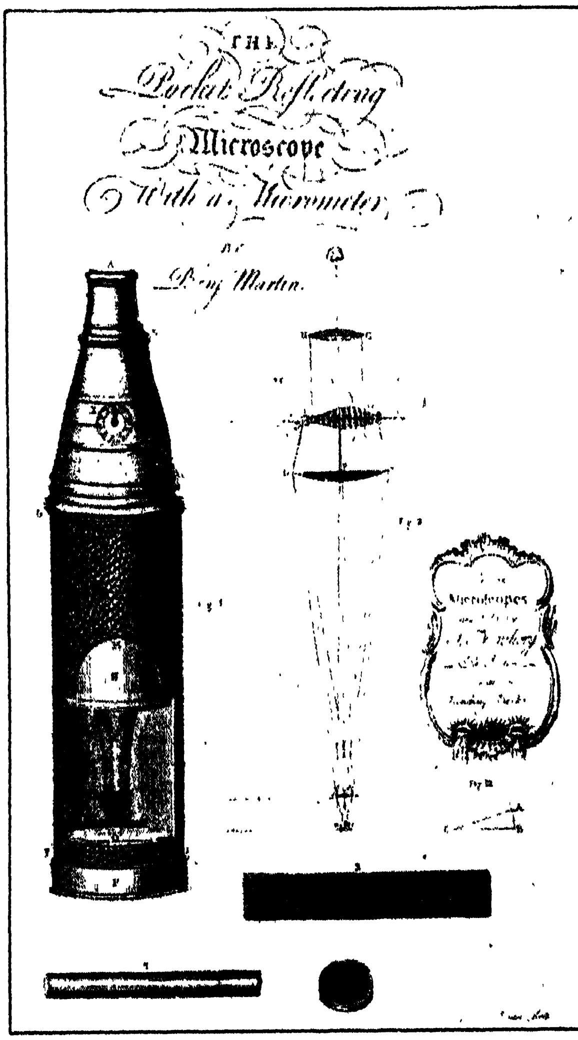


FIG. 1.—Microscope, drum type, by Benjamin Martin.

for a trifling sum—a tragic ending to a more than usually successful career.

George Adams, the elder, perhaps the greatest of English scientific instrument makers, was born about 1704. It is known that he was apprenticed in 1718, and that he was established in business on his own account at Tycho Brahe's Head in Fleet Street in 1735. It is also known that he was making instruments for the East India Company in 1735–36. He obtained a world-wide reputation as a maker of globes. In 1766 he published the first edition of his book "A Treatise describing and explaining the construction and use of new celestial and terrestrial globes". Dr. Samuel Johnson, the lexicographer, wrote the dedication to the King, and for so doing received a present

of "very curious meteorological instruments of a new and ingenuous construction". The book had a great vogue, passing through thirty editions.

Adams was essentially a mechanic and delighted in good workmanship. There can be little doubt, I think, that the microscope was his favourite instrument, and he developed several types of it. In 1746 he published his "Micrographia Illustrata: or The Knowledge of the Microscope explained in several new inventions etc.". The preface to the "Micrographia Illustrata" emphasises the religious side of Adams's character, and also shows that he must have had the artistic and poetic temperament highly developed. The first edition of the book contained an account of a "New Universal Microscope" which was made to an entirely original design, the object being, as Adams states, "to have a Microscope which would be Portable and Universal, that is to say, ONE ONLY INSTRUMENT, by which all Sorts of minute Objects might be observ'd". The microscope was provided with six single lenses of different foci with a common focusing screw. Adams remarked of this focusing screw that it "is to be turned as your hands and arms are resting on the table, which is a conveniency to be met with in no other Microscope". A second edition of the "Micrographia Illustrata" appeared in 1747, and a fourth in 1771. Despite exhaustive researches it has not been possible to find a copy of the third edition—if it were ever published.

The fourth edition commences with a description of the variable microscope of which Adams was evidently very proud. He states that "We owe the construction of the Variable Microscope to the ingenuity and generosity of a noble person", and we know that the "noble person" was the Earl of Bute. By having a compound eye lens and by introducing an auxiliary lens placed some distance above the objective the definition was improved. Adams also introduced the method of screwing two or three objective lenses one on top of the other. By drawing up the eyepiece relative to the object glass the power of the combination could be altered and hence the name "variable". Adams, in common with Martin and other makers of the period, developed the solar microscope with the large mirror projecting out of the window, by means of which brilliant illumination could be obtained, and magnified images of the object projected on to a screen.

(*To be continued.*)

Biometry and Evolution.

WHEN an entirely novel and revolutionary view is put forward by a man of scientific eminence, the critic must endeavour to form a decision between two alternatives, for both of which he must necessarily be, to some extent, unprepared. Either a scientific discovery has been made of such a magnitude as to subvert a whole body of apparently well-founded opinion, or, what is more disturbing still, some incredible error has frustrated in its effect all that we might hope from trained ability, industry, and patient thought. We owe it to science to keep this latter possibility in view, whatever may be the weight of authority which is in the balance.

Under the title of "On a New Theory of Progressive Evolution" (*Annals of Eugenics*, vol. 4, pp. 1-40) Prof. Karl Pearson puts forward a theory which, as he realises, will be difficult to bring home to the biologist. In his own words, "The intensity of heredity is such that with isolation and inbreeding any individual characteristic, or deviation from racial type, will be gradually emphasised and become a factor of progressive evolution. Thus all organisms if isolated are in a constant state of evolution, and it is only interbreeding and the selective action of environment which preserve a type. In other words, natural selection controls evolution, but the progressive urge is provided by heredity itself."

It is obvious that in this statement Prof. Pearson is using the word 'heredity' in a sense somewhat different from its popular and biological meaning. There is, however, little occasion for surprise in this, for those familiar with his writings will know that the term is used to cover all the statistical relationships between the measurements of related individuals. What is asserted is that these relationships require that when a group of individuals, differing, however little, from the mean of their species, is isolated, so that they and their descendants interbreed without further selection, then the mean of this isolated population will continue to depart further and further from the mean of the population from which their ancestors were originally selected. A diagram on p. 10 of the monograph shows this process in detail. The first generation following isolation shows, indeed, some regression towards the mean of the original population and differs from it by only about 70 per cent as much as its parents. In the second generation, however, the mean has progressed to nearly 95 per cent and, thereafter, the successive means actually exceed that of the foundation stock, and increase so rapidly that by the eighth generation the deviation is nearly seven times as great as it was at first.

For the formulæ from which these astonishing results were derived recourse should be had to the mathematical appendix, where, on p. 23, we find that they are the result of applying a certain recurrence formula, based upon a system of formulæ for the correlations between the averages of different groups of ancestors of the same individual; the numerical values come ultimately from three correlations found in human stature, namely, parental correlation 0·50625, fraternal correlation 0·53367, and marital correlation 0·2804.

Prof. Pearson has been content to apply his recurrence formula numerically, but it is capable of algebraic solution. It appears that the deviation

after n generations will be M times the deviation of the foundation stock, if M is given by the formula

$$M = \frac{a}{b} \cdot \frac{(1/b-1)!}{\{(1+a)/b-1\}!} \cdot \frac{\{n-2+(1+a)/b\}!}{(n-1+1/b)!} \cdot 2^{n/2}.$$

The formula involves two numerical constants, a and b, for which Prof. Pearson's values are $a = 0{\cdot}494155$, $b = 0{\cdot}55916$. It will be noticed that the progressive evolution deduced from this method depends upon two factors, of which one, $2^{n/2}$, representing a doubling in every two generations, has perhaps been introduced through an incomplete allowance for the fact that, with bi-parental reproduction, each individual has 2^n ancestors of the nth degree. The remaining factor

$$\frac{\{n-2+(1+a)/b\}!}{(n-1+1/b)!}$$

increases progressively only when a exceeds b. This is not so with Prof. Pearson's values, which, if the factor $2^{n/2}$ were removed, would thus give a progressive decrease, less rapid than, but equally foreign to biological reasoning as, the progressive increase shown by his values. This trouble disappears, however, if a is equal to b, as it may well be, if the relatively small difference between Prof. Pearson's values be ascribed partly to sampling errors in the original data, and partly to a second but slighter inexactitude in the process of reasoning by which the infinite series of ancestral correlations is deduced from the three correlations actually observed.

The thesis thus derived theoretically is supported both by the author's own experiments and by a reinterpretation of the experiments of others. Although Prof. Pearson writes strongly, when genetical concepts come into view, it may be doubted if he would much rely upon these two sources of information, if his theoretical deductions were once shaken. The personal observations cited are indeed somewhat meagre. It appears that an experiment started twenty-five years ago with the crossing of toy Pomeranians and Pekinese has been continued since with much inbreeding; the experimenter has "been a good deal puzzled of recent years by a progressive tendency to lengthen the leg". The experiment was not concerned with leg length. "But this very ungainly length of leg has been continually obtruding itself, although I have paid no regard to it in mating." Unfortunately, no measurements were taken, and the skeletons were not preserved, so that it is largely a matter of taste whether or not we share the author's deduction: "Given isolation and inbreeding, say from a single isolated pair, then if both members of the pair differ by excess or defect from type—and this by however small a quantity—their offspring by continual inbreeding will progress for this character, and therefore for all correlated characters. This is the idea that came to me from the long-leg progress of my dogs."

The reviewer feels a particular regret that the data on this case are not fuller, for about eighteen months ago he happened to write, in connexion with the biometric effects of recent selection, "Equally, when, as in the development of toy breeds of dogs, selection has favoured diminished size, we should expect to find an excess of recessives tending to increase the average dimensions".

R. A. FISHER

Food Preservation.

THE practical value of the numerous researches carried out under the auspices of the Food Investigation Board is clearly shown on perusal of the Report for 1929.* The work on meat deals with the influence of quality and pre-freezing treatment upon the appearance or 'bloom' of the meat after thawing, with proper conditions for transport, with the changes occurring in rigor, and with the bacteriology of frozen carcasses. The investigations on fruit include researches on wastage in store, on the chemical changes during ripening and senescence, and on variations in resistance to fungal invasion. Work has been carried out on pig products, fish, the causation of corrosion in tins, and on engineering problems of refrigeration.

The extension of the Low Temperature Research Station at Cambridge has been completed; the Ditton Laboratory at East Malling, Kent, for research on the storage of fruit is nearly ready for occupation, and the temporary buildings of the Torry (fish) Research Station at Aberdeen are in use. Special stress is laid in the Report on co-operation with industry; a combined research with the trade and members of the New Zealand Department of Scientific and Industrial Research and the Australian Commonwealth Research Council is in progress; an exhibit of frozen carcasses of mutton was held at Smithfield, and a small laboratory is maintained at Covent Garden, acting as a liaison with the trade.

As illustrative of the scope of the scientific work of the Board, certain of the researches on meat, fruit, and pig products may be referred to in more detail.

Moran and Smith report that the unpopularity of imported frozen beef is probably chiefly due to its initial poor quality, since the palatability of prime frozen beef compares very favourably with that of prime home-killed Scotch. Another factor of importance is the pre-freezing treatment, since it is during this interval that the changes associated with rigor mortis occur: in this process the consistency of the muscle substance changes, and it appears that the rate of hardening is controlled by the course of the chemical reactions which lead to the post-mortem production of heat. The formation of lactic acid is not directly associated with the hardening. The importance of the rate of freezing, the temperature reached, and the subsequent rate

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1929. Pp. 146. (London: H.M. Stationery Office, 1930.) 2s. 6d. net.

of thawing in reducing the amount of 'drip' is now well known (see also Cook, Love, Vickery, and Young, *Austral. Jour. Exp. Biol. and Med. Sci.*, vol. 3, pp. 15 and 81; 1926). Vickery has investigated the effects of freezing muscle before and after the onset of rigor, and the freezing of pure sols and emulsions; Moran has examined the rate of freezing in gelatin gels when supercooled. In the latter case, there is a critical concentration at which the rate changes from that approximating the rate in pure water to a rate only one-hundredth as great. The next stage in the treatment to which the meat is subjected is its transport to the consumer; and the temperature of transport is governed by the necessity of ensuring the absence of mould and bacterial growth, the slowing down of changes in the fat leading to rancidity, and a certain degree of rigidity of the carcass, when others are stacked upon it. Suitable conditions raise questions of biological engineering which are also dealt with in the Report.

The appearance or 'bloom' of the meat plays an important part in its value; it depends on the state of the hæmoglobin of the muscle, of the superficial fat, and of the connective tissue. The change in colour on storage is due to the conversion of the pigment to methæmoglobin and to superficial drying of the surface. Brooks has examined the former in some detail (*Biochem. Jour.*, vol. 23, p. 1391; 1929); the conversion depends on the presence of oxygen and therefore occurs only in the superficial regions into which it can penetrate: the rate of conversion, however, is maximal at a pressure of oxygen considerably less than that occurring in air. It is also increased by freezing and thawing. Lea has investigated the chemical changes in the fat during storage; under ordinary conditions they are too slight to account for any loss of bloom observed. He has also examined the accelerating influence of light upon the development of rancidity, and worked out a new test for this change. The fat is heated with glacial acetic acid, chloroform, and potassium iodide in the absence of air, and finally titrated with thiosulphate solution.

Haines has investigated the bacterial contamination of carcasses in cold store and found it to be practically negligible, although the presence of a flora capable of slow growth at low temperatures on wood and straw was detected.

Callow has examined the curing and freezing and storage of cured bacon. For scientific control it is necessary to estimate the chloride content of the meat; for this purpose the minced bacon is thoroughly extracted with boiling water, the extract treated with silver nitrate and nitric acid and boiled, the silver chloride filtered off, and the excess of nitrate estimated by Volhard's method (*Biochem. Jour.*, vol. 23, p. 648; 1929). He has also adapted the Hanes modification of the Hagedorn Jensen method for estimating glucose (*ibid.*, p. 99) to the estimation of sucrose (*ibid.*, vol. 24, p. 57; 1930). In curing, the meat takes up both salt and water, the maximum of water absorbed occurring at a concentration of 4·5 per cent sodium chloride in the meat. Mild cured bacon frozen at −25° C. can be stored successfully at −10° C. for three months.

Brief reference may now be made to some of the investigations carried out on fruit and vegetables. Barker points out that wastage depends on the intervention of a series of factors operating at various stages in the life-history from the orchard to the consumer. Moreover, different fruits, even different varieties of the same fruit, may require different optimum temperatures for storage; it is therefore very important that the temperature control of the store, for example a ship's hold, should be exact. Kidd, Onslow, and West have continued their investigations of the relationship between duration of life, respiratory activity, and nitrogen content in apples; the relation between respiratory activity and nitrogen content is direct but roughly inverse with the duration of life. At the same time, the rate of loss of sugar and acid and the potash content play a part in prolonging or shortening the life of the fruit. Haynes and Archbold have continued their work on the metabolism of apples; improvements in the methods of estimating glucose and fructose have been made; thus the iodometric oxidation is carried out at 1° C., and the rate of oxidation of fructose as well as the time necessary for the complete oxidation of glucose have been carefully worked out.

Storage life can be divided into three periods: in the first the products of hydrolysis of starch are the materials chiefly respired; in the second the products of inversion of sucrose are utilised, but the reducing sugar increases at the same time: in the third, products of sucrose inversion as well as reducing sugar are combusted. The phases of development of the growing apple have also been studied: in the first there is a rapid increase in size accompanied by a slow increase in sugars and the laying down of cell-wall material; the second is a period of maximum synthetic activity associated with starch-formation and nitrogen-intake; in the third, synthetic activity declines, the rate of formation of total solids decreases, starch synthesis and acid synthesis cease, and sucrose accumulates.

Bracewell, Hoyle, and Zilva have investigated the antiscorbutic potency of different varieties of apples by means of tests on guinea-pigs, and have found that 'Bramley's seedling' is markedly more active than all the others, that soil, age of tree, and season have no influence on the activity, and that three months' storage results in only slight loss, cold storage being better than gas storage at a higher temperature (*Biochem. Jour.*, vol. 24, p. 82; 1930).

West has noticed that storage life is favourably influenced by a few weeks of warm, dry weather preceding the date of gathering. Tomkins has found that acetaldehyde vapour is absorbed by healthy fruit and apparently utilised: at the same time, the vapour is fatal to fungal spores on its surface and to fungal mycelium. This fact may find an obvious practical application. Horne has found that the susceptibility of apples to fungal invasion is closely correlated with their nitrogen content, and that the resistance changes with the age of the fruit.

Obituary.

DR. E. B. KNOBEL.

EDWARD BALL KNOBEL, who died on July 25 last, was born in London on Oct. 21, 1841. He was educated at Stockwell Grammar School and at the Royal School of Mines, but did not take a university degree; he was given an honorary D.Sc. at Oxford in 1927. He was engaged in business as a manufacturer throughout the greater part of his life, and his work for astronomy could be done only in his leisure hours.

Dr. Knobel's published work began in 1873 with papers containing observations, illustrated by sketches, of Jupiter and Mars. He also invented a photometer and produced two papers on observations made with it. But his work as an observer was terminated by his removal from Burton to London in 1875. There he found an opportunity for studying astronomical bibliography, which determined the main drift of his studies for the rest of his life. In 1876 he presented to the Royal Astronomical Society a "Chronology of Star Catalogues", dealing with all the star catalogues the existence of which he could trace. With unimportant exceptions he had examined them all with his own eyes. To this collection he added a separate collection of catalogues of proper motions and a table of the names and places of stars contained in Aboul Hhassan's first catalogue. He also included notes on errors in texts of Ulugh Beg and Cusa, which, like those in the text of Aboul Hhassan, he attributed to misreadings of Arabic numerals. In the same year Dr. Knobel published a reference catalogue of books and papers on double stars, variable stars, red stars, nebulæ and clusters, proper motions, stellar parallax, and star spectra.

During the next forty years Dr. Knobel produced numerous papers on points connected with star catalogues, including those of Ulugh Beg, Al Sufi, and Al Achsasi, in which he displayed a growing confidence in his reading of Arabic and Persian manuscripts. He also published in 1905 a collection of the observations contained in the Japanese chronicle, the Nihongi, and edited a Chinese planisphere in 1909 with a valuable commentary. But Dr. Knobel's largest works were his editions of the star catalogues of Ptolemy and Ulugh Beg, published in 1915 and 1917 respectively. In each case the work had been begun by the German-American astronomer Peters, who died in 1890 and whose papers passed into Dr. Knobel's hands. In neither case did Dr. Knobel give a critical Greek or Persian text, but the work is based on a careful collation of the manuscripts in different languages for star places and magnitudes, and each star was identified, so far as identification is possible.

Probably Dr. Knobel contributed even more to astronomy by his long and devoted service to the Royal Astronomical Society than by his publications. Except for the one year, 1922–23, he was a member of its council uninterruptedly from 1876 to his death. He was twice president, 1892–93 and 1900–1; for fifteen years he was treasurer and for ten years secretary, and he will be remembered with gratitude by all British astronomers.

J. K. F.

WE regret to announce the following deaths:

Prof. A. Gullstrand, formerly professor of physiological and physical optics at the University of Uppsala, and Nobel prizeman for medicine in 1911, aged sixty-eight years.

M. Joseph Achilles Le Bel, For.Mem.R.S., formerly president of the French Chemical Society, on Aug. 8, aged eighty-three years.

Prof. J. F. Pompeckj, professor of geology and palæontology in the University of Berlin, on July 8, aged sixty-three years.

Dr. Harvey Washington Wiley, from 1883 to 1912 chief chemist of the U.S. Department of Agriculture, on June 30, aged eighty-five years.

News and Views.

THE lives and labours of those eminent English botanists and naturalist travellers, Sir William and Sir Joseph Hooker, and their connexion with Halesworth, Suffolk, will receive recognition on Aug. 17, through the unveiling of a tablet memorial in St. Mary's Church, Halesworth, a dedicatory duty to be performed by Sir David Prain, a former director of the Royal Botanic Gardens, Kew. The requisite funds for the erection of the tablet were provided by a number of representative scientific institutions, supplemented by contributions from a small band of botanists and others who were contemporary with Sir Joseph Hooker.

SIR WILLIAM HOOKER, born at Norwich on July 6, 1785, was educated there at the grammar school. He died on Aug. 12, 1865, in his eighty-first year, and was buried in the churchyard of St. Anne's, Kew. Here it should be mentioned that his residence at Halesworth comprised the period 1809–1820. The story of the elder Hooker's varied career was mirrored with filial care by his son Joseph in the *Annals of Botany*. Early devoted to ornithology, entomology, and botany, he found a friend in Sir Joseph Banks. On the latter's advice he explored Iceland (1809). From 1820 to 1840 he was Regius professor of botany in the University of Glasgow. A vigorous pedestrian, Hooker, when taking weekly rest at Helensburgh, habitually on Sunday walked to Glasgow—twenty-two miles—to be in time for his eight o'clock Monday morning class. In 1841 he became director of the Botanic Gardens, Kew, remaining in office twenty years. Sir Joseph Hooker, born at Halesworth, on June 30, 1817, graduated at the University of Glasgow in the medical faculty. His scientific achievements, whether as naturalist, traveller in unexplored regions of the world, or as a master of botanical nomenclature, scarcely need recapitulation. His friendships were with men such

as Darwin, Lyell, Huxley, Wallace. He followed his father in the directorship at Kew, became president of the Royal Society, and was an original member of the Order of Merit. Hooker the younger died in 1911, aged ninety-four years.

ON Aug. 19 occurs the centenary of the birth of the distinguished German chemist Julius Lothar Meyer, whose career recalls some of the most famous men of science and some of the greatest scientific achievements of the nineteenth century. The son of a doctor, Lothar Meyer became the pupil of Virchow, Ludwig, Bunsen, Kirchhoff, and Neumann; he succeeded Fittig and was the joint recipient with Mendeléeff of the Davy medal of the Royal Society. Born at Varel in Oldenburg, a province which had already given Mitscherlich to chemistry, Meyer became a student of medicine at Zurich and Würzburg, and it was on the advice of Ludwig that he devoted himself to chemistry. At Heidelberg, where he attended the lectures of Bunsen and Kirchhoff, he counted among his fellow-students Baeyer, Roscoe, Beilstein, and Quincke. Appointed a *Privatdozent* at Breslau in 1859, he undertook the direction of the laboratory of the Physiological Institute and in 1864 published his "Modernen Theorien der Chemie", by which his name was first brought into prominence. Two years were spent as a teacher at the school of forestry at Neustadt, Eberswalde, and in 1868 he was called to Carlsruhe, where for a time his work was interrupted by his care for the wounded of 1870. His final appointment came in 1876, when he was chosen successor to Fittig in the chair of chemistry at Tübingen, and this position he held until his death at Rastede on April 11, 1895. His brother, Oskar Emil Meyer (1834–1909), was the well-known physicist.

THE life of Lothar Meyer was written by his pupil Seubert, while the memorial lecture to the Chemical Society was delivered by Prof. P. P. Bedson in 1896. With great intellectual gifts, Lothar Meyer possessed characteristics which gained for him the esteem and appreciation of his contemporaries. Though his scientific publications embraced a great variety of subjects, his name is best known for the share he had with Newlands in England and Mendeléeff in Russia in the periodic classification of the elements. Speaking of the Periodic Law, Thorpe said: "The first chemist of note to grasp the significance of Mendeléeff's generalisation was Lothar Meyer, who, dealing at the outset with one of the characteristic properties of the elements—viz. their specific or atomic volumes . . . greatly developed the principle of periodicity, representing it graphically in a most striking and suggestive manner, leading up to a classification almost identical with that of Mendeléeff". It was for this work that Lothar Meyer was awarded the Davy medal in 1882. Lecturing three years later, Meyer himself spoke of Mendeléeff's contribution as forming "the coping stone of the building which in the course of years has been erected on the foundation of Döbereiner's Triads, as a work which did not, like Pallas Athene, spring ready armed from the head of a Jove, but has been gradually completed by the slow, painstaking, and often apparently vain endeavours of a whole series of workers".

THE Royal Institution has issued further particulars of the arrangements being made to celebrate the historic discovery by Faraday of electro-magnetic induction, recorded in his diary on Aug. 29, 1831. Jointly with the Institution of Electrical Engineers, the Royal Institution has drawn up a provisional programme for Sept. 21–23 next year. The first day will be devoted to the reception of delegates at the Royal Institution and a Faraday commemorative meeting in the Queen's Hall, the proceedings of which will probably be broadcast by the B.B.C. Following this will come the joint conference of the Institution of Electrical Engineers and allied associations, conversaziones at both the Royal Institution and the Institution of Electrical Engineers, and the opening of a Faraday Exhibition in the Albert Hall. The latter, which will be open to the public for about ten days, will include reproductions and illustrations of Faraday's work, and special exhibits showing the full development of electrical and chemical science and industry which have their origin in his researches. It is further proposed to publish Faraday's diary of his experimental work in full and to issue a souvenir volume. The delegates will also be entertained by the Royal Society. The Faraday celebrations will precede immediately the opening of the centenary meeting of the British Association, which is to take place on the evening of Sept. 23 in the Central Hall, Westminster.

THE purpose of the work of the Rothamsted Experimental Station is, as the director, Sir John Russell, states at the beginning of his recently issued annual report, "to discover the principles underlying the facts of agriculture and to put the knowledge thus gained into a form in which it can be used by teachers, experts and farmers for the upraising of country life and the improvement of the standard of farming". But the results of the work of the large and expert staff engaged in the Rothamsted laboratories and on the experimental plots contain much of scientific interest, especially as regards certain specific problems. The artificial inoculation of lucerne, a process developed in the Bacteriological Department for supplying the nitrogen-fixing organisms, is increasingly used at home and overseas. Study of the relationship of the nodule-organisms to the plant has shown that they do not normally enter the plant until the true leaves begin to form, when the root extrudes a substance, not yet determined, which facilitates their entry. Work on barley indicates the possibility of visualising the relationship between growth and the quality of the grain; and a simple method has been elaborated for estimating the amount of extract obtainable from a given sample of malt, an important aid to the maltster. Experiments with sugar beet emphasise the need of new varieties better suited to English conditions. The roots refuse to respond to schemes of manuring which are successful with mangolds and potatoes, though there is an increase in the leaves.

OF great value to overseas farmers is a process which has been devised at Rothamsted for converting straw and other cellulose-containing plant residues, such as the 'trash' from sugar-cane plantations, into useful manure. The chemistry of the process is being worked out. The organisms mainly concerned in the decomposition of the straw are fungi, including several Aspergilli and Actinomycetes. An important discovery by the Microbiological Department is that of a group of nitrifying organisms producing nitrites from various ammonium salts, but differing from the previously known forms, *Nitrosomonas* and *Nitrosococcus*, in that they thrive in the presence of organic matter. They are found to be commonly distributed in the soil. In the Plant Pathological Department physiological and genetical work on fungi has been continued. The subject is a complex one. Strains apparently identical in structure and cultural reactions differ markedly in pathogenic properties, and conversely, strains different in structure and cultural reactions have similar pathogenic properties. Two or more strains are frequently intermingled in one host-plant. Progress has also been made in the study of virus diseases, those elusive phenomena which can only be studied in their effects on the infected plant. The activities of the staff are indicated by the inclusion of abstracts of the scientific papers, twenty-seven in number, published during the year. The report may be obtained from the Secretary of the Rothamsted Experimental Station, Harpenden, price 2*s*. 6*d*.

ARCHÆOLOGICAL excavations on the projected line of the new by-pass at Colchester have now been in progress under Mr. C. L. Hawkes of the British Museum since the middle of June. It will be remembered that this work was undertaken by the Colchester Excavation Committee to avert the loss of valuable archæological material by the making of the new road. The area of operations has since been extended owing to the purchase of adjacent land by the Essex County Council for playing-fields, which has been placed at the disposal of the Committee until the end of August. The results obtained to date, of which a report appeared in the *Times* of Aug. 4, are of very great interest, especially in their bearing upon the relations of Britain and the Continent in the century before the Roman conquest. They fully support what was previously known of the importance of Colchester as a centre of British culture and prosperity. It would appear that this low-lying site was an overflow area from the British town, at first not too thickly populated. Then after several decades, at about 10 B.C., it was more thickly settled under Cunobelinus. The site was abandoned at about 47–50 B.C. when the Romans built their Colonia near by on virgin ground. In the ten-acre field, nearer the Roman site and farther from the centre of the Celtic town, the remains are more scattered. The abundant pottery and metal work point to a period of great prosperity in British Colchester for a period of fifty to sixty years before the Roman conquest. With much native pottery and many native brooches is a large proportion of imported ware and ornaments, pointing to a considerable volume of pre-Roman trade with Italy, southern and northern Gaul, Belgium, and the Rhine area. The numerous coins include early Roman types, issues of Cunobelinus himself, the Iceni and native issues from Gaul. The conduct of the excavations has now been taken on by Mr. J. N. L. Myres of Oxford.

THE menacing condition of the South Italian volcanoes is fully discussed by Prof. H. Reck in *Matériaux pour l'Étude des Calamités*, No. 1, 1930. The changes in Vesuvius since 1906 as studied by Malladra and Friedlaender are passed in review and the lava-flows of 1926, 1927, 1928, and 1929 are described with maps. The later eruptions are distinguished not only by the higher temperatures of effusion but also by the greater abundance of the gases and the increase in hydrochloric acid. Vesuvius is clearly heading towards another catastrophic outburst like that of 1906. The villages on the southern flank (Terzigno, etc.) are most likely to be in danger from future flows, if, as is anticipated, the southern walls of the cone are fractured by the accumulating stresses. Areas likely to be overwhelmed with ashes and vapours cannot be predicted, as they will depend on the atmospheric conditions at the time. Etna is also in a slow crescendo of activity as indicated by the 1928 eruption and its unusually high temperature. Although there can be no direct connexion between the volcanic hearths of Etna and Vesuvius, there have nevertheless been numerous coincidences between their eruptions which suggest that both may be affected by common tectonic disturbances.

IT is known that for every kilogram of grain consumed in the world to-day there is approximately a kilowatt hour of energy expended. The grain is a necessity, but some think that the world would be happier without this great expenditure of machine labour. The rapidly advancing mechanisation of labour is, it is thought, tending to make work more monotonous and hence leads to a craving after amusement and to the lowering of the mentality of the race. In an address to the World Power Conference at Berlin, an abstract of which is given in the *Electrical Review* for Aug. 8, Dr. A. F. Enstrom combats this view. In his opinion, the operation of machines instead of dulling the faculties sharpens them. A skilled operator is instantly on the alert when the noise made by his machine alters by a minute amount. His powers of observation are always being exercised. The younger generation seems to grasp with ease how to operate motor-cars and how to look after machinery. Schoolboys even have done valuable research work with home-made radio sets. The great advantage of the mechanisation of labour is that it makes possible an eight hours' day. The labourer has to expend much less muscular effort during the course of it. There is no evidence that this lowers his mentality and he has opportunities for improving his knowledge which his predecessors never had.

THE scientific instrument industry of Great Britain has deservedly a high reputation for the quality of its

products, a reputation which the Institute of Physics has done much to foster through the publication of the *Journal of Scientific Instruments*. Appreciation of its services to the industry is shown by the recent decision of the British Optical Instrument Manufacturers Association to offer an annual prize, to be known as the B.O.I.M.A. Prize, for the best paper appearing in the *Journal of Scientific Instruments*. The prize, which is of the value of ten guineas, is offered for a period of five years, the award being entirely in the hands of the Board of the Institute of Physics. The Board has accordingly decided that in awarding the prize, all papers appearing in the *Journal* during the year will be considered and due weight will be given to (1) originality, (2) scientific value, (3) practical utility to instrument makers or users, (4) presentation. The first award will be made in 1931 in respect of a paper published in the *Journal* during 1930. It is also announced that through the generosity of a member of the Board, it has become possible for the Institute to offer a prize of £5 for the best "Laboratory and Workshop Note" which appears during the year. The donor has guaranteed this prize for a period of five years. These notes serve a useful purpose in acting as the medium through which the devices, special methods, etc., evolved in one laboratory or workshop are passed on to other workers. The first award of this prize will also be made in 1931, in respect of a note published in the *Journal* during 1930.

A SERIOUS obstacle in the development of radio telegraphy and telephony was the difficulty in developing high voltage direct current for supplying the amplifiers of transmission plants, as the necessary voltages vary from 9000 to 30,000. An early solution was to adapt motor generator sets coupled in series so as to obtain the requisite voltage. The large demand led to considerable improvements in their design so that sets can now be built which will give pressures of 15,000 volts. The main drawback to this solution was the comparatively long time required to start the reserve set if anything went wrong. The next solution was thermionic rectifiers, which can be put into use at a moment's notice. The disadvantage in this case was the great expense of upkeep, as their life is limited to about 5000 hours. The most recent and perhaps the best solution is to use mercury arc rectifiers. We learn from the *Brown Boveri Review* for July that this solution has been adopted by Marconi's Wireless Telegraph Co., Ltd., in the firm's research laboratories at Chelmsford. The rectifier and rectifier transformer were designed for an output of 400 kilowatts at direct current pressures of 9000, 10,000, and 12,000 volts. The plant was installed a year ago and has given entire satisfaction. It has a high efficiency, can be started at a moment's notice, and withstands short circuits. Water cooling of the rectifier is not necessary as radiation and convection suffice to lead away the thermal losses. The new large broadcasting station which is to be opened shortly at Warsaw will be equipped with two Brown Boveri rectifiers which will give an output of 500 kilowatts at from 10,000 to 15,000 volts.

THE meetings of the International Electrotechnical Commission which were held on June 27–July 9 in all three Scandinavian countries were very successful, twenty-two countries being represented. The opening meeting was held in Copenhagen, the advisory committees carried out their work in Stockholm, and the plenary meeting took place at Oslo. The committee on nomenclature after considerable discussion adopted the following names for the magnetic C.G.S. units. The unit of magnetic flux was called the 'maxwell' and the unit of flux density the 'gauss'. The unit of magnetic field intensity was called the 'oersted' and of magnetomotive force the 'gilbert'. It will be some time, however, before these names are adopted in text-books in Great Britain. Following the Italian suggestion, a unit 10^8 times as large as the maxwell has been adopted for practical engineering use. It is proposed to call it the 'pro-maxwell'. The committee on the rating of machinery had a long discussion as to the maximum permissible temperature at which machinery and apparatus should work. Engineers consider that a few degrees centigrade in the permissible temperature is of great practical importance. A unanimous decision was ultimately reached. The symbols committee reached agreement on the symbols to be used in telephony, telegraphy, radio communication, and electric traction. It was thought a pity that the standardised symbols are not more widely used by the Press and in industry. The aluminium committee had difficulty in reconciling European and American practice, but some progress was made in this direction. A proposal to standardise 132 kilovolts, which is the British grid pressure, was rejected.

A RECENT *Daily Science News Bulletin* issued by Science Service, Washington, D.C., gives some details about the progress of the plans which are being developed by Dr. Robert Goddard, professor of physics at Clark University, Worcester, Mass., for exploring the atmosphere at high levels by means of rockets. A liquid propellant has been perfected which is said to have many advantages over gunpowder or similar explosives. The rocket continually becomes lighter as it ascends owing to the burning of the propellant. The rockets will be sent upwards from a steel tower at Camp Devens, near Worcester, Mass. As yet only small rockets have been fired, which have ascended to levels of but a few hundred feet. A grant has recently been made by Mr. Daniel Guggenheim for the extension of the experiments, and an influential advisory committee has been appointed in connexion therewith. When it becomes possible to send rockets up to altitudes measured in tens of kilometres instead of hundreds of feet, carefully devised instruments will be added to the rocket with a parachute to bring them safely to earth when the charge is exhausted.

TRIALS of new and improved combine harvester-thresher machines have been arranged by the Ministry of Agriculture at Wellingore, Kesteven, Lincs., through the courtesy of Mr. Geoffrey Nevile. Farmers desirous of seeing these machines in operation may either send the cost of a telegram, or telephone to the

Estate Office, Wellingore (14X5 Fulbeck, Grantham), and they will be informed so far as possible of the exact day or days when harvesting is being carried out. At first it was thought that such machines would be unsuitable in England, since the grain in this country is much more moist at harvest time than is the case in Canada or the United States, where the combine method is widely used. However, judging from last year's experience in the trials carried out by the Oxford Institute of Agricultural Engineering, it seems probable that, although in some seasons a drying plant might be necessary, threshing may be safely carried out after the grain has stood for a day or two in summer heat. This view is supported by experience abroad, and the combined machine is becoming increasingly used in countries with cooler and wetter climates. Given favourable conditions for hire or purchase, the farmer would gain considerably by their general introduction into Great Britain, as not only would the total cost of harvesting and threshing be reduced, but also loss from vermin or mould in the stack be avoided.

THE Balkans correspondent of the *Times* gives an interesting account—in the issue of Aug. 4—of the health reform measures carried out in Yugoslavia during the last ten years. The person to whom most credit is due is Dr. Andriya Shtampar, who was appointed head of the Department of Hygiene in the Ministry of Health in 1919. The sanitary condition of the country was then deplorable, not only as the result of the War but also as the consequence of centuries of neglect, as was shown by the fact that 80-90 per cent of the population were infected with malaria and syphilis, while enteric fever, typhus, and smallpox were extremely rife. Dr. Shtampar's first step was to provide himself with competent assistants, who had to be trained abroad, and then to persuade the government to supply the necessary funds for his reforms. Since 1923, when he was first really able to start work, he has organised three main categories of institutions: (1) central institutes for each of the nine provinces, (2) 80 district health institutes, and (3) about 500 village stations. The central institutes comprise departments of bacteriology and parasitology, social medicine, and sanitary engineering. The district institutes contain departments for mother and child welfare, dispensaries for venereal diseases and tuberculosis, bacteriological laboratories and bath houses. The village institutes consist of a dispensary in charge of a nursing sister, a small health exhibition, and a shower bath. A school of hygiene is attached to the Zagreb Central Institute for the training not only of doctors and nurses but also for instructing the more intelligent peasants in the general principles of hygiene. Dr. Shtampar's work has received liberal aid from the Rockefeller Foundation as well as the strong support of King Alexander. The reduction in epidemic disease as the result of these measures has been most gratifying. During the last two years, there have not been more than a hundred cases of typhus in the country, there has been no smallpox for more than a year, and the incidence of malaria has fallen from 80 to 10 per cent, while there is a good prospect of a healthy generation growing up in formerly disease-ridden areas.

THE following appointments have been made by the Secretary of State for the Colonies: Dr. G. Bryce to be deputy assistant director of agriculture, Nigeria; Mr. B. G. Montserin to be agricultural officer, Trinidad.

THE Royal Microscopical Society, after residing in Hanover Square, London, for some forty years, has removed to new apartments in B.M.A. House, Tavistock Square, Bloomsbury, W.C.1, in which its library and slide collections will be more adequately housed, and where, in addition to the Society's lecture halls, meeting rooms, and offices, a portion of its unique collection of historical instruments will be on permanent exhibition.

AT the Brisbane meeting of the Australasian Association for the Advancement of Science which took place on May 28–June 4, it was decided by the General Council to change the name of the Association to "The Australian and New Zealand Association for the Advancement of Science". The Mueller Memorial Medal for 1930 was awarded to Sir Douglas Mawson for his contributions to Australian geology, associated with which are his achievements in geography and exploration. The first Liversidge Research Lecture under the bequest from the late Prof. A. Liversidge was delivered by Prof. N. T. M. Wilsmore, of the University of Western Australia, the title of the lecture being "Chemical Research and the State".

DR. HAROLD THOMPSON, senior naturalist on the staff of the Fishery Board of Scotland, has sailed for Newfoundland, where he will undertake on behalf of the Government of Newfoundland and of the Empire Marketing Board a survey of the fisheries. This is the first step in the formulation of a scheme having as its object the development on scientific lines of Newfoundland fisheries. The work in contemplation will embrace a systematic and statistical review of the fishery resources with the view of developing methods for the preservation, handling, and marketing of the fish (including brine freezing), and for the utilisation and marketing of surplus fish and fish by-products. The cost of the preliminary survey is being shared equally between the Government of Newfoundland and the Empire Marketing Board.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time teacher for mining courses under the West Riding Education Committee—The Education Officer, County Hall, Wakefield (Aug. 18). A cotton entomologist and an assistant pathologist in the Department of Agriculture and Stock, Brisbane—The Official Secretary, Queensland Government Offices, 409 Strand, W.C.2 (Aug. 20). A lecturer in civil engineering in the University of Birmingham—The Secretary, The University, Birmingham (Aug. 21). A temporary research assistant in civil engineering in the University of Birmingham—The Secretary, The University,

Birmingham (Aug. 21). Principal teachers of, respectively, mechanical engineering, mathematics and physics, and chemistry; also a qualified mechanic for taking care of the plant, and a laboratory steward to take charge of the laboratories at the Technical College, Coatbridge—The Director of Education, Lanarkshire House, 191 Ingram Street, Glasgow, C.1 (Aug. 22). A junior assistant in the department of the War Department Chemist—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18 (Aug. 23). A lecturer and demonstrator in the pharmacy department of the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (Aug. 25). A cacao soil research chemist at the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, E.C.3 (Aug. 30). A lecturer in mechanical engineering at the Norwich Technical College—The Principal, Technical College, Norwich (Sept. 3). An assistant in the Cancer Research Laboratories of the University of Manchester—The Registrar, The University, Manchester (Sept. 7). A demonstrator in chemical pathology in the University of Manchester—The Registrar, The University, Manchester (Sept. 13). A medical man or woman research worker in mental deficiency under the Medical Research Council, the governing body of the Darwin Trust, and the Committee of the Royal Eastern Counties Institution for the Mentally Defective at Colchester—The Medical Superintendent, Royal Institution, Colchester (Oct. 3). A chemical laboratory assistant in the experimental department of the Fine Cotton Spinners' and Doublers' Association, Ltd.—Prof. F. P. Slater, Rock Bank, Bollington, Macclesfield. Assistant masters for engineering subjects and for chemistry at the Smethwick Junior Technical School—The Director of Education, Education Offices, High Street, Smethwick. An assistant under the Directorate of Ballistic Research, Research Department, Woolwich, with several years' research experience in physics—The Chief Superintendent, Research Department, Woolwich, S.E.18. A temporary research assistant in a Government Department, with, preferably, a knowledge of rubber technique and mechanical methods—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. A temporary laboratory assistant in a Government Department, with, if possible, a general knowledge of chemistry and physics and of rubber manufacture—The Commandant, Experimental Station, Porton, near Salisbury.

Our Astronomical Column.

New Variable Stars in the Constellation Norma.—Arrangements have been made for the interchange of observers between the observatories of Johannesburg and Leyden. Mr. H. van Gent has taken a number of plates with the Franklin-Adams telescope at Johannesburg which were measured at Leyden by W. E. Kruytbosch (*Bull. Astr. Instit. Netherlands*, vol. 5, No. 194). The blink-microscope revealed 25 variables upon them, and afforded sufficient material for plotting the light-curves, which are given in the *Bulletin* together with diagrams of the fields. The second star on the list is an eclipsing variable of the W. Urs. Maj. type. Prof. Hertzsprung suggests, from the long stationary minimum, that either the companion is a white dwarf or that the system contains a third star from which most of the light comes during minimum. There are also some Cepheid variables: *p* on the list has a period of 2·4 days and a large light-range.

Images of Pluto on Yerkes Observatory Plates.—*Astr. Nach.* 5719 contains particulars of the measures of the image of Pluto detected by Dr. F. E. Ross on plates exposed on Jan. 29, 1921 (two plates) and Jan. 6, 1927. The positions are for the equinox of 1930·0. The magnitude of Pluto was estimated as 15 on each date.

U.T.	R.A.	N. Decl.	Aperture. (Inches.)	Focal Length. (Inches.)	Exposure. (Minutes.)
1921.					
Jan. 29·0806	$6^h\ 31^m\ 22{\cdot}04^s$	$19°\ 43'\ 13{\cdot}7''$	10	50	192
	22·01	13·6			
	22·28	14·1	6	30	192
1927.					
Jan. 6·2500	7 4 3·17	21 13 3·1	3	21	120

The estimated probable error is 1″ for the focal lengths 30 in. and 21 in., somewhat less for the 50-in. focus. The first 50-in. measure and the 30-in. measure were made by Prof. van Biesbroeck using three comparison stars in the Paris Astrographic Catalogue. The other measures were made by Dr. F. E. Ross using the star Berlin *A* 2257 for the 1921 plate, and three Paris Astrographic stars for the 1927 plate. No proper motions were applied. The 1927 position is in good accord with the revised measures of the image obtained at Uccle on Jan. 27, 1927. It is stated that the 1921 images were identified with the aid of the ephemeris of Prof. T. Banachiewicz (*U. A. I. Circular* 284), and the 1927 one with the aid of a manuscript ephemeris by Messrs. Bower and Whipple.

Astr. Nach. 5719 also contains a useful collection of the observations of Pluto obtained in March and April last: they are compared by Dr. C. H. Smiley with an ephemeris which he deduced from the following heliocentric positions and velocities derived by Prof. Banachiewicz for the date March 31·0 and the equinox of 1930·0.

		Daily Change.
$x=$	$-13{\cdot}29363$	$-0{\cdot}0020443$
$y=$	$+35{\cdot}84738$	$-0{\cdot}0017048$
$z=$	$+15{\cdot}41587$	$+0{\cdot}0000824$

The Photo-electric Cell at Berlin-Babelsberg.—*Astr. Nach.* 5713 contains a study by P. Guthnick and R. Prager of early-type stars, the duplicity of which had been detected at the Victoria Observatory by spectroscopic observations by Dr. Plaskett and Dr. Pearce. In five cases light-variation was detected, indicating mutual eclipses. *H.D.* 19820 has minimum masses of 19 and 9 times that of the sun. It is of type *O*8, but its colour is yellow: the other stars on the list are also yellow. *H.D.* 25638 has a period of 1·1487 days from the Berlin observations. Plaskett found a velocity range of 293 km./sec., but did not determine the period. *H.D.* 25639 is also an eclipsing binary, only 18″ from the preceding star, with which it forms the pair Σ485, but the light range is only 0·05 mag. The period is not yet determined.

Research Items.

Smoking in Papua.—Dr. A. C. Haddon, who is investigating tobacco smoking in Papua, communicates to *Man* for August an account by Capt. G. F. N. Zimmer of a method of smoking tobacco hitherto unrecorded, which is in use among bush natives on and to the west of the Fly River in an area including Shortland River and Lake Murray. The tobacco or a native cigarette is inserted in one end of a tube or cigarette holder—a narrow bamboo tube about nine inches long — and this end they place against a glowing log or fire-brand. When the tobacco is thoroughly alight, the end containing the tobacco is placed in the mouth and the other end inserted in the wider end of an arm guard or bracer which has been removed from the smoker's left arm, this end of the bracer being closed by the right hand, the tube going between the smoker's fingers. The narrower end is closed by the smoker's left hand. The bracer, *posiki*, is made of nine slats of wood, about 25 cm. long and tapering from 31 mm. to 25 mm. in width. The slats of wood are firmly lashed on both sides with rattan so as to make a very rigid object. The smoke is blown into the bracer through the tube. The tube is then removed and the smoke inhaled by slightly moving the left hand. This method of smoking is usually employed while hunting or when away from the village. It is in no way a freak, but has been observed on many occasions as a regular method in these circumstances.

Agricultural Rites in Northern Nigeria.—Mr. C. K. Meek describes in *Africa* for July (vol. 3, No. 3) the ceremonies observed by the Bachama of the Benue River in the cult of Nzeanzo, who is enshrined at Fare, a Bala village some seven miles east of Numan. Nzeanzo is believed to be the youngest of five sons of a woman named Venin, who herself receives divine honours in an annual mourning ceremony observed in April. The cult of Nzeanzo is the most honoured among the Bachama. It is in the hands of a kindred at Fare of which the head is called Kisami. He is assisted by a relative, who acts as spokesman on all occasions, and a man of another kindred who prepares the beer and food used in the rites. A woman known as Mbamto acts as intermediary between the god and the people. She is a perpetual virgin who has come from the district of Kona and is regarded as the bride of the god. She is not psychic and if she develops hysterical symptoms she is sent away. The principal festival of the cult is held at the end of April and lasts three days. The king, though not a priest, is regarded as president of all cults and is held responsible for the due performance of all rites. If he should fail in providing gifts at stated periods, any misfortune to the people would be regarded as due to his default. The Fare festival is primarily concerned with the opening of the agricultural year and precedes the sowing of the crops. It is even more important than the thanksgiving rites. Formerly one of the king's children was sacrificed annually during the fertility rites of 'Pilla' carried out at Lamurde. In comparatively recent times, the human victim was replaced by a cow. At Nafaran no one may sow his crops until the priest of the Nafaran cult has carried out certain rites and distributed the seed which he has had under his keeping, and is therefore believed to have magical qualities. Among the Jukun, Kona, and Mbum the seed-corn is distributed by the chief, and is the produce of the royal farm. This was apparently the custom of the old Bachama kings, and to this day the produce of the royal farm is considered the property of the community.

Fauna of South Africa.—Report No. 7, for the year ending June 1929, of the Fisheries and Marine Biological Survey, Union of South Africa, contains, besides general matter relating to the fisheries, several papers in the "Special Reports", amongst which are two of special value. These are Dr. C. H. O'Donoghue's "Opisthobranchiate Mollusca" and Mr. M. Burton's "Description of South African Sponges" collected by the South African Marine Biological Survey. The first is a long, systematic paper on various forms chiefly belonging to the tectibranchs (sixteen species) together with a few nudibranchs (five species). Amongst these are five new species of tectibranchs and three new species of nudibranchs. The examination of such a collection is a thankless task, for all the specimens are preserved and have lost their original beauty, which in life may be marked, and the absence of coloration in most cases makes diagnosis difficult. Nevertheless, Dr. O'Donoghue has managed to extract a large amount of information out of the collection, the radulæ, shells (when present), and jaws serving as valuable distinctive features, and these are fully figured in eight plates. *Euselenops lunicipes* (Cuvier) is specially carefully and minutely described, with details of its anatomy, although only one specimen was present. This is identical with *Neda luniceps* described by Adams and Reeve in 1848. Mr. Burton in his critical survey of the desma-forming sponges abandons for ever the family Lithistidæ, the heterogeneous collection of forms which have hitherto been placed together on account of the similarity of their skeletons being provisionally referred to several different families. Six species are recorded from South Africa, including one which is new. *Lithochela conica*, a new genus and species belonging to the Myxillæ, is also described.

Atlantic Foraminifera. — Dr. Joseph Augustine Cushman continues his valuable series of memoirs on "The Foraminifera of the Atlantic Ocean", the present part (7) consisting of the Nonionidæ, Camerinidæ, Peneroplidæ and Alveolinellidæ (Smithsonian Institution, United States National Museum, *Bulletin* 104, 1930). As in former parts, the species are specially described which have occurred in the waters adjacent to the shores of the United States, including the whole of the Gulf of Mexico and the Caribbean Sea, which is the area chiefly worked by the vessels of the United States engaged in dredging. These families are all represented by simpler and usually smaller forms than in the Indo-Pacific, where some of the species reach to a very large size. The Nonionidæ are most abundant in rather shallow water; three genera occur and numerous species. *Elphidium* is common, also *Nonion* and *Nonionella* in rather deeper water. The Camerinidæ are almost wanting in the Atlantic, the Peneroplidæ and Alveolinellidæ being represented by simpler and more primitive species than in the Pacific. The new species *Peneroplis bradyi* is common in the West Indian region, occurring at numerous stations off the Tortugas and the Florida Keys, at Bermuda and Jamaica, probably replacing *Paneroplis planatus*, which apparently does not occur in the western Atlantic.

Osteology of Pediculate Fishes.—Mr. Albert Eide Parr, in his paper entitled "On the Osteology and Classification of the Pediculate Fishes of the genera Aceratias, Rhynchoceratias, Haplophryne, Laevoceratias, Allector, and Lipactis" (Occasional Papers of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University, No. 3,

1930), discusses the homology of the rostral bone of Rhynchoceratias and describes the new species *Rhynchoceratias longipinnis* with special reference to its osteology. He finds that the median, unpaired rostral bone of this genus which forms the anterior part of the upper border of the mouth, supplying through its denticles or spines the only functional dentition of the upper jaw apparatus, has nothing to do with the mesethmoidal bones of these fishes, but is homologous with the illicium of other ceratoids, representing an extreme phylogenetic modification of the most anterior dorsal fin ray (spine) of ordinary teleosts. The relationships of the other genera are discussed and the family Aceratiidæ divided into two sub-families, the Eurostrinæ, to which *Aceratias* and *Rhynchoceratias* belong, having the dorsal denticles inserted on a well developed rostral bone, and the Cryptorestrinæ, including *Haplophryne* and *Lævoceratias*, in which the rostral bone is reduced or absent.

Iron in Humus.—Some explanation of the beneficial influence of humus substances on the growth of green plants in water culture has been brought forward by C. Olsen (*Comptes-Rendus du Laboratoire Carlsberg*, vol. 18, 1930). The solution of the much-debated question as to whether or not humus is beneficial to plants grown under these conditions centres round the form in which the iron is presented, and the reaction of the nutrient solution. *Lemna* plants grow equally well in a culture solution of pH 6·0, whether humus was added or not, provided the iron was given in the form of ferric citrate, but if ferric chloride was substituted for the citrate the addition of humus greatly improved growth. The explanation given is that under neutral or alkaline conditions iron is not available to the plant unless it is in the form of an organic compound such as citrate. The watery extracts of peat contain such complex organic iron combinations, and are therefore useful to the plant for the available iron they provide. In support of this theory attention is directed to the fact that chlorosis is often noticeable in Nature among plants growing on calcareous soil poor in humus, whereas on soils of similar pH but containing humus, the symptoms of iron deficiency do not appear.

Geophysics in the United States.—The United States National Research Council has issued (June 1930) the *Transactions* of the American Geophysical Union for both the tenth and eleventh annual meetings (April 1929 and May 1930) in one volume (pp. 314, no price stated). The reports of previous annual meetings (up to that for 1928) appeared about a year after the date of the meetings. The remarkable promptitude of publication of the report of this year's meeting is due largely to the adoption of photo-lithographic reproduction from typescript for the whole of the material. The result is not quite so readable or pleasing to the eye as printed matter, but the advantage of early publication seems to outweigh this drawback, in view of the necessarily mainly ephemeral interest of the reports and papers, which deal largely with matter published more fully elsewhere. The Union meets as a whole and in seven sections; the reports and papers numbered 54 (at the 1930 meeting) and cover a wide range of important and interesting topics in geophysics.

Magnetic Data from Mauritius.—Miscellaneous Publications of the Royal Alfred Observatory, No. 8, is devoted to a summary and discussion by the director, Mr. R. A. Watson, of "The Disturbed and Quiet Day Variations of Magnetic Force at Mauritius, 1916–26". The inclusion of quiet and disturbed day inequalities in the monthly bulletin of the observatory is not possible, and their collection and discussion for an 11-year period in this publication is therefore of special value and interest. The outstanding feature of the results is the manner in which disturbance is almost entirely confined to H (horizontal force). In D (declination) and V (vertical force) the inequalities are almost unmodified by disturbance, whereas in H both the type and the range of the inequality are entirely different on the two sets of days, quiet and disturbed. Even on international quiet days H usually shows some small disturbance, and though world-wide disturbances are in general considerably less intense at Mauritius than in latitudes 50° or more, small disturbances (in H) are more frequent at Mauritius, so much so that it is usually difficult to select one day in any given month as a typically undisturbed day.

Turner Valley Oilfield, Alberta.—Western Canadian oil possibilities have certainly derived stimulus from the developments on the Turner Valley oilfield, Alberta, of which Mr. E. H. Cunningham Craig gave some account to the Institution of Petroleum Technologists recently. In fact, it is not too much to state that if American interests in the oil potentialities of the Rocky Mountain region have flagged somewhat from the non-discovery of a second Salt Creek Oilfield, they have certainly been reanimated by the results of the last six years' work at Turner Valley, where geological conditions are closely allied to those in the relevant Rocky Mountain States. The Turner Valley anticline was first proved a producing structure by the drilling of the Royalite No. 4 oil-well some five years ago, and since then other producing wells have been completed. Significant interest attaches to this well, as it produced filtered oil and wet gas in considerable quantity; its present output is more than 500 barrels of light gasoline per day. It may be recalled that Alberta has in the past been specially noted for its enormous reserves of natural gas, chiefly of a dry character, with comparatively little oil; so that the Turner Valley developments are of more than usual importance. Some fifteen miles of the structure have been proved and other areas outside Turner Valley have been and are being prospected. The source of this oil and gas has revived the old controversy of upward or downward migrated oil. On one hand there is the possibility of derivation from Palæozoic (Devonian) horizons, and, on the other, from the Jurassic or lower Cretaceous. The author favours the latter source and inclines to the view that the parent oil rocks are of Kootenai age (base of Lower Cretaceous) with subsidiary possibilities in the overlying Dakota Sandstone. He dismisses the possibility of Palæozoic origin on the chief count of probable escape and loss of oil during the lengthy geological period intervening between the critical formations, during which considerable orogenic movement and accompanying erosion were accomplished. On the other hand, there is no doubt that the chief reservoir rock is a dolomitic limestone of pre-Jurassic age; so that, if the "stratigraphically downward migration" theory is proved, which we cannot easily admit on the basis of the facts so far presented, a most important principle, applicable to many other limestone fields in the world, is thus established.

Ionised Regions of the Upper Atmosphere.—Some fresh investigations of the upper air by wireless methods, which differ chiefly from earlier ones in the use of short waves and in the multiplication of the number of receiving stations, are described by Prof. E. V. Appleton, J. A. Ratcliffe, and A. L. Green in two papers in the July issue of the *Proceedings of the Royal Society*. These now show conclusively that

even relatively long waves (400 metres) occasionally pass through the lower ionised layer (the E region) at night when it is at a height of approximately 100 kilometres, and are then returned from the F region, which has a greater concentration of electrons, and is approximately two to three times as high. With shorter waves (100 metres) the penetration of the E layer occurs frequently, the waves being returned from it usually only in the middle of the day, when it is still at a height of approximately 100 kilometres. The equivalent height of the E layer for 400 metre waves varies very little with the angle at which they are incident upon it, and there is likewise little variation in the reflection coefficient, to explain which it is suggested that there is a zone below the E layer which causes considerable attenuation of the waves, without, however, deviating them. The receiving station at King's College, London, at which many of the interference records have been obtained, is distant only 18 kilometres from the transmitting station at Teddington.

Collisions Between α-Particles and Helium Atoms.—The solution of the problem of collision between two particles which act upon each other with forces varying as the inverse square of the distance between them is the same in quantum mechanics and in classical mechanics, unless the particles are identical. In this case an important additional term appears in the quantum theory expression for the probability of scattering, and it is possible to decide between the old and the new theory by experiment. A test of this nature, in which the number of particles projected through 45° by slow α-particles passing through helium is measured, is described by Dr. J. Chadwick in the *Proceedings of the Royal Society* for July. An annular type of scattering apparatus was used, with a strong polonium source, and a zinc sulphide detecting screen. The number of particles deviated was definitely greater than would be expected on classical theory, and for the slowest particles used, of range about 1·2 cm. in air under standard conditions, was close to the number predicted by quantum theory. A fundamental theoretical assumption which is verified by this result is that the helium nucleus has no spin or vector quantity associated with it, and that its field of force is spherical.

Measurement of Candle Power of Electric Lamps.—The measurement of the candle power of lamps is one of the most difficult problems that physicists have to solve. The probable error of the routine tests of comparing the candle powers of incandescent lamps by visual methods in the factory are of the order of at least 2 per cent high or low. This is due not to carelessness but to the real difficulty which every observer has in judging when two surfaces have the same brightness or when two shadows have the same intensity. This is apart altogether from the difficulties arising in determining the mean intensity of the light emitted and from those arising from differences of colour. In a paper communicated to the May number of the *Journal of the Institution of Electrical Engineers*, Mr. Winch, of the G. E. C. Research Laboratories at Wembley, describes a photo-electric photometer for the commercial measurement of incandescent electric lamps. It seems to us that this instrument will go an appreciable way in meeting the commercial demand for higher accuracy combined with very rapid measurement. Whilst the eye must, of necessity, be the ultimate source of reference, there seems reason to believe that in the near future commercial photometry will, in general, be carried out photo-electrically. As an experiment, lamps were measured in the ordinary photometric way and the work done was equivalent to having five observers working for four days, without taking into account the time taken in making calculations. The same series of tests when carried out photo-electrically by one observer took four hours. The method is capable of being developed so as to obtain higher accuracy and also so as to obtain spherical integration with one reading.

Turbo-Vapour-Compressors for Refrigeration.—Among the Selected Engineering Papers chosen to be published in pamphlet form by the Institution of Civil Engineers is one by Dr. H. Mawson on "Turbo-Vapour-Compressors and their Application to Refrigeration". While reciprocatory compressors have been developed for refrigeration, turbo-compressors have not received serious consideration, and in the paper an attempt is made to consider the thermodynamic and practical possibilities of this type. Fundamental equations which are applicable to liquids, gases, and vapours are applied to the flow of fluids through a centrifugal compressor; the choice of a fluid for centrifugal compression between definite temperature limits is considered and the performance of a sulphur dioxide turbo-compressor for a given temperature range is examined by the aid of the p/I chart. Outlines of the design of a sulphur dioxide centrifugal compressor of definite duty for the same temperature range are given, together with a general arrangement of the compressor, and, finally, centrifugal and reciprocating compressors are contrasted, and the possible application of the former to central-station distribution of fluids under pressure for refrigeration is also considered.

Metal Carbonyls.—The *Journal of the Society of Chemical Industry* for June 13, 20, and 27 contains a most interesting article by Dr. Robert Mond on the metal carbonyls. The early experimental work which led to the discovery of the first known member of the group, nickel carbonyl, in 1890 by Ludwig Mond and C. Langer, and the subsequent investigations (in which Dr. Robert Mond played an active part) leading to the discovery of the other metal carbonyls, are described. The properties of the carbonyls and their actual and possible technical uses are next considered, and a full bibliography of the literature is given. The Mond Nickel process, which is a very important technical application of the properties of nickel carbonyl, is dealt with at some length. These three papers constitute an important and authoritative addition to chemical literature.

Sorption of Gases by Charcoal.—The June number of the *Journal of the American Chemical Society* contains a paper by McBain and Britton on the sorption of gases and vapours by charcoal under great pressure (up to 60 atm.) The experiments were completed in 1927 at the University of Bristol. The gases used were nitrogen, nitrous oxide, and ethylene, and the temperatures used were above and below the critical temperatures. It is claimed that the results enable a decision to be reached between rival views as to the nature of sorption by charcoal, that the Langmuir conception that only such molecules are sorbed as are in direct contact with the molecules holding them is correct, and that the Saussure-Polanyi conception of a compressed film is not supported by the experiments. In this connexion, however, it should be mentioned that the same issue of the journal contains a paper on the adsorption of water and benzene vapours on manganese dioxide, by Foote and Dixon, in which it is stated that Polanyi's theory is in agreement with the data, so that the question cannot be regarded as settled.

Geology in Great Britain.

THE welcome innovation introduced last year of issuing the "Summary of Progress" of the Geological Survey in two parts is continued, one part being devoted to an account of the routine work of the year, while the other serves as a medium for the publication of a series of papers on subjects of special interest. Students are thus enabled to purchase at a reduced price the second part of the "Summary" without having to pay for the section dealing with administrative matters. Part I.[1] contains the annual report of the Geological Survey Board and of the Director. Seventy-five maps were published during 1928, together with fourteen memoirs, most of which have already been noticed in our columns (NATURE, Aug. 10, 1929). The reports of the district geologists contain many records of interest. Fieldwork was largely concentrated on the revision of the coalfields, but in Shropshire the Longmynd has been invaded afresh and a provisional classification of some of its puzzling formations is offered, while in the Lake District the relations of the Skiddaw slates, the Borrowdale volcanic series and the Carrock Fell complex are being actively attacked. The new survey of the Orkneys has yielded a fine suite of fossil fishes and plants from the Old Red Sandstone. On the petrological side, it is announced that the Tertiary igneous rocks of Ardnamurchan exemplify in a most striking way the phenomena of ring-dyke intrusion and present many important facts bearing on magmatic differentiation. Hybridisation is thought to be responsible for the reproduction of the tonalitic and monzonitic types of the central complex. Publication of full details is promised in the near future. An interesting account is given of the successful experiences of the geophysical party.

The work of the geophysical party is described at greater length in Part 2.[2] The first two papers are by W. F. P. M'Lintock and J. Phemister, and deal respectively with gravitational surveys over the buried channel of the Kelvin at Dumtry, near Glasgow, and over the Pentland fault near Portobello. The results clearly demonstrate that the method may be usefully employed to supplement boring evidence. and that in practice it is both cheaper and quicker than drilling. Sir John Flett contributes a masterly investigation of a lamprophyre dyke on the west side of Loch Lomond. The dyke is of unusual significance because of the variety of its inclusions. In so far as these provide an indication of the nature of the underlying rocks, they suggest that the sequence of formations from the Highland border northwards is a descending one; as this is not the sequence usually adopted, the suggestion may have very far-reaching consequences. T. H. Whitehead describes a presumably Arenig rhyolite occurring near Pontesford Hill in Shropshire between Ordovician and Longmyndian rocks. The remaining papers are devoted to the Coal Measures or their fossils. W. B. Wright describes the zonal succession around Manchester; R. Crookall gives an invaluable and well-illustrated summary of the stratigraphy and flora of the Bristol and Somerset coalfield; Emily Dix and J. Pringle describe various forms of *Xiphosura* from the South Wales coalfield; and T. Eastwood discusses the *nips* and *rock-riders* (interruptions in the continuity of coal-seams) of the West Cumberland field.

The district described in the Oswestry memoir[3] is represented on Sheet 137, which covers parts of Shropshire, Denbigh, and Montgomery. Ordovician formations come to the surface in the west and pass under successively later deposits, Silurian, Carboniferous (including Coal Measures), and Triassic, the latter outcropping in the east. Glacial drifts overspread the eastern half of the area. The controlling structural feature is the great anticlinal uplift of the Berwyn Hills, which enters the north-western quarter from the west. In the south-west this gives place to a synclinal depression. The tectonic features are ably discussed in relation to the larger area of which the district forms a part. There are also chapters dealing with the Palæozoic igneous rocks (albitised derivatives from an andesite magma) and with the mineral products and water supplies.

The memoir describing Sheets 320 and 321[4] will serve as a valuable guide to the geology of a popular coastal district, since it deals with Hastings, St. Leonard's, and Bexhill, and the ancient towns of Rye and Winchelsea. The solid geology is restricted to the Purbeck and Wealden, but topics of unusual interest, ranging from palæontology to sedimentary petrology, are by no means limited. The account of the superficial deposits is notable for the inclusion of a valuable description of Dungeness, a great dumping ground of beach-shingle, drifted alongshore from the chalk cliffs and flint deposits west of Eastbourne, and deposited where the interplay of tidal currents produces an area of relatively slack water.

The next memoir[5] to be noticed (Aldershot and Guildford, Sheet 285) describes an area of south-eastern England which is a favourite residential district of great geological interest and topographic charm. The Surrey Hills, composed of the Lower Greensand beds, present some of the most beautiful scenery in England. To the north of these, across the middle of the area, run the North Downs. The geology thus embraces a representative series from the Lower Cretaceous upwards. Attention is given to the evidences of early man with special reference to their distribution in the river terraces.

The country around Sudbury (the "Eatanswill" of Pickwick and his friends) is described by Prof. Boswell[6] in a memoir explanatory of Sheet 206. The geological setting is of great simplicity. Chalk underlies the whole area, but on account of the thickness of the Tertiary cover and the glacial deposits, it crops out only on the lower flanks and in the bottoms of the larger valleys. The glacial deposits are, however, far from simple. Here are found some of the finest sections of drift in Great Britain; they have been intensively studied in recent years by Gregory, Marr, Boswell, Slater, and others. This memoir is further notable for its clear account of the history of the local river systems.

Mr. E. J. Lovegrove has carried out attrition tests on some 460 samples of road-stones and his results are summarised in a recent memoir,[7] together with supplementary results on water absorption, hardness, toughness, and cementing value. Notes on the petrographical characters and their bearing on the behaviour of the specimens are added. Samples of all the stones referred to are conserved in the Museum of Practical Geology, together with a complete set of microscopic sections. The memoir is made easily available for use by the inclusion of an index to localities and a glossary of rock names and definitions. There are four excellent plates of photomicrographs with descriptions facing each plate, an arrangement worthy of special commendation.

Dr. Alex. Scott has written a report[8] in which for the first time the ball clays of the south-west of England—one of the most important raw materials of the pottery industry—are systematically dealt with. The term 'ball-clay' is applied to plastic clays which when fired in an oxidising atmosphere to the tempera-

ture of certain pottery ovens (c. 1150°–1200° C.) have a white or nearly white colour. The name refers only to the original method whereby the clay was obtained in Dorset and Devonshire, and not to any particular property. The memoir gives a complete account of the geological relations, mineral and chemical characters, and physical properties. There are numerous analyses and results of tests and a glossary of terms uxed by the clay miners.

Continuing the county series of memoirs in which the sources of underground waters are described in detail, the Derbyshire memoir[9] has been issued. It gives an admirable short account of the geology of the county, illustrated with a clear map and sections. Details are given of the local sources of supply from springs and wells, with many particulars of the strata recorded from wells and borings. A number of analyses of Derbyshire waters are supplied, and reference is made to the medicinal waters of Buxton and Matlock Bath.

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part I. Pp. iv + 99. 2s. net.
[2] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part. II. Pp. vi + 128. 3s. net.
[3] Explanation of Sheet 137: The Geology of the Country around Oswestry. By C. B. Wedd, Dr. B. Smith, W. B. R. King, and Dr. D. A. Wray. With contributions by T. C. Cantrill and Dr. H. H. Thomas. Pp. xix + 234 + 4 plates. 5s. 6d. net.
[4] Explanation of Sheets 320 and 321: The Geology of the Country near Hastings and Dungeness. By H. J. Osborne White. Pp. xii + 104 + 6 plates. 3s. net.
[5] Explanation of Sheet 285: The Geology of the Country around Aldershot and Guildford. By H. G. Dines and F. H. Edmunds. With a Chapter on Palæontology by C. P. Chatwin. Pp. xiv + 182 + 6 plates. 4s. 6d. net.
[6] Explanation of Sheet 206: The Geology of the Country around Sudbury (Suffolk). By Prof. P. G. H. Boswell. Pp. x + 74 + 2 plates. 2s. net.
[7] Attrition Tests of British Road-stones. By E. J. Lovegrove. With notes by J. Allen Howe and Sir John Fleet. Pp. viii + 84 + 5 plates. 3s. net.
[8] Special Reports on the Mineral Resources of Great Britain. Volume 31: Ball Clays. By Dr. Alex. Scott. Pp. x + 73. 2s. 6d. net.
[9] Wells and Springs of Derbyshire. By J. V. Stephens. Pp. viii + 155. 4s. net.
London: H.M. Stationery Office.

Descendants of the *Bounty* Mutineers.

IN 1923, Dr. Harry L. Shapiro visited Norfolk Island for the purpose of making a series of observations on the Pitcairn Islanders, the descendants of the English sailors who survived from the mutiny of the *Bounty* in 1790 and the Tahitian women with whom they settled on Pitcairn. The Islanders removed to Norfolk Island in 1856, but some of them afterwards returned to Pitcairn. These latter Dr. Shapiro was prevented from visiting by stress of weather. The results of his observations on Norfolk Island, together with a summary of previously recorded observations of the settlement, have been published in Vol. 11, No. 1, of the *Memoirs of the Bernice P. Bishop Museum* of Honolulu.

The special interest of the anthropometric measurements depends upon the fact that they represent hybrids of two well-distinguished stocks with a long history of inbreeding. In stature the male hybrids are distinctly taller than either parent stock. The women, however, reach but do not exceed the mean for Tahitian and English. Both male and female have inherited the longer head-length of the English; in head-breadth both have inherited a head mid-way between English and Tahitian, the latter being the greater by 6·7 mm. in the male. In face breadth both sexes again show an intermediate position, the male being slightly more than the English average. In face height the males are not significantly different from the Tahitians; the females are intermediate. The hybrid males have inherited a narrow forehead which resembles the Tahitian. Other features in which the Islanders show an intermediate position are nose height (males), nose width, fronto-parietal index, and zygomatico-frontal index. The cephalic index is much nearer the English than the Tahitian, which is prominently brachycephalic, and the nasal index, though distinctly greater than the English index, approximates more nearly to it than to the Tahitian.

In eye colour, the pigmented eye of the Society Islander is dominant over the unpigmented eye, but the males have a greater percentage of blue eyes than the females. The epicanthic fold is rare among the hybrids. The unexposed skin colour of the hybrids is intermediate to the medium dark-skinned Tahitians and the relatively fair-skinned English. The exposed skin colour among the hybrids is as dark as the exposed skin of the Society Islanders. The dark hair of the Tahitian is dominant over the light hair of the English, and curved hair over straight hair. The males are also more hairy than the Tahitians. The variability of the Islanders is less than in either parent stock.

Recent Work on Vitamin D.

III.

OCCURRENCE.

ALTHOUGH cod-liver oil is the richest natural source of vitamin D, it is clear that most animals must obtain their supply from other food or by the exposure of their body surface to the sun's rays. E. M. Hume, N. S. Lucas, and H. H. Smith (*Biochem. J.*, vol. 21, p. 362; 1927) have shown that irradiated 'cholesterol' can cure rickets in the rat or rabbit when lightly rubbed into a small area of depilated skin almost as efficiently as direct irradiation of a similar small depilated area. These results afford experimental proof that exposure of the skin to a suitable source of light will result in the production of vitamin D in the exposed area, whence it will be transferred to the body tissues to exert its function.

J. L. Leigh-Clare (*ibid.*, vol. 21, p. 368; 1927) has examined the diatom *Nitzschia closterium* for vitamin D and has found it to be absent even when the organism was grown in sunlight. Up to 0·4 gm. was given as a daily dose to rats maintained on the rachitogenic diet. It appears, therefore, that the cod must obtain its vitamin D from plankton or smaller fish, since it is unlikely to be sufficiently exposed to sunshine itself (unless, of course, it possesses the power of synthesising it in the absence of the sun's rays). The absence of vitamin D from this organism may be compared with the poverty of green land plants in it. M. H. Roscoe (*ibid.*, vol. 21, p. 211; 1927) has found small amounts in spinach: its effect was more obvious in rabbits than rats, since relatively larger amounts could be consumed by the former animal. S. G. Willimott and F. Wokes point out, however, that administration of spinach involves at the same time an increase in the consumption of calcium and phosphorus: they therefore examined an ether-acetone extract of the dried leaves (*ibid.* p. 887). Twenty-five mgm. of the extract, equivalent to 6 gm. fresh spinach, were sufficient to prevent xerophthalmia

and produce nearly normal growth, from its content of vitamin A, in rats on a high fat diet: only slight signs of rickets were observed, but the fæcal pH became alkaline. On a low fat diet 100 mgm. extract daily failed to shift an alkaline fæcal pH to the acid side of neutrality, although cod-liver oil quickly brought about such a reduction. They conclude, therefore, that at a level supplying a fair amount of vitamin A, vitamin D could not be demonstrated.

It appears probable that green foodstuffs contain little vitamin D, but the amount can be increased by exposure to ultra-violet light. For the production of milk containing more than minimal quantities of the vitamin, it is best to add cod-liver oil to the cow's diet, although summer green stuffs and exposure of the animal to sunlight also raise the vitamin D content of the milk to some extent.

It is of some interest that vitamin D has also been found to be present in ergot of rye, although it might possibly have been inferred since ergosterol is an important constituent (E. Mellanby, E. Surie, and D. C. Harrison, *Biochem. J.*, vol. 23, p. 710; 1929). The authors, however, found that mushrooms, which also contain ergosterol, contain no vitamin D and that exposure of ergot to sunlight does not increase the vitamin content, although irradiation with a mercury vapour lamp does so to a slight extent. The experiments were carried out on puppies maintained on a diet deficient in vitamins A and D. The calcifying factor had the properties of vitamin D in that it was soluble in alcohol and ether and withstood saponification.

D-HYPERVITAMINOSIS.

With the preparation of vitamin D synthetically from a pure precursor, attention was soon directed to the question as to what effects, if any, the administration of large doses of the vitamin might have upon the tissues of the body. Some previous work had shown that large doses of cod-liver oil or its concentrate (that is, the unsaponifiable fraction) might have deleterious effects upon rats, but it was not possible to attribute such to the presence of a vitamin, since other substances occur in both the oil and its concentrate. In irradiated ergosterol, on the other hand, there are only present compounds formed from it, with probably some unchanged ergosterol. If, therefore, any toxic effects seen bear a relation to the known effects upon the body of vitamin D and, further, if their intensity is proportional to the amount of vitamin present, it is reasonable to attribute these effects to the vitamin itself: unless, however, a very close parallelism between toxicity and potency is observed, there always remains the possibility that another substance may play some part in producing or even mitigating any deleterious effects observed.

It is impossible here to do more than refer to a few of the papers published on this subject: some of the earliest work was carried out by Pfannensteil and Kreitmair and Moll: in Great Britain two groups of workers have devoted some attention to it (L. J. Harris and T. Moore, *Biochem. J.*, vol. 22, p. 1461; 1928: vol. 23, pp. 261 and 1115; 1929: Harris and C. P. Stewart, *ibid.*, vol. 23, p. 206: W. E. Dixon and J. C. Hoyle, *Brit. Med. Jour.*, vol. 2, p. 832; 1928: Hoyle and H. Buckland, *Biochem. J.*, vol. 23, p. 558; 1929: Hoyle, *Lancet*, vol. 1, p. 734; 1929: and *J. Pharm. Exp. Therap.*, vol. 38, p. 271; 1930).

When rats are given a synthetic diet containing all known nutritive factors, to which are added daily 10 mgm. or more of irradiated ergosterol, the animals show loss of appetite, with failure to grow or loss of weight, diarrhœa, and skin lesions: death ensues in a few weeks. The amount which must be given daily to produce these effects varies: Harris and Moore found 0·1 per cent in the diet of ergosterol irradiated in alcohol lethal, whilst 0·025 per cent of similar material or of oil-irradiated ergosterol prevented growth. Dixon and Hoyle found that 0·2 per cent in the diet of ergosterol irradiated in oily (cocoa-butter) solution, giving an average daily consumption of 17 mgm., prevented growth in half-grown rats, whilst 11 mgm. daily gave little retardation. (The daily consumption in Harris and Moore's experiments was about 10 mgm. with 0·1 per cent in the diet.) Smaller doses of irradiated ergosterol, for example, 0·001 per cent in the diet, or 0·1 per cent ergosterol, heated ergosterol or over-irradiated ergosterol in which the potency had been almost entirely destroyed, had no deleterious effects on growth. In later experiments, Hoyle found that about 26 mgm. daily of oil-irradiated ergosterol caused some loss of weight but was not lethal in young adult rats, whereas 20 mgm. of ergosterol irradiated in alcohol caused death in a short time. He therefore considers that oil-irradiated is less toxic than alcohol-irradiated ergosterol, whilst Harris and Moore consider that the two products are equally toxic: it is possible that the discrepancy may be due to differences in vitamin D potency of the materials used, or to differences in the constituents of the synthetic diets.

In addition to the deterioration in the general condition of the animals noticed above, slowing of the heart has been observed and an increase in the inorganic phosphate and calcium of the blood. In addition, irradiated ergosterol produces a marked diuresis but without any increase in the total phosphate or chloride output. Post-mortem, the pathological changes vary in general with the toxicity as disclosed by the effect on growth, except that time is required for their development, so that early death may be accompanied by few lesions, whilst a prolonged maintenance on a low dose may produce as marked changes as a shorter existence upon a high one. The general condition is one of emaciation, with atrophy of the spleen and thymus: in addition, calcareous deposits are found in the kidneys, blood-vessels, heart muscle and the walls of the gastrointestinal tract. The calcification of the walls of the aorta is often particularly striking; the deposits appear to be laid down at first in close connexion with the elastic fibres; on macroscopic examination the tube is brittle and inelastic. Similar sclerosis occurs in the vessels of the heart and kidneys. These changes are not found in animals on non-toxic doses of irradiated ergosterol, or given large doses of ergosterol, or heated or over-irradiated ergosterol. Dixon and Hoyle found that the only lesions in their rats given 11 or 17 mgm. oil-irradiated ergosterol daily were calculi in the urinary tract, frequently accompanied by hydronephrosis and also some degree of fatty change in the kidneys.

The nature of the diet has a marked influence upon the toxicity of irradiated ergosterol: on a natural diet of bread and milk, 20 mgm. of alcohol-irradiated material daily had little effect upon the growth of young rats although producing cessation of increase in weight in the case of young adults. Pathological lesions were correspondingly absent or slight. It is possible that this is due to a lessened intake of calcium and phosphorus on the bread and milk diet (Harris, *Lancet*, vol. 1, p. 237; 1930), although Hoyle considers that this result should be compared with the lower toxicity of oil-irradiated material found by him and that it is in favour of the toxic factor and vitamin D being different substances. It might be suggested that early death is due to a different substance from vitamin D: and that the sclerosis observed in relatively long time experiments is produced by the vitamin and leads later to a fatal result.

It may be pointed out that the toxic amounts of irradiated ergosterol in these experiments contain from 10,000 to 100,000 times what may be called the physiological dose of vitamin D. In healthy adult men, Havard and Hoyle found that 8 mgm. daily for three weeks in winter failed to raise the blood inorganic phosphate or serum calcium and had no toxic effects (*Biochem. J.*, vol. 22, p. 713; 1928). Hess and Lewis, however, found that 2·5-5 mgm. daily in rachitic infants, whilst curing the disease, might lead to an excessive rise in the blood phosphorus and calcium.

In conclusion, brief reference may be made to a paper by Harris and Moore in which it is shown that the requirement of the rat for vitamin B is increased *pro rata* with increase in the intake of vitamins A and D in the form of a cod-liver oil concentrate. The amount of vitamin D consumed was below the level which had previously been found to be toxic (when given in the form of irradiated ergosterol), whilst the amount of vitamin A taken was up to 25,000 times the minimum dose. It is considered that the 'vitamin balance' is probably between vitamins A and B, although the possible action of other unidentified substances cannot be excluded when both sources of the vitamins contain other materials.

University and Educational Intelligence.

APPLICATIONS are invited for the following research scholarships at the Huddersfield Technical College: The Joseph Blamire's Research Scholarship for research in colour chemistry (value £100 a year, with remission of fees), and the British Dyes Research Scholarship for research in colour chemistry (value £75 a year, with remission of fees). Forms of application can be had from the Secretary of the College.

ROBERT BLAIR fellowships have been awarded to Mr. Cyril H. Bowden and to Mr. Philip Carpenter. These fellowships, which carry a grant of £450, are the most valuable scholarship awards in the gift of the London County Council. Mr. Bowden has been engaged upon research work in the physical chemistry department of the Imperial College of Science, and proposes to study chemical engineering at the Massachusetts Institute of Technology, U.S.A. Mr. Carpenter, who is an associate of the Royal School of Mines, proposes to visit mines in the United States to study the principles and practice of the flotation process for separating minerals from their ores, with a view to the value of its application on the large copper field now being opened up in Northern Rhodesia.

FROM the University of Cambridge we have received summaries of dissertations approved for the Ph.D., M.Sc., and M.Litt. degrees during 1928–29, as follows: in science 44, in the humanities 12, total 56. By departments the dissertations are thus distributed: departments of the faculties of biology 22 (biochemistry 6, geology 6, botany 4, zoology 3, physiology 3), chemistry 9, agriculture 6, mathematics 4, physics 3, English 4, classics 3, modern and mediæval languages 2, economics and political science 1, history 1, moral science 1. The preponderance of science, especially biological science, is remarkable. So likewise is the fact that of the 56 candidates 34 were drawn from other universities in every quarter of the globe, namely, from London (4), Wales (4), Manchester (2), Sheffield, St. Andrews, Glasgow, Aberdeen, Berlin (moral science) Lausanne (mathematics), Budapest (biochemistry), Pisa (chemistry), four universities in the United States of America (English, modern and mediæval languages, chemistry, and physiology), two Canadian universities (history and agriculture), four Australian universities (botany, geology, biochemistry, English, chemistry), New Zealand (botany, geology, physics), South Africa (chemistry), and Bombay (zoology).

IF the number of doctorates conferred in the sciences be proportionate to the advance of the frontiers of knowledge, there has been a notable acceleration in the progress of science in the United States during the past ten years. 1928–29 is the tenth year for which particulars of such doctorates have been compiled by the Research Information Service of the American National Research Council, and its recently published bulletin on the subject shows a steady increase from 330 in 1919–20 to 1025 in 1928–29. The University of Chicago alone created 99 new doctors last year, Wisconsin 66, Johns Hopkins 62, Columbia 61, Cornell 60, Minnesota 53, California 50, Ohio State 48, Yale 47, Harvard 40, fifty-one other universities 439. Of greater interest than the list of conferring universities is the list of subjects in which the degrees were conferred. This discloses the portentous fact that, excluding chemistry, which is in a class by itself, accounting for nearly a third of the total number, more doctorates (112) were conferred in what has only barely established its claim to recognition as a science, namely, psychology, than in any of the other sciences. The universities chiefly responsible are: Iowa (15), Ohio (13), Chicago (10), Columbia (9), Cornell (9), Minnesota (8), Wisconsin (6), and Yale (6). The titles of the theses indicate in many instances the schools of psychological doctrine in which the writers are interested, and a very large proportion of them are attempts to solve practical educational problems. Next to psychology come, in the order given, physics, zoology, botany, mathematics, geology, physiology, engineering, pathology, agriculture, and bacteriology.

THE report of the work of the Petroleum Department of the Sir John Cass Technical Institute for the session 1929–30 is now available, and shows that satisfactory progress has been made in all sections. The close of the session to which the report relates marks the completion of the third triennium of the activities of the department. The courses provided embrace lectures on general technology of petroleum, bulk transport and distribution of petroleum products, introduction to the chemical and physical properties of petroleum; properties, applications, and examination of petroleum, and its applications to engineering. There is also a preliminary course in elementary physics, chemistry, and mathematics, as a basis of introduction to the subject of oil technology for those who have little or no knowledge of first principles. The total number of class entries for the session was 160 as compared with 145 last session, student hours showing an increase from 2153 to 2876. The report, as in previous years, gives no indication of the syllabus of the lectures offered, so that it is not possible to form an idea of the precise ground traversed in the several courses. While a report is naturally not intended to constitute in itself a prospectus, at the same time these annual reports of the Petroleum Department of the Institute have always seemed to us rather bald statements, and the inclusion of a little more internal detail is desirable; for example, the names of all the lecturers who have contributed to the work, results of any particular research which may have been inspired by the Institute, some mention of the companies whose representatives have attended courses, any particular departures from or modifications in routine designed to keep the curriculum up-to-date, plans for the future, and so on: all this is of direct import not only to the School itself, but also to those for whom it so adequately caters.

Historic Natural Events.

Aug. 17, 1876. Electrical Phenomena near Weymouth.—At Ringstead Bay, near Weymouth, Dorset, during a sultry afternoon, on ground above the cliffs, a number of globes of light were seen of the size of billiard balls, extending from a few inches above the surface to a height of 7-8 ft. They slowly rose and fell vertically, sometimes within a few inches of the observers but always eluding the grasp. The number of these objects varied from twenty to 'thousands'. No sound accompanied the display, but at 10 P.M. there was a thunderstorm.

Aug. 17, 1929. Shyok Glacier Floods.—Near its source the Shyok River, a tributary of the Upper Indus, flows through a narrow valley, into which the Kumdan Glaciers protrude. At times the glaciers advance to the opposite wall, completely blocking the valley and damming the river. This occurred in 1928 and 1929, when the ice dam was 1000 yards long and more than 400 feet high. The force of the great volume of water broke through the barrier on Aug. 17, 1929, and a disastrous flood followed. At Khalsar, where the river runs through a narrow gorge, it rose rapidly to 93 ft. above the normal level, and by 8 P.M. on Aug. 18 the flood, travelling about 20 miles an hour, had raised the level by above 50 ft. at Attock, 600 miles from the dam. Owing to the system of warnings which had been arranged, the losses of life and property caused by the flood were comparatively small.

Aug. 18, 1631. Aurora.—The account of the search for the North-West Passage by Capt. Luke Foxe in His Majesty's Pinnace *Charles* contains an entry made on Aug. 18 at the mouth of the Nelson River, Hudson Bay: "This night 10 were many Pettiedancers". Mr. W. J. Healy of the Provincial Library, Winnipeg, explains that the term 'Dancers' or 'Merry Dancers' is a local name for the aurora borealis.

Aug. 18, 1923. Typhoon at Hong Kong.—The centre of a violent typhoon passed within 14 miles of Hong Kong. On Aug. 18 the calm centre had a diameter of seven miles, outside which the winds had a velocity of more than 100 miles per hour, while a gust was recorded, after correction for instrumental error, of 127 miles per hour. This was at the time the highest wind velocity ever recorded autographically.

Aug. 19, 1867. Thunderstorm over London.—After a day of intense heat one of the greatest London thunderstorms began at 9 P.M., and continued until 5 A.M. next morning. The lightning was continual, and the thunder scarcely ceased. Rain fell in torrents, accompanied by a violent wind and in some places by hail. The storm was very violent in all parts of Surrey and in some parts of Sussex and Berkshire.

Aug. 19, 1880. Typhoon.—This disturbance, known as "The Great Typhoon of 1880", originated to the east of the Liu Kiu islands on Aug. 19–22. On Aug. 24–27 it travelled north-eastward along the east coast of Japan, doing great damage.

Aug. 19, 1889. Cloudburst in Japan.—The Kii Peninsula, on the south of Nippon, was the scene of a deluge of rain unequalled in the history of Japan. On Aug. 18, a typhoon approached the south coast, and during Aug. 19 crossed the inland waters to the Sea of Japan, causing a southerly gale over the Kii Peninsula. Heavy rain was experienced on Aug. 18, and on Aug. 19 the rain was so violent and continuous that a considerable area was devastated. At Tanabe the fall was 14·5 in. on Aug. 18, and 35·5 in. on Aug. 19, the latter quantity falling in 17 hours. During a period of four hours from 2 P.M. to 6 P.M. the fall amounted to 14·25 in. and near by 9·5 in. fell in two hours. The observer reported that in the mountains of the interior the rain was even heavier. The Izugawa, a tiny stream only eleven miles long, became a devastating torrent. The lower part of Tanabe was deeply flooded, while a stream south of Tanabe rose 50 feet in two hours. Hundreds of thousands of trees were washed out to sea, forming temporary dams in the valleys which added to the flooding; 1502 lives were lost and 400,000 persons were ruined.

Aug. 19, 1924. Heavy Rain in British Isles.—During a thunderstorm in the early morning, a total of eight inches of rain fell in five hours at Brymore House, near Cannington in Somersetshire. In the twenty-four hours ending at 9 A.M. the fall amounted to 9·40 in., the second largest recorded in the British Isles. It appears that two or three thunderstorms followed one another in rapid succession. After the storm hailstones lay on the ground to a depth of three or four inches, but were not especially large.

Aug. 21, 1852. Eruption of Etna.—A violent eruption of Etna, that lasted more than nine months, began on this day. Streams of lava flowed from craters in the Val del Bove, on the south-east side of the mountain, one stream advancing towards Zaffarana and another threatening La Macchia and Giarre. The total volume of lava was estimated to cover an area 6 miles long and 2 miles wide to an average depth of 12 ft.

Aug. 23, 1923. Sandstorm at Khartoum.—During a violent sandstorm at Khartoum the wind reached a velocity of 62 miles per hour. Many large trees were blown down. During storms of this type the dust is raised to a height of about 3000 feet, and advances across the ground like a solid wall ten or twenty miles in length.

Societies and Academies.

LONDON.

Geological Society, June 25.—**J. E. Richey**: Tertiary igneous complex of Ardnamurchan. The district is chiefly noteworthy on account of its intrusive rocks, and only small outliers of the widespread Tertiary plateau basalt-lavas are preserved. The types of intrusion include volcanic vents piercing the basalt-lavas, and largely filled with acid and trachytic fragmental materials; minor intrusions, including cone-sheets, chiefly quartz-dolerite, and dykes; and plutonic masses, nearly all gabbro or dolerite, occurring mainly as ring-dykes. The above, excepting the dykes, are arranged in concentric series around three different centres, marking three foci of igneous activity which functioned successively. It is suggested that the three complexes are successively more deep-seated, due, presumably, to the growth of an overlying volcanic pile. The regular ring-patterns marked by the intrusions are of more especial interest and constitute evidence of the formation of annular or arcuate fissures that are considered here, as in Mull, to have resulted from localised stresses set up in the roof of an underlying magma-reservoir.

PARIS.

Academy of Sciences, June 23.—**Bigourdan**: The Observatory of Cagnoli in the rue de Richelieu.—**Ernest Esclangon**: The determination of an orbit, planet or comet, by three observations, taking into account the perturbations caused by other planets.—**Léon Guillet and Marcel Ballay**: The influence of reheating on the electrical resistance and resistance to shearing of the tempered aluminium-silicon alloys.—**Louis Roy**: The propagation of waves on isotropic elastic surfaces with three parameters.—**André Nessi and Léon Nisolle**: A machine for calculating by means

of a planimeter the integral of the product of two functions.—**T. Popovici**: Convex functions of one real variable.—**Georges Bouligand**: The figuration of imaginary points and the theory of functions.—**Michel Fekete**: Series of factors keeping the class of a Fourier's series.—**Luigi Fantappié**: The extension of a theorem of M. Hadamard to series of multiple powers.—**F. E. Myard**: An absolutely general mode of linkage of two axes of rotation in space.—**Nicolas G. Perrakis**: The sensitometric study of a new panchromatic plate. A study of a Guilleminot panchromatic plate, with special reference to the interpretation of photographs of the solar corona taken on similar plates.—**André Marcelin** and **Mlle. S. Boudin**: Stratifications coloured by sublimation. A description of the technique necessary to obtain crystals suitable for microscopic examination.—**René Lucas**: The mutual influence on their absorption bands of the chromophore groups of a molecule.—**J. Aharoni** and **Ch. Dhéré**: Study of the influence exerted by the exciting rays on the fluorescence spectrum of etioporphyrin. The structure of this spectrum from the infra-red to the ultra-violet.—**L. Goldstein**: The distribution of potential and charge in a diatomic molecule.—**Lespieau** and **Bourguel**: Chemical constitution and the Raman effect: ethylenic hydrocarbons. As regards the Raman effect, the double bonds of the benzene nucleus give the same effect as ordinary ethylene double bonds; both are characterised by the line 1600. The Raman spectra of six hydrocarbons of known composition have been studied and the results applied to the verification of the structure of a new double ring hydrocarbon, phenyltrimethylene.—**G. Arrivaut**: The formation of a violet copper alloy, Cu_2Sb. This has been prepared by the action of a 10 per cent solution of antimony chloride containing some free hydrochloric acid upon finely divided copper.—**Maurice François**: The rational preparation of the bromides and chlorides of mercurammonium. Crystallised dimercurammonium bromide and dimercurammonium chloride.—**M. Tiffeneau** and **Mlle. Jeanne Lévy**: The affinity capacity of the piperonyl radical, $CH_2O_2C_6H_3$.—**Urion**: The decomposition of divinylglycol by various catalysts: 1-methylal-1-cyclopentene.—**H. Colin** and **P. Ricard**: The glucides and the glucidic derivatives of the brown Algæ.—**H. Lagatu** and **L. Maume**: Observation, by leaf diagnosis, of the influence of temperature on the mode of nutrition of a plant.—**Emile Saillard**: Adsorption in the sugar industry.—**A.** and **B. Chauchard**: Sleep produced in fishes by compression of the brain.—**D. Bennati** and **E. Herzfeld**: The action of formaldehyde on neuromuscular excitability.—**P. Sédallian** and **Mme. Clavel**: The use of flocculated diphtheric toxin in the preparation of antidiphtheric serum. Other conditions being the same, and with some reserve as regards individual reactions of animals, experimental proof is given that the toxin precipitated at pH 4·7, brought into solution in a suitable volume of peptone solution, furnishes an antigen of at least equal value to that of the total toxin.—**H. Simonnet** and **G. Tanret**: The calcification of the lung in the healthy or tuberculous rabbit by larger doses of irradiated ergosterol.—**S. Bratianu** and **C. Guerriero**: The phagocytic power of the epithelial cells of the mammary gland.—**Mlle. G. Cousin**: The endoparasitic development of the ectoparasitic larva of *Mormoniella vitripennis*.

CAPE TOWN.

Royal Society of South Africa, May 21.—**P. R. v. d. R. Copeman**: Changes in the composition of oranges during ripening (Part 2). Changes in soluble solids. The percentage of soluble solids in the juice and the weight of soluble solids per fruit both increase during ripening. The changes follow the course of an autocatalytic reaction. During the final three weeks the effects of transpiration become dominant and the percentage soluble solids show an abnormal increase. Spraying with lead arsenate mixtures does not produce any significant change in the amount of soluble solids.—**B. Farrington**: The life of Vesalius by Boerhaave and Albinus. A translation of the preface by Boerhaave and Albinus to their edition of the works of Vesalius. It contains a brief history of anatomy from the earliest times until its revival in Italy in the beginning of the fourteenth century. It gives a more extended account of the work of the Italian pioneers; and then establishes the epoch-making importance of the work of Vesalius. The career of Vesalius is treated in considerable detail and with many lively biographical touches. This preface of theirs is not now readily accessible in Latin, and has not before been translated into English.—**A. Zoond** and **G. Rimer**: The mechanism of equilibration in *Xenopus Lævis*. An analysis of the function of the eyes and the labyrinthine organs in connexion with equilibrium and the response to rotation. Whereas extirpation of eyes and labyrinths abolishes completely the response to rotation on a turntable, eyed labyrinthless animals do respond to such rotation by definite muscular movement. This response is still maintained when the animal is rotated in total darkness. The same phenomenon is recorded also for *Rana*.—**A. Zoond**: Dermal photoreceptivity in *Xenopus Lævis*. *Xenopus* is negatively phototropic and response is not in any way affected by the removal of the eyes, the eyeless animals reacting to light in the same way as the eyed. Immersion in 1 per cent cocaine solution for six minutes completely abolishes the sensitivity to light of the eyeless animals, although the spinal reflexes are not impaired. These observations demonstrate the presence of photoreceptive elements in the skin of *Xenopus*.

CRACOW.

Polish Academy of Science and Letters, Mar. 3.—**W. Seislowski**: The radiation of semi-conducting cells.—**D. Doborzyński**: The dielectric constant of liquid bromine.—**K. Kostanecki**: The course of the cæcum of the great bustard, *Otis tarda*.—**F. Rogoziński** and **Mlle. M. Starzewska**: Experimental rickets. The influence of ultra-violet light on the mineral metabolism and on the composition of the bones. Experiments on the white rat prove the favourable action of irradiation on the retention of calcium and of phosphorus.—**L. Monné**: Comparative researches on the structure of the Golgi apparatus and of the vacuome in the sexual and somatic cells of some gastropods (*Helix*, *Paludina*, *Cerithium*).—**St. Ciechanowski**: (1) Study of tar cancer tumours. (2) The influence of the anatomical structure of the region exposed to tar on the appearance and development of tar tumours.—**K. Sciesiński**: The influence of the species of the rabbit on the appearance and development of tar tumours.—**St. Ciechanowski** and **K. Sciesiński**: Pregnancy and tar tumours. The influence of the intensity of the local agent on the formation and development of tar tumours in the rabbit.—**R. Weigl**: The nature and forms of the micro-organism of exanthematic typhus.—**R. Weigl**: The methods of active immunisation against exanthematic typhus.—**L. Hirszfeld** and **Mlle. W. Halber**: The serological unity of cancers.

April 7.—**T. Banachiewicz**: First orbit of the trans-Neptunian star.—**A. Wilk**: Discovery of a new comet.—**Wl. Gorczyński**: Values of the intensity of the solar radiation measured on board different vessels

on the Atlantic and Indian Oceans.—**E. Chauvenet** and **J. Dawidowicz**: Zirconyl oxyiodides.—**K. Dziewoński, Cz. Baraniecki**, and **L. Sternbach**: A new method of synthesis of colouring matters of the thio-indigo type. Syntheses in the naphthalene group.—**J. Kuhl**: Contribution to the knowledge of the Trembowla grits in the neighbourhood of Mogielnica (Eastern Little Poland).—**Mlle. C. de Kleist**: Phyto-sociological researches on the peat bogs of the region of the dunes of the right bank of the Vistula in the neighbourhood of Warsaw.—**Z. Grodiński**: The development of the blood vessels in the anterior extremities of *Amblystoma mexicanum*.—**J. Zacwilichowski**: Researches on the innervation of the wings of insects.—**L. Hirszfeld** and **Mlle. W. Halber**: Deviation of the complement by the serum of cancer patients and of pregnant women with alcoholic extract of cancers.—**Z. Zakrzewski**: Researches on the production of the principles stimulating the growth of normal tissues by sarcomatous cells in culture *in vitro*.

MELBOURNE.

Royal Society of Victoria, June 12.—**John Clark**: New Formicidæ; with notes on some little-known species. Fourteen species and one genus are described as new. The ants described by Kirby in 1896, collected by the member of the Horn Expedition to Central Australia, have been revised. Of the twelve species mentioned by Kirby, five now stand as apparently valid species.—**Alan P. Dodd**: New Hymenoptera Proctotrypoidea from Victoria. Six new species are described, belonging to the families (1) Scelionidæ and (2) Belytidæ. The genus *Xenotoma* is here recorded for the first time from Australia.—**Alan Coulson**: Notes on the Jurassic Rocks of the Barrabool Hills, near Geelong, Victoria. Fossil plants, of which a list is given, were discovered in a mudstone band intercalated with basal boulder beds. The flora indicates a Lower Jurassic age. The pebbles of the boulder beds are Ordovician spotted slate, quartzite, quartz and mica schist, Heathcotian (Up. Cambrian) epidiorite, and Lower Palæozoic granite. Two faults have affected the Jurassic beds.

SYDNEY.

Linnean Society of New South Wales, May 21.—**C. P. Alexander**: Observations on the Dipterous family Tanyderidae. A preliminary description of the immature stages of the family Tanyderidæ. The material consists of larvæ and pupæ of a North American species, *Protoplasa fitchii*, from the Gaspé Peninsula of eastern Quebec, Canada. More than half the known species of the family are from Australasia, which is the great centre of distribution of the family.—**H. L. Jensen**: The genus *Micromonospora* Orskov, a little-known group of soil micro-organisms. Morphological and biological description of nine strains of the practically unknown genus *Micromonospora*, which appears to be of common occurrence in Australian soils.—**A. Jefferis Turner**: Revision of Australian Oenochromidæ (Lepidoptera). Part 3. This completes the revision of the family. In this part twenty genera and forty-seven species are dealt with, one genus and six species being described as new. Keys are given for the determination of the species of *Oenochroma* and *Derambila*.

VIENNA.

Academy of Sciences, May 22.—**G. Machek**: The linear pentacene series (19). The constitution of the bi-derivatives of pentacene-diquinone.—**M. Kohn** and **E. Gurewitsch**: The 2, 5-dichlor-hydro-quinone-dimethyl-ether.—**M. Kohn** and **S. Fink**: Chlorination of *p*-amido-phenol. 35th. Communication on bromophenols.—**K. Przibram**: Recrystallisation and coloration of rock-salt.—**G. Ortner**: Recrystallisation of compressed rock-salt. **M. Blau** and **E. Rona**: Application of Chamie's photographic method to reactions and electrolysis of polonium.

Official Publications Received.

BRITISH.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 15: Preliminary Spinning Tests on Mixings of Indian and American Cottons using Ordinary and High Drafts. By R. P. Richardson and Dr. A. James Turner. Pp. 21. (Bombay.) 1 rupee.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 4: October, November, December, 1929. By Ernest A. Hodgson. Pp. 51-65. (Ottawa: F. A. Acland.) 25 cents.

A Summary of Data relating to Economic Entomology in the British Empire. Prepared for the Third Imperial Entomological Conference by Dr. S. A. Neave. Pp. 23. (London: Imperial Institute of Entomology.) 2*s*. 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 41: Study of the Polysaccharides. Part 3: Acetamide as a Polysaccharide Solvent. By Dr. J. Reilly, Dr. Reinhold Wolter and P. P. Donovan. Pp. 467-473. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Memoirs of the Asiatic Society of Bengal. Vol. 11, No. 3: The Palæography of the Hathigumpha and the Nanaghat Inscriptions. By R. D. Banerji. Pp. 131-146+plates 17-23. (Calcutta.) 4.8 rupees.

The Half-Yearly Journal of the Mysore University. Vol. 4, No. 1, January. Pp. 144. (Bangalore.) 2 rupees.

Education, India. Pamphlet No. 26: Note on Education at Jamshedpur in Bihar and Orissa. By G. E. Fawcus. Pp. iii+8+2 plates. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d*.

Journal of the Indian Institute of Science. Vol. 13A, Part 10: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.) Part xi: New Methods of Disease Transmission and their Significance. By M. Sreenivasaya. Pp. 113-117. (Bangalore.) 12 annas.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1929. Pp. 227+18 plates. (Bristol.)

Queensland. Department of Mines: Queensland Geological Survey. Publication No. 278: The Queensland Upper Palæozoic Succession. By J. H. Reid. Pp. 96. (Brisbane: Anthony James Cumming.)

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1929 to 31st March 1930. Pp. 22+6 plates. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, July. Pp. 391-473+xlii. (London.)

Harper Adams Agricultural College, Newport, Shropshire. Advisory Report No, 5: Report of the Advisory Department, 1929-1930. Pp. 32. (Newport.)

Ministry of Agriculture and Fisheries. The National Mark. Second edition. Pp. 11. (London: Ministry of Agriculture and Fisheries.) Free.

FOREIGN.

Annales de l'Institut Henri Poincaré: recueil de Conferences et mémoires de calcul des probabilités et physique théorique. Vol. 1, Fasc. 1. Pp. 74. (Paris: Les Presses universitaires de France.) 35 francs.

Transactions of the San Diego Society of Natural History. Vol. 6, No. 4: Upper Eocene Orbitoid Foraminifera from the Western Santa Ynez Range, California, and their Stratigraphic Significance. By W. P. Woodring. Pp. 145-170+plates 13-17. 50 cents. Vol. 6, No. 5: A new Race of Gilded Flicker from Sonora. By A. J. van Rossem. Pp. 171-172. 10 cents. Vol. 6, No. 6: New Species of Mollusks. By Fred Baker and V. D. P. Spicer. Pp. 173-182+plates 18-19. 25 cents. (San Diego.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 69: Die retrograden periodischen Bahnen um die beiden endlichen Massen im Problème Restreint, mit direkter absoluter Bewegung (Klasse *l*). Von Elis Strömgren. Pp. 31. (København: Bianco Lunos Bogtrykkeri A.-S.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1929. By Dr. H. A. Tempany. Pp. ii+19. (Kuala Lumpur.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 93: Some Supplementary Records to Muschler's Manual Flora of Egypt; including many Species collected by Mr. G. W. Murray. By N. Douglas Simpson. Pp. iv+59. 6 P.T. Bulletin No. 94: The Angular Leaf Spot of Cotton in Egypt. By Dr. Tewfik Fahmy. Pp. 5+7 plates. 5 P.T. (Cairo: Government Publications Office.)

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 7, Juillet. Pp. 441-488. (Prague: Regia Societas Scientiarum Bohemica.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. The North American Retinellae. By H. Burrington Baker. Pp. 193-219+plates 9-14. Results of the Pinchot South Sea Expedition. 1: Land Mollusks of the Caribbean Islands, Grand Cayman, Swan, Old Providence and St. Andrew. By Henry A. Pilsbry. Pp. 221-261+plates 15-19. (Philadelphia, Pa.)

Bulletin of the Bingham Oceanographic Collection. Vol. 3, Art. 4: Scientific Results of the Third Oceanographic Expedition of the *Pawnee*, 1927. Teleostean Shore and Shallow-water Fishes from the Bahamas and Turks Islands. By Albert Eide Parr. Pp. 148. (New Haven, Conn.: Peabody Museum of Natural History, Yale University.)

SATURDAY, AUGUST 23, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The Royal Veterinary College.

It would indeed be a national calamity if the Royal Veterinary College, London, the premier veterinary college of the British Empire, had to close its doors. The precarious condition of the College was emphasised by the Earl of Harewood recently in the House of Lords when he asked what steps the Government is prepared to take to maintain it. Reference to Lord Harewood's speech and to the discussion which followed was made in our issue of Aug. 9, p. 212.

Less than a year ago there was issued as a White Paper the report of the Departmental Committee on the Royal Veterinary College appointed by the Minister of Agriculture and Fisheries in 1928. The report stated that "the condition of the Royal Veterinary College is a national disgrace, it needs rebuilding and re-equipping". After a very thorough investigation the Committee stated clearly that "the deplorable condition to which the College has been reduced both as regards buildings and finance has not been due to any lack of enthusiasm on the part of those few members of the Governing Body who for many years past have been sufficiently public-spirited to devote attention to the affairs of the College, or to the small staff who, despite their meagre salaries and wholly inadequate facilities, continued loyally at their work. It is nothing less than extraordinary that the College has been able, in spite of the most depressing circumstances, to turn out year by year a regular flow of qualified students." The necessities of an Institution have never, we venture to state, been more strongly emphasised by a Government departmental committee, and it should have been unnecessary for the question to have been raised again in either House of Parliament.

The response of the Government to the appeals which have been made is frankly disappointing, and one wonders if the responsible ministers have really taken the trouble to read the report or to weigh up its import. The committee recommended a grant of £280,000 for building and equipment, and a guaranteed annual income of not less than £21,000. The Government offer, as stated by the Earl de la Warr, of pound for pound up to £100,000, is totally inadequate in view of the circumstances. The governors have collected £30,000 as the result of four or five years' urgent endeavour and urgent appeal, and it is believed to be absolutely impossible substantially to increase that amount, so that the offer is practically abortive. Lord Ernle pointed out in the debate in the House of Lords

that in Berlin the *annual* sum paid for veterinary science is £280,000, and yet in London a single capital grant of that same amount is refused.

Earl de la Warr suggested that Lord Harewood and his friends should confer with the Ministry of Agriculture before coming to a decision as to the future of the College. While agreeing that the Ministry of Agriculture is the chief ministry concerned with veterinary science, we agree with the suggestion recently made by Major-General Sir John Moore that other ministries are also vitally concerned and that a conference of responsible heads of those ministries might be held to consider the necessities of the case, with the view of obtaining a proportionate grant from each of them. The Lovat Committee appointed by the Colonial Office emphasised the importance of a good supply of fully trained veterinary officers for the Colonies; the Ministry of Health requires veterinary officers for its administration, particularly in regard to milk supply and meat inspection as well as in respect of animal diseases communicable to man; the Ministry for War still requires a fully competent Army Veterinary Corps, and will continue to do so in spite of mechanisation; and the Ministry for Education must certainly be concerned with the technical education of a College affiliated with the University of London and training candidates for science degrees of the University. Thus no fewer than five ministries are more or less seriously concerned, and a conference as suggested of the Ministries of Agriculture, the Colonies, Health, War, and Education might yield some satisfactory results.

The progress of veterinary science has, moreover, introduced a new factor. The governing body of the profession—the Royal College of Veterinary Surgeons—has extended the course of training from four years to five years, and the change is expected to take place next year. This extension alone will increase the need for more accommodation and a larger staff at the Royal Veterinary College. If it is difficult to carry on the work under present conditions, it will become impossible under the new curriculum.

An International Veterinary Congress has just been held in London and upwards of two thousand delegates attended from all over the world. Most of them visited the Royal Veterinary College and must have wondered at the depressing and humiliating spectacle which is presented by this dilapidated structure, the premier veterinary college of the British Empire. It is to be hoped that the Government will realise its responsibilities in this matter, and take early steps to place the College on a sound basis both as regards buildings and finance.

Popular Science under Discussion.

(1) *The Pastures of Wonder: the Realm of Mathematics and the Realm of Science.* By Prof. Cassius Jackson Keyser. Pp. xii + 208. (New York: Columbia University Press; London: Oxford University Press, 1929.) 14*s*. net.

(2) *Modern Science: a General Introduction.* By Prof. J. Arthur Thomson. Pp. xi + 210 + 6 plates. (London: Methuen and Co., Ltd., 1929.) 3*s*. 6*d*.

(3) *The Rhythms of Life, and other Essays in Science.* By Dr. D. F. Fraser-Harris. (Science for You Series.) Pp. vii + 185. (London: George Routledge and Sons, Ltd., 1929.) 5*s*. net.

(4) *Short Stories in Science.* By J. G. Crowther. (Science for You Series.) Pp. viii + 213. (London: George Routledge and Sons, Ltd., 1929.) 5*s*. net.

(5) *Science and the New Civilisation.* By Robert A. Millikan. Pp. vi + 194. (New York and London: Charles Scribner's Sons, 1930.) 7*s*. 6*d*. net.

(6) *Popular Research Narratives.* Vol. 3: *Fifty Brief Stories of Research, Invention or Discovery, directly from the 'Men who did it'.* Pp. viii + 174 + 5 plates. (London: Baillière, Tindall and Cox, 1929.) 4*s*. 6*d*. net.

(7) *Men Who Found Out: Stories of Great Scientific Discoverers.* By Amabel Williams-Ellis. Pp. 224 + 15 plates. (London: Gerald Howe, Ltd., 1929.) 5*s*. net.

(8) *This Bondage: a Study of the 'Migration' of Birds, Insects and Aircraft, with some Reflections on 'Evolution' and Relativity.* By Cmdr. Bernard Acworth. Pp. xxiv + 229. (London: John Murray, 1929.) 7*s*. 6*d*. net.

A. WHAT have you there?

B. The eight books on popular science that I asked you, as an educated man disclaiming any special knowledge of science, to read and to discuss with me. They were written especially for people like you.

A. Have you read them too?

B. Well, I have to review them for NATURE; and I am reasonably conscientious. A discussion with you might give me some useful ideas for the review.

A. I am honoured. But how shall we begin? The books do not fall into any special order.

B. Shall we take them as they come? Here is Keyser's "The Pastures of Wonder", which explains the philosophy of mathematics, and bases on that a philosophy of science. I suspect you found it heavy going.

A. I must confess I did. I struggled along to page 36, where I met my Waterloo: "If a pro-

position P is such that to assert it is equivalent to asserting that a proposition q is logically deducible from a proposition p, or— what is tantamount—that p implies q, then P is a hypothetical proposition ; in the contrary case P is a categorical proposition ".

B. I sympathise with you. In no sense of the word can logic or the theory of mathematics be made popular. But I strongly recommend Section 2 of the book, in which Keyser deals with the realm of science. You will follow most of it in spite of your disaster with page 36, and enjoy, I hope, the courageous examination of the veiled antipathy between the scientist and the philosopher—a conflict due, of course, to differences in temperament, not in ideals.

A. You encourage me. I like the feel of the book - its binding, paper, and the excellent print. But isn't it somewhat dear at 14*s*. ?

B. American books are always expensive.

A. Ah ! that's due to protection.

B. You forget. I am reviewing for NATURE, not for the *Spectator*. Here is the next book : " Modern Science ", by J. Arthur Thomson. There was no difficulty here, I imagine ?

A. None at all. Thomson's books—I've read most of them—never give me the impression that he is writing down to my level, and yet, of course, he is.

B. Few people have that happy gift, and Thomson is one of them. But I must be critical if possible. What did you think of the diagrams ?

A. I don't remember them particularly, except, of course, those illustrating some definite point, such as the development of a coral.

B. Exactly. I cannot feel that the complex relations between organism and environment, for example, are much illuminated by a few concentric circles with arrows of different lengths scattered over them. But I mustn't be dogmatic ; they may serve as mnemonics. Now for the next book : " Rhythms of Life ", by Fraser-Harris.

A. That ranges over almost as wide a field as Thomson's book. I like the manner in which all kinds of out-of-the-way information has been welded into a coherent whole. The chapters on " Suspended Animation " and " How many tastes have we ? " show that particularly well.

B. " Rhythms of Life " deals mainly with biological subjects. It is, I see, in the same series as J. G. Crowther's " Short Stories in Science ", which is largely concerned with physics and chemistry. I shall be most interested in your views on Crowther's book.

A. Why that one more than the others ?

B. Well, Crowther implies in the preface that he is a layman in science. That brings up the question whether science for the general public is presented better by laymen or by professional scientific workers. In other words, should the author be a man who knows his subject or one who knows his audience ?

A. I don't quite follow you. Surely every author should know his subject ?

B. Obviously. But among men of science, ' knowing the subject ' implies the initiation and control of original research work. So I will put my question in this form : Is the discoverer the best man to explain his own discoveries, and those of others, to the educated public ?

A. An awkward question. I am not competent to answer it. But I thoroughly enjoyed Crowther's book.

B. Frankly, so did I. If every layman-author understood as much of science and wrote as well as he does my question would be answered. Incidentally, Crowther devotes his last chapter to this very question. He argues that the majority of men of science should avoid non-technical exposition, and bluntly says : " a scientist who chases both literary and scientific images is endangering his scientific career ". The argument is cogent and merits the careful attention of all scientific workers who hanker after the fleshpots of journalism. But we cannot spend more time on that point now ; we have still four books to deal with. I suggest we take Millikan's " Science and the New Civilisation " next.

A. That will be most appropriate, for I can see it is an exception to Crowther's general argument. Although the book is a collection of various addresses, and therefore discursive in parts, there is an unmistakable air of authority about it ; Millikan knows what he is talking about.

B. Yes, and knows how to say it, too. In fact, I wish he had not used italics so freely in places, for his literary style does not need such artificial aid. Take, for example, his address on the relation of science to industry given to the hard-headed business men of the New York Chamber of Commerce. That speech must have been a triumph ; yet in its printed form it contains scarcely any italicised words. Well, the next book also hails from the United States : " Popular Research Narratives ", vol. 3, with the comprehensive sub-title, " Fifty Brief Stories of Research, Invention or Discovery, directly from the ' Men who did it ' ".

A. That left me with rather a dizzy feeling. From "Distances of the Stars" to "Cast Iron Pipe" and thence to "Wealth from Cornstalks"—to mention three typical examples—is rather a big jump; and an average of only three pages for each account gives the book a hurried, breathless atmosphere.

B. It was written for the American public, which has an insatiable appetite for concentrated information, and has no time to waste on literary trimmings. This book undoubtedly meets that demand; and it has given me, with my sneaking admiration for the crude vivacity of American phraseology, another addition to my collection. It is the opening of the article on moulding rubber with electricity: "Man has long used rubber to keep electricity where it belongs". I could quote some others, but I know you detest them. So let us pass to "The Men Who Found Out", by Mrs. Williams-Ellis.

A. I had no opportunity of reading that; my children discovered it and stuck to it firmly.

B. I don't think we could find any higher tribute than that, but I would like to add one thing. These stories were first given as broadcast lessons to young children. A mere transcription of such lessons into book form would make a poor book, for the technique of broadcasting to children, and of writing for them, are two very different things. Mrs. Williams-Ellis evidently appreciated this point, and she has produced a most enjoyable book. Her descriptions of Harvey, Faraday, Pasteur, and other scientific pioneers will set many youngsters on the path of hero-worship.

Now we come to the last book: "This Bondage", by Commander Bernard Acworth. Well?

A. Well?

B. From which illuminating remark I judge that the Commander has not had an enormous success. What was the trouble?

A. I had the uncomfortable feeling that the author had a few axes to grind. He has no use for airships, aeroplanes, scientists, Dean Inge, and the Bishop of Birmingham; and all this is based on his demonstration that the track of a bird or insect in flight is inevitably affected by air currents.

B. We can dismiss the axe-grinding with the cynical remark that it would have been better had he collaborated with one of the despised scientists. With regard to the effect of wind velocity on the flight of birds, which is ostensibly the main purpose of the book, I feel unkind enough to say that the author has discovered—somewhat belatedly—the parallelogram of velocities and is anxious to tell the world about it. He should have confined himself to that, for, as he justly points out, some naturalists talk a lot of nonsense on the subject.

Now, having completed our discussion of these books, I propose not to write a formal review, but to give instead the gist of our conversation.

B. A. KEEN.

Life and Physics.

Beyond Physics, or the Idealisation of Mechanism: being a Survey and Attempted Extension of Modern Physics in a Philosophical and Psychical Direction. By Sir Oliver Lodge. Pp. 172. (London: George Allen and Unwin, Ltd., 1930.) 5*s*. net.

SIR OLIVER LODGE could not write a dull or uninteresting book if he tried. In this book he puts forward his own views so modestly and discusses the view of others so lucidly and fairly that it is an ungrateful task to criticise him. At the same time he states the problems so fully and candidly that he provides all the material needed for criticism. His main object is to find a place for life and mind in the world of physics, or rather behind the world of physics as a primordial ingredient of the universe. In the reviewer's opinion he is looking in the wrong direction for the solution of the problem, and if his theory were true the problem would be of its very nature insoluble. Of course the problem may be insoluble.

The nature of the argument can perhaps be made clear by an analogy. It is said that a tourist once got into a cab at Cambridge Station and asked to be driven to the University. The cabman after much thought and with some hesitation stopped midway between the Senate House and Great St. Mary's and said that that was the best he could do. He realised that the University is not, as the tourist imagined, a physical object. Neither is it a set or class of physical objects. The class of all members of the University plus all inanimate objects such as buildings, books, and so on that belong to it, is not in itself the University. The University is rather a system of relations among members of this class and many other physical objects too numerous to mention, but including the King, his Parliament and all his subjects, in accordance with whose laws the University continues to exist. What constitutes the University and why we give it a single name is that there is a unifying principle among these relations. In a word, the University is an organism, or a system of organisation among a group of physical objects, which are in a more or less intimate way its organs. The

Vice-Chancellor is one such organ, but so also to a less degree is the cheque for five guineas sent to an external examiner. From the ordinary point of view of physics, which is not unlike that of the tourist, the University is a pure nonentity.

The University in its relations to physical objects is taken as being analogous to the life or the mind of a man in its relations to his body and physical environment. There is nothing novel in this statement; the matter has come to the fore recently in the writings of several well-known philosophers, and it is all excellently discussed by Sir Oliver Lodge. But he is not content to say simply that the life of an organism *is* the unity or principle of its organisation; he looks for something physical or quasi-physical to be its basis. His answer is (to put it crudely) as though the cabman had said to the tourist: "All these buildings and people you see round you being physical objects are ultimately only sets of group waves having relatively slow velocities, of the order u. Their constituent waves in the ether, which have higher velocities v such that $uv=c^2$ where c is the velocity of light, *are* the University. These constituent waves, though they possess no energy, control the direction of propagation of the group waves, which possess all the energy and consequently are what you perceive. But I can assure you that though the constituent waves are not accessible to observation they pervade the whole ether, and the specific University of Cambridge waves are specially concentrated on this spot."

This is meant seriously as a *reductio ad absurdum* argument. As we all admit we know little about life and mind we are ready to believe almost anything about them. It is easier to see the fallacy of a theory if it is applied to a similar type of organisation we do know something about, though there is the risk that the analogy may be misleading. In this case the analogy is of course imperfect, but it is not likely to be seriously misleading, because practically all we know of life from the physical point of view is that it is a process of organisation among material objects.

The fallacy (as I believe it) that Sir Oliver Lodge has fallen into is a common one. Everybody sees that life and mind are not physical objects or things related in any simple way to physical objects, therefore they either say that there are no such things or try to discover something quasi-physical to fill the gap. Most of the traditional theories of life and mind are of this type. The savage and the child cannot believe in an entity which is not a physical object, and the difficulty lurks at the back of the minds of all of us. Even Sir Arthur Eddington inclines in this direction when he would base spontaneity and freedom on the supposed indeterminism of intra-atomic processes, and Sir Oliver Lodge very properly criticises him for it.

Up to the present time physical theory has developed on analytic lines. Where the behaviour of aggregates has proved too complex for study they have been analysed into their components, and it has been assumed that the behaviour of the aggregates can be found by compounding in some simple way the behaviour of the components. The other type of aggregate that has been dealt with is the random aggregate to which the theory of probability can be applied. The great triumphs of physical theory have been in the treatment of random aggregates on one hand and of 'microscopic' transactions on the other. Organised aggregates have until recently been left alone. If the essential character of living things lies in their mode of organisation rather than in the nature of their parts, we can infer from the failure of physics to discern the nature of life among macroscopic objects that it is useless to look for it among molecules and atoms or electrons and protons, still more so in a hypothetical underlying ether. If you cannot see the design of a house in the pile of bricks dumped on the site, still less can you see it in the clay the bricks were made from. It may be mentioned in passing that the biologist has for the most part been confined to using the tools that physics has provided, and this is his excuse for having gone such a little way with such great efforts. The psychologist labours under similar but even greater difficulties.

There is evidence, as indeed Sir Oliver Lodge points out, that the physicist is beginning to consider the problems of organisation. Atoms are evidently organisms of electrons and protons, not aggregates in the simple sense. Again, a crystal is an organism of atoms of a very elementary kind. It is possible that from the study of these simple cases a physics of organisms will develop to supplement the classical physics of mere aggregates; and thereby new and superior tools will be put into the hands of the biologist for the study of higher grade organisms. On the other hand, it is possible that the human intellect will not be able to advance much beyond the classical analytical procedure. However, the problem does not appear to be inherently hopeless.

The suggestion that the nature of life and mind is to be sought in some property or process of the ether refers the problem to something outside the range of ordinary experience or knowledge. Sir

Oliver Lodge admits that no perceptible effect, however small, which can be attributed to the ether, has yet been found. He says (p. 100): "We may not be able as yet to measure motion except with reference to other pieces of matter, but some day I hope it may be measured with reference to the ether; . . ." If the principle of relativity is correct this hope cannot be realised: if it is false the probabilities are still all against it, seeing how hard physicists have tried to realise it and failed. As things stand at present we can assert anything we like about the ether, but nothing we assert will enable us to infer anything definite about any perceived or perceptible event. It was pointed out long ago by Leonardo da Vinci that valid scientific knowledge must begin with what is experienced and in the end point to something that can be experienced.

In the whole material universe life appears as something accidental and trivial. It needs very special and inherently unlikely combinations of circumstances for its development. So far as we know, it emerges only for a little while on one obscure planet. To say that the ultimate basis of life is something inherent in the constitution of the physical world makes the problem more difficult. If the seeds of life occupy all space and time, why are their flowers so few and brief?

To us as living and conscious beings the most important aspects of life and mind, the aspects that interest us, are not to be described in terms known to contemporary physics. So far as they can be described at all, it must be in terms of value, of praise and blame, of desire and aversion. It is conceivable that a system of knowledge might be built up from the general and abstract basis of physics to give an adequate account of life and mind, but it will need to include many elements not originally given in that basis. It is scarcely conceivable that a theory that uses only the most abstract and general physical terms can answer the questions about life and mind we are most concerned to ask.

A. D. Ritchie.

Savage Life and Thought.

Orokaiva Society. By F. E. Williams. Pp. xxiii + 355 + 37 plates. (London: Oxford University Press, 1930.) 25*s.* net.

Mr. F. E. Williams, the Government Anthropologist of the Territory of Papua, has given us in "Orokaiva Society", a book that will be of great value to ethnologists, to psychologists, and to those interested in administration. His excellent previous book "Orokaiva Magic" (1928) should be read in conjunction with the new one, as together they afford an illuminating study of savage life and thought. It is not too much to say that this combined work is one of the best that has been written about a particular group of peoples, for it not only gives detailed and well-illustrated accounts of the multifarious aspects of native life and the things that are made, but, what is of special value, the conclusions of a thoughtful investigator who has had, and made full use of, exceptional opportunities.

The useful, though obscure, name of Orokaiva is given to the group of tribes who inhabit the northern division of Papua from the lower Eia River (8° S. lat.) to Oro Bay, north of Hydrographers' range and inland for a distance of thirty miles or more. They are Papuan-speaking peoples with a fairly uniform culture which, on the whole, resembles that of many parts of New Guinea, but there is a notable difference between the northern and southern groups. The former includes the Aiga, Binandele, and Tain-Daware, and is characterised by numerous and remarkable dramas (at which very small drums are employed) which seem to replace the use of the bullroarer and ritual flutes in the initiation ceremonies of the southern tribes and in those of other tribes to the north and north-west.

All the tribes perform certain ceremonies, which are virtually *rites de passage* to convert the candidate, usually about the age of puberty, into a 'new child'. As among the Marind-anim of the extreme south-west of New Guinea, both sexes are initiated together. Those of the southern group are interned in a specially built house where they are introduced to the spirits of the dead, who are supposed to emit the noises caused by the bullroarers and flutes, and they are subjected to ill-treatment and terrifying experiences. The novices are completely covered with hoods of barkcloth, and the fathers and mothers entreat the spirits not to devour their children. Then follows a long period of seclusion in the special house, the avowed object of which is to make the children grow big and well-conditioned. They are taught to be honest, obliging, and diligent, and how to play the flutes. The end of this period is marked by a spectacular display; each novice is invested with a feather headdress which had been worn by a man who impersonated a spirit, and some of them, but not all, are adorned with a valuable ornament, the possession of which involves certain ethical obligations, and formerly in some cases it constituted the

distinctive badge of a homicide. Then follows promiscuous intercourse (on this occasion only), but not by the novices. A small rite releases the taboo on the mother's cooking, and a mixed stew is brewed and, after the novices are fumigated in its steam, they partake of it and may then resume full diet; this last rite is to prevent bodily deformities. It may be pointed out that there is a remarkable general similarity between these customs and those which obtain among the peoples north of Huon Gulf, and to a somewhat less extent to those of certain tribes about the Fly and farther west, all of which point back to an ancient cult of a monster or ancestral spirit who devours the novices.

A curious example of native psychology is found in what is termed *meh*, a feeling of shame, humiliation, and contrition. An Orokaiva who has been wronged is not only sorry for himself but he also wants others to be sorry for him, and particularly the man who has wronged him. Such a man will destroy his own property, run away from home, deliver himself up to an enemy tribe, or even hang himself on a tree, for the Orokaiva is very prone when his feelings are hurt to punish himself instead of the man who has hurt him, or rather by punishing himself to take revenge upon the other party or in order to make him feel *meh*. The state of anger and self pity endured by the wronged man has a definite name, *sisira*, and by his action the culprit is put to *meh*, and very unpleasant he finds it, as apart from his own sense of shame he is the object of public reprobation.

The foregoing will suffice to indicate the interest and value of this careful piece of work.

A. C. Haddon.

Aviation and Meteorology.

(1) *Exploring about the North Pole of the Winds.* By Prof. William Herbert Hobbs. Pp. viii + 376 (24 plates). (New York and London: G. P. Putnam's Sons, 1930.) 5 dollars.

(2) *La navigation aérienne transatlantique.* Par Capt. G. Voitoux. Pp. 144. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1930.) 28 francs.

(1) PROF. HOBBS'S book is a well-illustrated and entertainingly written account of three expeditions under his leadership between 1926 and 1929 to the south-west coast of Greenland. The expeditions were organised as a University of Michigan enterprise, and were for the purpose of studying the wind system controlled by the Greenland ice-sheet. An aerological station was established on Mt. Evans at a little above 1000 feet, some distance inland from Holstenborg in about latitude 67° N., and functioned uninterruptedly for two years. The staff of the observatory had to be changed at intervals, and though the latter has now been closed, everything has been left in readiness for a resumption of activity in the future. A large number of balloon ascents were made from here and at encampments elsewhere in this part of Greenland in addition to the usual ground observations, and several sledge journeys were conducted to the inland ice-sheet.

The observations appear to confirm the prevalent theory that the winds blow outwards from the ice-dome and inwards at higher levels. Prof. Hobbs, of course, has always been a champion of the Glacial anticyclone, and it is satisfactory to find his views substantiated in the chapter on the "Winds from the 'Great Ice'", wherein he shows that the entire circulation over the ice-cap is similar to the outline of an hour-glass. What serious meteorologists will miss, however, is something like a complete log of the actual daily observations which would give them an idea of the extent of the variations from these standard conditions. The southern part of Greenland has a heavy snowfall, which certainly points to temporary influence by the Icelandic depressions. The expedition appears to have met with an abnormally mild winter on the south-west coast in 1927–28, when föhn winds, raising the temperature at times above 40° F., would cause a complete clearance of the scanty snowfall. Storm winds are recorded of the order of 120 miles an hour, rendering navigation difficult and perilous in the long winding fjords. One is struck with the frequent reference to rain instead of snow in the summer months along this part of the Arctic circle, and wonders whether this is usual. The reader will, in fact, wish for a little more discussion of the weather events experienced in relation to general climatic conditions in Greenland.

Prof. Hobbs considers that Mt. Evans has unique advantages for a flying base on a proposed northern air route across southern Greenland between America and Europe. Along the route from Mt. Evans eastwards to Angmagssalik the ice plateau has a maximum altitude between eight and nine thousand feet, and it should be possible for the aviator to navigate safely by the use of his altimeter above the smooth snow surface.

On the human side the book is pleasant reading, and there are naturally some exciting adventures to record.

(2) Capt. Voitoux's book, if somewhat close reading, affords nevertheless a very intelligible account of North Atlantic weather in relation to aerial navigation. It is based fundamentally on a full year's observations from vessels at sea, and in order that the reader may have, so to speak, all the author's cards on the table, these observations are reproduced in the form of a log covering 366 daily observations over the period May 1, 1927–April 30, 1928. This shows the positions of the centres of high and low pressure (produced also on a handsome map of the North Atlantic), the direction and force of the wind, and the state of the weather. After a general explanatory account of the regimen of North Atlantic wind and weather, a number of weather situations that occurred during the period are carefully analysed with the aid of the weather charts of the French Meteorological Office, and opinion expressed as to what, in the particular conditions, should be an airman's route across the ocean, having regard first to safety and then to speed.

Wind according to its relative angle can be helpful to aircraft, but is more usually prejudicial even if not actually dangerous, whilst storms and all atmospheric conditions that the author comprises under the term 'intempéries' are always inimical. That the North Atlantic is a stormy ocean is brought out in a way that cannot fail to impress the reader. It appears that a ship crossing the ocean must practically always reckon on encountering storm winds on some part or other of the voyage even in summer, and that in sixteen years a Commandant de Transatlantique only once enjoyed fine weather the whole way. The mean wind velocity is about 40 kilometres per hour, a figure based upon a great number of observations from all parts of the North Atlantic, including calms and tempests. Out of 5782 ships' observations, calm is noted only for 111 positions on 86 different days, but on these 86 days winds of varying strength were experienced on other parts of the course.

A contrast is drawn between the conditions of the seaman and the airman over the ocean. The seaman has his navigation charts to rely on, and whilst the marine currents can only deflect him from his course by relatively small known amounts, the effect of the air currents on the drift of his vessel is insignificant. The airman's case is very different. For him the most advantageous route to follow is constantly changing from day to day, or even from hour to hour; the air currents may help or hinder him in a way he does not immediately appreciate, and may deflect him from his course by an amount ten, twenty, fifty times greater than is the case with the seaman.

The aviator's chart cannot, unfortunately, indicate the mobile dangers of the atmosphere as the mariner's chart does the fixed dangers of the sea. It is nevertheless essential that the airman should study the behaviour of cyclones and anticyclones, and learn to take the favourable side of these systems, for on this procedure depends success or failure, safety or death. Reference is made, further, to the vast lonely tracts of ocean even in the frequented liner routes, giving poor chance of succour to an airship or aeroplane in distress.

Capt. Voitoux writes throughout with a strong note of caution, and deprecates reckless adventures of the kind that inevitably spell disaster. He quotes expert opinion to the effect that in the present state of the science of aviation the flight across the North Atlantic from west to east is almost impossible in the higher stormier latitudes. Whilst fully endorsing all the caution that the author enjoins, we must yet ask whether there is really much justification for supposing that the *present* state of the science in question will obtain much longer. With all that has already been achieved, it seems to us disproportionate to think that the time will be long before the flight across the Atlantic becomes a commonplace in either direction. We must also remember that all mechanical progress has been purchased at the cost of a toll of human life.

Our Bookshelf.

Shells of the Tropical Seas. By Ida Colthurst. Pp. iii + 13 + 6 + 6 plates. (Calcutta and Simla: Thacker, Spink and Co., 1930.) 4.8 rupees.

THE author has a pleasant way of writing about what is usually made dull. She might quite well expand her pamphlet into a short volume to re-awaken interest in shells. A little story is told us about most conspicuous families, their varieties of shells and their beauty and interest being brought out with subtlety. The author should visit Tuticorin, Ceylon, or the Andamans, and collect her molluscs on the reef flats, if she wants to make the attractive picture of the living animals that the present generation requires. We want to know much more about the *cilia-moving forms* and the mode of feeding of bivalves. We wonder whether pressure is of any importance in the distribution, and surely diminution of light is only indirectly so as inhibiting the growth of the plants on which they feed. There is no laminarian zone round southern India, being replaced by the coralline zone, which extends to about 30 fm., where it is stated that it commences. Nor is any evidence given that the pearly nautilus or any other existing animal lived

in palæozoic times. To say nothing about the squids is extraordinary.

It is foolish to-day even for a " Diocesan Press " to talk about "the book of creation" and "the power which makes the planets go"; the religion which prints such worn cliches can only be laughed at by educated Indians; it is best to take advice from S. Athanasius, who is quite clear on this subject. Why drag in a Laccadive sea of no particular interest and certainly not a "sea"? An author must handle oysters and mussels before they can be written about, and why not say how the starfishes of tropical seas kill oysters? Most shelled Buddhas are in freshwater mussels—and Bideford bridge is not at the junction of the Taw and Torridge. The illustrations are well chosen and badly reproduced, but clearly the book is not intended to sell, for 23 pages of letterpress with 6 half-tone plates will never find a wide market at 6s. 9d., taking the rupee at 1s. 6d. Perhaps some member of the staff of the Calcutta Museum might supply the facts for a book and Miss Colthurst the indispensable vivacity; it would do both good.

British Museum (Natural History). British Antarctic (Terra Nova) *Expedition, 1910. Natural History Report. Zoology*, Vol. 5, No. 5: *Coelenterata.* Part 5: *Hydroida.* By A. Knyvett Totton. Pp. 131-252 + 3 plates. (London: British Museum (Natural History), 1930). 15s.

EIGHTY species of hydroids were obtained by the *Terra Nova* expedition, of which four only belong to the Athecata, a discrepancy which is not explained. Their geographical distribution is not considered, but judging from the list of stations there would seem to be about the same number of species on suitable bottoms from the surface to 300 fm. The present treatment of a group of beautiful little animals is in a hard systematic strain. The author restrains his soul, for there is scarcely a reference to, and not a single drawing of, any polyp. We wonder whether the classification almost solely on the external skeleton is sound and how far it is going to lead us. The British Museum alone of institutions in Great Britain has the material necessary to answer this question. Like all its publications, the work is well reproduced. We would, however, ask the director to consider the advisability of enforcing standard magnifications in all figures, one genus showing no less than thirteen different magnifications in the plates.

The Colloid Chemistry of Rubber. By Dr. Paul Stamberger. Pp. vii + 80. (London: Oxford University Press, 1929.) 6s. net.

THE Oxford University Press has already published under the title "The Colloid Chemistry of the Rubber Industry" a small volume (of 56 pages) by Dr. E. A. Hauser, professor of colloid chemistry at the Massachusetts Institute of Technology, as a report of lectures of a series instituted by Mr. Patrick Gow. The present volume contains the subject-matter of lectures of the same series, given at University College, London, in November 1928, under the title "Colloid Chemistry and its Relation to the Rubber Industry". The first chapter is a general introduction to the study of colloid chemistry and colloids, the second chapter—on the colloidal properties of rubber—deals with rubber latex and its industrial applications, the third chapter —on lyophile colloids—deals with crude rubber and its solvation, whilst the two remaining chapters deal mainly with the 'compounding' of rubber with 'fillers' of various types, and with its vulcanisation, but also include a section on the synthesis of rubber, and an account of current views on the structure of rubber. The book will appeal most strongly to those who are concerned with the manufacture and use of rubber, but is written on such broad lines that it may be read with interest by other students of colloid science. The volume is presented in a very attractive form and at a reasonable price, and it should have a wide circulation.

Medicinal Herbs: and How to Identify Them. By Richard Morse. (The "How to Identify" Series, No. 21.) Pp. 64. (London: The Epworth Press, 1930.). 1s. 6d. net.

IN this little book of 64 pages, descriptions are given of twenty-seven commonly found wild plants that either are or have been used for medicinal purposes. An illustration is given of each plant described, and the descriptive matter includes a description of the plant in popular language, particulars as to where the plant is to be found, and an account of its medicinal properties and uses. The author does not claim that his work is exhaustive in any direction, his object in writing the book being to provide a pocket guide which would enable people on country rambles to learn something about some of the plants they pass.

The Trauma of Birth. By Otto Rank. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xv + 224. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 10s. 6d. net.

LIKE so very many examples of psycho-analytic writing, this work is almost purely speculative and the author allows himself to be carried away by theorising, seeing and believing what he wishes to see and believe. His main theory is that the trauma of birth is the most deeply repressed portion of the mind. Anxiety and other symptoms are attributed to this birth trauma. From a therapeutic point of view, experience with schizophrenics leads one to be very sceptical of analysis as a procedure of any value.

The Truth about Mind Cure. By Dr. William S. Sadler. Pp. viii + 206. (London: George Allen and Unwin, Ltd., 1929.) 5s. net.

"THE Truth about Mind Cure" is a simple and straightforward account of elementary psychotherapy by an American physician. He deals with his subject in a popular way and certainly presents a very readable account for the lay reader. The advice is sound and may do good to many lay people who are interested enough to read it.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spontaneous and Induced Magnetisation in Ferromagnetic Bodies.

ACCORDING to Weiss's well-known theory, a ferromagnetic body in the absence of an external magnetic field must be spontaneously magnetised in such a way that the direction of magnetisation varies in an irregular manner in different portions of the body. It was originally assumed by Weiss that these portions coincide with the minute crystals of which the body is built up. That this is not so is clear from the fact that spontaneous magnetisation (as revealed by the existence of a Curie temperature) is present also in single crystals. We are thus forced to assume that a moderate-sized single crystal of a ferromagnetic body consists of a number of 'elementary magnets' the resultant magnetic moment of which vanishes. This spontaneous subdivision of a ferromagnetic body into elementary magnets can be interpreted both qualitatively and quantitatively in the following manner.

In the absence of Weiss's 'quasi-magnetic' forces (forming the molecular field and depending, according to Heisenberg,[1] on the quantum exchange effect) the individual magnets (electrons) would tend to orient themselves in such a way as to insure the disappearance of the resulting magnetic moment in every unit cell of the crystal-lattice—just as in the case of a crystal built up of electric dipoles.[2] The usual conception that such dipoles—whether electric or magnetic—tend to orient themselves in the same direction is wholly wrong, the minimum value of their mutual potential energy corresponding to a state of electric or magnetic neutralisation, that is, to the disappearance of the resulting polarisation in the least possible volume.

In the case of a ferromagnetic body, there are, on the other hand, the quasi-magnetic forces, which at small distances are much more powerful than the Coulomb ones and tend to orient the individual magnets in exactly the same direction. This struggle between magnetic and quasi-magnetic forces results in a compromise, the individual magnets uniting in elementary 'bunches', which owing to Coulomb forces acting between them are oriented in a way similar to those in which the individual magnets would be oriented in the absence of quasi-magnetic forces. This spontaneous magnetic splitting can be compared with the splitting up of a large mass of a liquid into single drops, under the condition that the surface energy of the latter should be compensated by some sort of mutual potential energy quite different from the energy of the ordinary cohesive forces.

In our case, the work done against the quasi-magnetic forces in the process of splitting up of a uniformly magnetised body into single 'drops', which magnetically neutralise each other, is equivalent to a surface energy of the amount $\frac{1}{2}AI^2s\delta$ per drop, where I is the original magnetisation of the body (equal to the magnetic moment of each drop M, divided by its volume v), A is the constant of Weiss's molecular field, s is the surface of a drop, and δ the thickness of its surface layer, that is, the range of the quasi-magnetic forces; δ is obviously of the order of magnitude of one atomic distance. The Coulomb potential energy per 'drop', corresponding to the work done by the magnetic forces in the process of 'disorientation', is equal to $-\frac{\alpha M^2}{l^3} = -\frac{\alpha I^2 v^2}{l^3} \cong -\alpha I^2 v$, where l is the distance between the centres of the neighbouring drops (since it is of the same order of magnitude as its linear dimensions, $l^3 \cong v$) and α a numerical coefficient; in Born's theory of a dipole lattice (*loc. cit.*) $\alpha \cong 1{\cdot}5$. We thus see that the increase of quasi-magnetic energy due to splitting is just compensated by the decrease of magnetic energy when $\frac{1}{2}AI^2s\delta = \alpha I^2 v$, that is, when the linear dimensions of the 'drops' $\frac{v}{s} = l$ reach the minimum value $l_0 = \frac{A}{2\alpha} \cdot \delta$. Since Weiss's constant A is of the order of magnitude of 20,000 (for iron), we have approximately $l_0 \cong 10{,}000 \cdot \delta \cong 10^{-4}$ cm. This shows that *the elementary regions of spontaneous magnetisation must contain at least* $(l_0/\delta)^3 = 10^{12}$ *atoms.*

To find the average size of these regions or 'magnetic drops', we must consider the minimum value of the quasi-magnetic and magnetic energy of a body consisting of a given number of atoms as a function of the linear dimensions of the drops l. Denoting the volume of the body by V, we get for the total quasi-magnetic surface energy $U_1 = \frac{1}{2}AI^2s \cdot \delta \frac{V}{v} = \frac{1}{2}AI^2\frac{\delta}{l} \cdot V$ (it may be remarked that this energy can be regarded as the quasi-demagnetisation energy of the 'interspaces', connecting the uniformly magnetised elementary regions of the body). As to the total magnetic (Coulomb) energy, we must add to the volume part of it $U_2 = -\alpha I^2 v \cdot \frac{V}{v} = -\alpha I^2 V$, which does not depend upon the size of the drops (if the volume of the interspaces is neglected with respect to V), the surface energy of the whole body, due to the incomplete 'screening' of the surface drops. For this surface energy we get in the same way as for the surface energy of an electric dipole substance the expression $U_3 = \alpha' I^2 l \cdot S$, S being the surface of the body and α' a numerical coefficient of the same order of magnitude as α ($\alpha \cong \alpha' \cong 1$). The minimum value of $U = U_1 + U_2 + U_3$ is determined by the equation $\frac{dU}{dl} = 0$, which gives $\alpha' I^2 S - \frac{A}{2} I^2 \frac{\delta V}{l^2}$, $l^2 = \frac{A}{2\alpha'}\delta \cdot \frac{V}{S} = l_0 \cdot L$, where l_0 is the above defined minimum value of l and $L = V/S$, the linear dimensions of the whole body. For a body of moderate size we thus get $l \cong 10^{-2}$ cm. (It must be, of course, supposed that $L >> l_0$.)

The fact that the mean size of the 'magnetic drops' depends upon the size of the whole crystal seems at first sight somewhat bewildering. It should be mentioned, however, that a similar fact is met with in various other problems; thus, for example, in the Debye theory of specific heats of solid bodies, the wave-length of the elastic waves extends on the long wave-length side up to the linear dimensions of the body, and the total number of normal vibrations within a given frequency interval is proportional to the body's volume.

It is probable that actually there are to be found in a ferromagnetic body 'magnetic drops' of various size—from the smallest one (l_0) and up to 10^{-3} cm. or even more. Experiments on the Barkhausen effect by Bozorth in fact give evidence of drops of such large dimensions. An important corollary from the above considerations which should be emphasised here is the fact that very small (colloidal) particles,

the linear dimensions of which do not exceed $l_0 = 10^{-5}$ cm., can never split into drops, and must therefore be permanently magnetised.

Another important consequence is the absence of remanent magnetisation in ferromagnetic single crystals of an ordinary size and, more generally, the absence of hysteresis in such crystals as this was actually shown by Gerlach. It should be remembered that hysteresis is a direct consequence of the Langevin-Weiss theory when applied (as is usually done) to the individual magnets. Actually, an external magnetic field acts on each drop as a whole, the magnetic moment of the drop being determined practically by Weiss's molecular field only, and thus being a function of the temperature alone. We have not yet been able to derive the exact formula giving the dependence of the observed induced magnetisation I' upon the field strength H and the temperature T. According to Weiss's empirical formula, one has, for large values of H, $I' = I(T)(1 - a/H)$, where $I(T)$ is the saturation magnetisation for a given T, and a is a constant independent of the temperature. Our 'drop' picture of a ferromagnetic body leads to an expression of the type $I' = I(T) . f(H)$, where $f(H)$ is a function of H only, different, however, from Weiss's $(1 - a/H)$. It may be observed that the process of orientation of the 'drops' by the magnetic field must be accompanied by their gradual fusion, the whole body becoming a single large drop when saturation is reached.

The phenomena of retentivity and hysteresis which are observed in ordinary ferromagnetic bodies (not single crystals), appear to be connected with the inner stresses characteristic of their structure. It is possible that they are due to the formation of strongly prolate drops arranged in chains (a disposition which is not consistent with the principle of minimum energy within a single crystal). We hope to consider these questions at a greater length in a future communication.

J. FRENKEL.
J. DORFMAN.

Physico-technical Institute,
Leningrad.

[1] See also J. Frenkel, *Z. f. Phys.*, **49**, 34; 1928.
[2] Cf. M. Born u. Kornfeld, *Phys. Zs.*, **24**, 121; 1923.

Space and Matter.

"SOMEWHERE in the absolute elsewhere."—*Punch*, July 9.

> "My interest in Nature
> Is rather based, I feel,
> On freaks of nomenclature
> Than scientific zeal."

Reading these lines, I feel that not a little truth is expressed in poetry, particularly when published from Bouverie Street (July 16). It is true

> "I sometimes like to ponder
> Upon the proper mien
> For coping with a condor
> Couched on the nineteenth green:
> Or else a capercaillie
> Conversing in Old Bailey
> About the works of Paley
> With our tremendous Dean."
>
> Or talk to Ol'ver Lodgey
> About his great big body,

especially when he tells us (July 5) that "Matter is inert; space is energetic. Matter *does* nothing". Like another Bellman,

> "He has bought a large map representing the sea
> Without the least vestige of land."

Perhaps history will be repeated:

> "This was charming, no doubt: but they shortly found out
> That the Captain they trusted so well
> Had only one notion for crossing the ocean
> And that was to tingle *his* bell.
>
> "He was thoughtful and grave, but the orders he gave
> Were enough to bewilder a crew."

Apparently, matter is more window-dressing. Is not perhaps Sir Oliver a window-dresser? *Are* his doings, his writings, *nothing*? They seem to sell. Do they just come out of space? He more than fills a stall and definitely fills space when he jazzes. Would there be no difference between his body and a sculptured likeness in stone from the 'point of view' of space? Is there really no hope for us bits-o'-chemists—is our occupation of structure-hunting gone? He would put matter 'on the dole'. Will he tell us: if not energetic, how does it smoke cigarettes, or is this a function of space? It seems now to be the universal habit: space, we suppose, must have its bad as well as its good habits.

I do venture to question my old friend's modern freaks of nomenclature—his contortions of our vulgar tongue. I have just received a company circular in which the chairman replies to a shareholder's question—"What do the complicated Resolutions really mean in plain and unmistakable language?" I should like to ask, what does Sir Oliver mean in terms of plain English? Is he merely breaking a lance on behalf of his beloved steel-hard ether or is he 'getting at us', in order to air his more than nebulous notion of a future life in space, whatever that may be?

'Science' is something that we are endeavouring (perhaps I ought to say, should endeavour) to pass on to the masses. It were time, therefore, that some protest were made against the language used by our would-be leaders:

> "They have wholly forgot (and it vexes me much)
> That English is what we speak."

The public is being played upon and utterly misled by the dreamery of the rival mathematical astronomers and physicists—not to mention the clerics who are touring to-day and raising the game of notoriety to a fine art. In rivalry to religious mysticism, a scientific pornography is being developed which attracts the more because it is mysterious—apparently the professors are seeking to outrival Mrs. Eddy. They have no regard for consequences. These may well be serious, as is shown by the way in which nonsense about the energy in a drop of water is being repeated everywhere—by law lords thinking of the world in 2030, as well as presidents of societies bordering on the learned, discoursing either of water or of the future of chemical industry—as if it were possible to make such energy available, a contingency which honest men know to be more than remote.

'Science' to-day is prostituted by over-speculation in public; no proper use is made of it to moral ends. Machinery is being made omnipotent: in fact, we need a new word: we no longer *manu*facture; not space but the machine does the work. Man certainly is not energetic. Whilst human beings are fast increasing in number, every attempt is being made to 'rationalise' them out of usefulness. We are even told that agriculture is soon to be handed over to a new synthetic agency—the craze to escape from Nature is upon us. Living matter will soon have nothing to do but lapse into space—we shall al

seek our fortunes 'somewhere in the absolute elsewhere'; in fact, be

"A pack of pure porbeagles,
For hunting of the Snark."

Is it that our make-up is such that we cannot be scientific—that we are perforce only religious?

HENRY E. ARMSTRONG.

Stability in Soap Films.

IN his letter to NATURE of June 28, p. 970, Mr. Lawrence has not, in my view, made the sandwich structure for soap films appear more likely, but has only discussed some necessary limitations to the layered arrangement that I suggested. One or two definite points may therefore be acceptable.

1. Surface layers are almost universal for solutions, but only soap solutions give stable mobile films. If their mobility and permanence is to be ascribed solely to the surface layers, these must be of surprisingly unique cohesiveness.

2. Such surfaces admittedly take time to form, especially in dilute solutions. The process of a slowly growing bubble may be sufficiently deliberate, but the 'throwing' of a film—described by Dewar as workable certainly up to a diameter of 19 cm.—takes only a very small fraction of a second. It would therefore seem that to persist, a film must be formed of material capable of being drawn into some initial structure; the nature of this is, I think, suggested in the definite boundaries which frequently appear, either in long-lived bubbles in the absence of convective disturbance, or in plane films during steadily maintained vertical motion, and in other gradations exhibited in films in a permanently liquid form (see Clerk Maxwell: "Scientific Papers", II. 397. Dewar: "Papers", II. 1341). This is very different from the abnormal solid stratifications depicted in the frontispiece to "Soap Films". The described crystallisation extruded into the original film and provided by solute from the surrounding Gibbs ring can, of course, only occur in tiny films and not over large areas; some of Perrin and Wells's films may be similar, but Perrin says of those last described (*Koll. Zeit.*, April 1930) that they are certainly liquid, and describes the means he took to satisfy himself about this.

3. It is obvious that a five per cent solution can only provide in any film a limited number of layers if these are to be close packed solute; the possible lamination of colloid threads or flakes would certainly be even more limited; and if instead of five per cent we consider a solution of 0·1 per cent (which Dewar found to give perfectly stable films) a statistical estimate such as that suggested would give only a fifth of a molecular layer in a 1000 $\mu\mu$ film. If we then assumed that the equivalent of two close packed layers is present as surface film on either side of this vestige, the disproportion of concentration between soluble surface and enclosed solution becomes miraculous, and how to maintain the supply for the reserve layer an embarrassment, even in such a thick film; reduce the thickness and therefore the available material to one-tenth to get to the order of a silvery film, and I think it may be agreed that we shall need to enlarge our conceptions beyond what close packed solute can provide. Hydration—or may I say 'hydrosolation'—may provide one clue: be it noted that the 'anchoring' of carboxyl groups, etc., to water must be by molecules or molecular groups, and not into an indefinite statistical 'surface' as is sometimes implied.

4. Soap films maintained in vertical motion by steady air jets continuously exhibit sharply defined colour tracks (Dewar: "Papers", II. Front.). Not only is there in such circumstances a main stream in rapid motion—at about one metre a second (*ib.*, 1376)—but the successive adjacent tracks move at different rates, so that the whole film is in continuous relative motion of distinct thicknesses. A similar discontinuous appearance is revealed by almost any horizontal film under microscopic examination (with a vertical illuminator). It is therefore evident that the soap film does not need to be a smooth sandwich.

5. The interfacial attractions that I suggest between self-cohesive layers would be successively equilibrated throughout the film, whereas an ordinary film of liquid without some structural cohesiveness must and does collapse under 'surface' tension despite the universally present adsorbed layer, admittedly because the inwards forces at the surfaces are not equilibrated. The word 'powerful' applied to the interfacial attractions may be misleading; but I see no reason why such layers (see Rideal: "Surface Chemistry", 1926, 91) though yielding to lateral displacements, should not be successively shed or aggregated in the relentless separation of the black. After Lyons's recent work on the variations with pH value of the submersion of oleic acid lenses (*Jour. Chem. Soc.*, April 1930) we may expect the pH value of a soap solution to influence or even control the intensity of aggregation by varying the interfacial or intramolecular attractions within the film. It is certainly to be hoped that the pH value will now be regarded as an essential part of the description of experimental soap solutions.

6. The 'black' area is the only portion of a soap film giving evidence of a close packed structure, because it is non-extensible (Dewar: II. 1197, also Clerk Maxwell: *ib.*, 398) except possibly in very dilute solutions which give misty greys rather than blacks (Dewar: *ib.*, 1345). The observed mechanism of the appearance of the black is by the separation of clots emerging (at greatly varying intensities) from the initial thick film (*ib.*, 1335). Fig. 1 shows (what

FIG. 1.—Development of horizontal soap film: slow aggregation of one 'black' layer on another, film still two-thirds coloured.

has never before been illustrated) that even this sometimes occurs in stages. The distinct character of the coloured area was early evident in the account of one of Dewar's 56 cm. black films (II. 1209). Wandering coloured clots on approaching the periphery are not absorbed into the 'Gibbs channel', as they would be with avidity if they were enclosed between elastic surface layers, but on the contrary divide and circulate in both directions, obviously because they are at the foot of the curved slope of the liquid ring of contact, and actually on the black film surface.

Such observations show that an examination of a directly accumulated mass of black film is very desirable. It should be possible by passing a clean glass rod through masses of black film as collected by Dewar in a 200-litre globe (*ib.*, 1210); or accumulating

a succession of films (drained by cellulose threads to blackness) in a McBain apparatus. Even more valuable would be a trial of the forces at the black boundary by the Langmuir-Adams method, using quite a small trough or film-frame in a moteless Dewar enclosure.

After years of observation I find it difficult therefore to accept that one oriented layer and one irregular reserve layer below this on either face, and nothing but chaos between, can explain the appearances presented by soap films, or maintain their tenacity under such conditions as have been described.

W. J. GREEN.

Royal Institution,
Albemarle Street, W.1,
June 25.

Daily Variations of Temperature.

IN the discussion on the "Irregular Variations of Temperature in London" (NATURE, 126, 61) the case of periods of several days was in question, and smoothed averages were taken. Some years ago I was attracted by the daily irregularities observed at Greenwich, in averages of fifty years, and compared them with those of other available records, Falmouth, Kew, Valentia, and Aberdeen. I wished to have included Buitenzorg, but the volume of records was missing from the Royal Society library.

The results are in the diagram (Fig. 1). The maxima will represent the true solar effect, as we do not know of any other cause of heat; all below the maxima must be due to some cause of deficiency. It will be seen that at the vertical lines (marked with the day-number in the year) each of the records shows a minimum; such a deficiency cannot therefore be due to a local cause. The only obvious cause would be the interposition of streams of minute asteroids in regular orbits. To study this farther would need the comparison of records from a large number of positions, over short terms of years, as orbits may shift by precession. The zodiacal light seems only explicable as due to a large diffusion of matter between the earth and sun, certainly extending as far as the earth's orbit.

FLINDERS PETRIE.

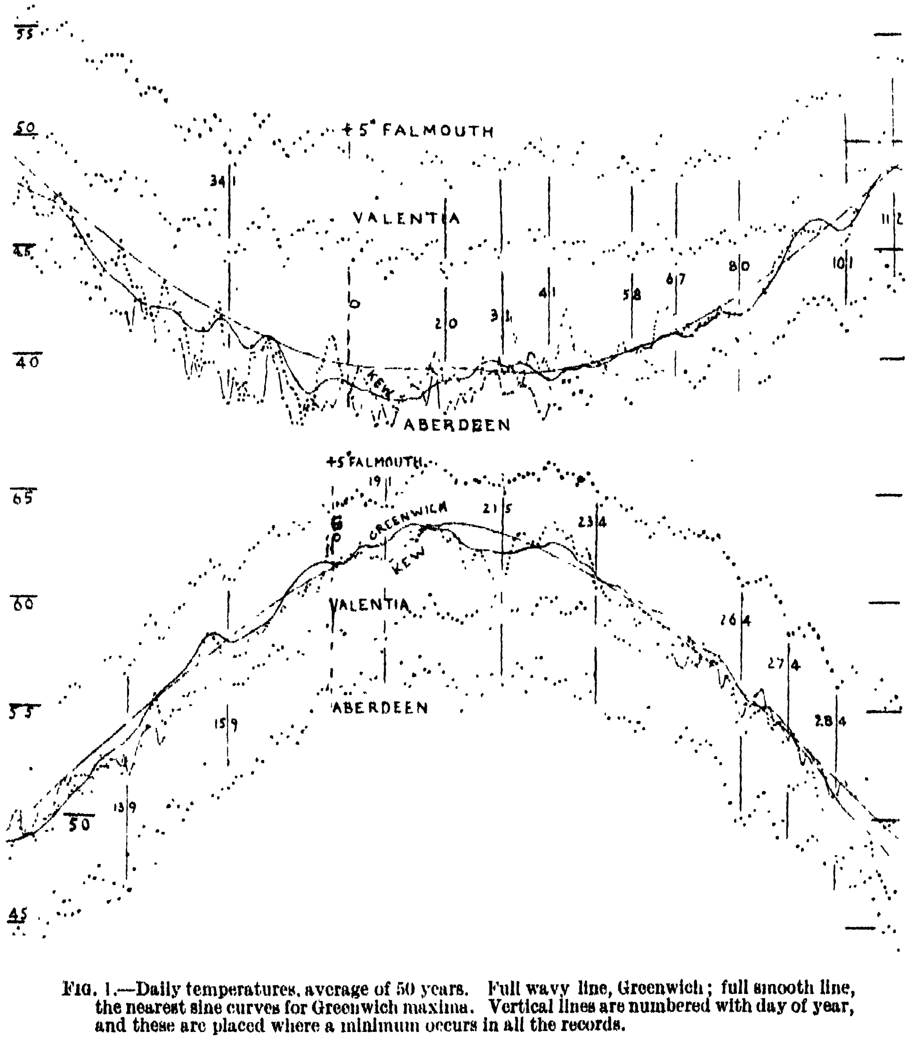


FIG. 1.—Daily temperatures, average of 50 years. Full wavy line, Greenwich; full smooth line, the nearest sine curves for Greenwich maxima. Vertical lines are numbered with day of year, and these are placed where a minimum occurs in all the records.

SIR FLINDERS PETRIE'S suggestion that regular periods of low temperature may be caused through partial cutting off of the sun's rays by cosmic dust is an old one, but is not supported by any real evidence. In Britain temperature is governed far more by wind direction and cloud amount than by solar radiation, especially in winter, when it is practically independent of latitude. The only real test of the cosmical hypothesis would be the examination of averages over a number of years of the daily measurements of solar radiation made by the Smithsonian Astrophysical Observatory. I do not think this test has yet been made; probably the number of observations is still insufficient. The occasional agreements between minima at different stations, shown on Sir Flinders Petrie's curves, may be due to the frequent occurrence of extensive systems of northerly winds on those days, or may be merely accidental coincidences.

C. E. P. BROOKS.

Bird Flotation.

IN commenting on a paper of mine in NATURE of June 14, p. 902, it is suggested that the ability of a bird to extend its feathers further from the skin may enable it to displace a greater volume of water when afloat than the volume measurable to the same surface level when ashore.

Undoubtedly this ability does exist, but, in comment upon the suggestion, I would like to point out that, if the displaced volume were materially increased in this manner the bird could not maintain an upright position but would overturn. This instability is due to the lowering of the metacentre, so that it would be brought well below the centre of gravity of the bird. The facts can be ascertained by calculation and experiment. A duck was provided with a waterproof jacket fitting closely against the underbody feathers; when put afloat, the freeboard of this bird was about one-eighth of an inch less than without the

jacket, but the bird was unable to remain upright. It lolled over about 15° to port, or to starboard, as set; and, from such data, the position of the centre of gravity could be obtained with reasonable accuracy.

As regards the suggestion that a check might be employed to measure the actual water displaced, this is not so simple a matter as it may appear. It seems necessary to define the word 'displacement' as applied to flotation.

A waxed needle can be made to float by the aid of surface tension, and, when doing so, actually displaces a volume of water more than seven times its own volume, however absurd this may seem. In a similar sense, a bird weighing 5 lb. on land may, and must, displace a volume of water weighing 5 lb. In the case of the needle, the weight of water below the line of contact of needle and water surface is only about one fourteenth of the weight of the needle; in the case of the bird, I contend that the weight of water displaced below the line of contact between bird and water surface is only about one-third of the weight of the bird. Possibly surface tension accounts for $\frac{13}{14}$ of the weight of the needle, and for $\frac{2}{3}$ of the weight of the bird. Are we sure, however, that surface tension is the supplementary force in action in the latter case? The usually observed characteristics of surface tension do not seem to be apparent.

The usual meaning of the term 'displacement', when applied to ships or other floating bodies, is restricted to the volume of the body which lies below the line of its contact with the water-surface; and in this sense it was used in the paper to which the comments referred. FRANCIS H. ALEXANDER.

Armstrong College,
Newcastle-on-Tyne, Aug. 5.

IN his original paper, Mr. Alexander, while examining curious suggestions such as that the super-inflation of the internal air-sacs might account for flotation, did not mention the possibility of, and made no allowance for, increased displacement due to the fluffing out of the feathers. Therefore his calculation regarding the amount of water displaced was invalid. His argument against the practical value of the suggestion, that it would cause instability, ignores the power of the living bird to control its balance by its peculiarly adapted feet and perhaps also by feather adjustments. Yet this is the one power that his waterproof jacket experiment demonstrated, for although he actually lowered the centre of gravity, the bird became unstable—obviously because its control had been interfered with. We still think that Mr. Alexander's data are insufficient; until he has measured the actual displacement of the swimming duck and found the water displaced to weigh less than the bird itself, it is futile to argue about supplementary forces of 'levitation' or any other force. Last week, I watched a grebe at one time swimming high in the water, at another time almost submerged. That suggests an alteration in specific gravity, that is to say, since the bird's weight is constant, in volume; and the raising or adpressing of the feathers, with a corresponding increase or decrease in the air-jacket, seems a possible and natural explanation of the change.

THE WRITER OF THE NOTE.

Crystal Structure of Normal Paraffins.

DR. MÜLLER has recently (*Proc. Roy. Soc.*, A, vol. 127, p. 417) made a detailed study of the effect of temperature on the crystal structure of the normal paraffins. He found two modifications, a 'normal' structure *A*, and a second form *B*, the *A* form having a 001 spacing 2 A. longer than the *B* form. Paraffins having more than 22 carbon atoms were found only in the 'normal' *A* form, whilst those of carbon content from 11 to 22 could assume both modifications. The 'normal' form of these was only stable at temperatures near the melting points.

We have recently examined specimens of hexacosane (26), triacontane (30), and tetratriacontane (34). They were supplied by Prof. Garner, and had been prepared by electrolysis of the pure acids, purified by distillation and crystallisation from alcohol, and finally digested with concentrated sulphuric acid at a temperature of about 130° C. Final crystallisation was from alcohol or benzene. Hexacosane and tetratriacontane showed two *stable* forms at room temperature. One had the normal *A* spacing, whilst the other spacing, about 4 A. shorter, was obviously not the *B* 'second form'. In hexacosane this *C* form occurred alone in the crystals from benzene and from alcohol, whilst a melted layer showed both *A* and *C* spacings, the former being the stronger. Crystals of tetratriacontane from benzene gave only *C* spacings, a layer evaporated rapidly from benzene had equally intense *A* and *C* lines, whilst melted specimens showed only the *A* or 'normal' form. The triacontane did not yield quite such brilliant photographs and was in the 'normal' form under all conditions. The spacing of this preparation was rather high, and we believe it to have been less pure than the other two. In no case did we obtain a spacing corresponding to Müller's *B* form.

It seems probable that pure *even* numbered hydrocarbons crystallise in the *C* form if the chain has 26 or more carbon atoms. This is in striking contrast to the odd numbered paraffins, for the single crystal of nonacosane (29) examined by Müller (*Proc. Roy. Soc.*, A, vol. 120, p. 437) had an *A* spacing and was undoubtedly of the highest purity.

This alteration of habit of the longer odd and even numbered hydrocarbons is in accord with the behaviour of similar compounds. Even numbered monobasic fatty acids of 16 or more carbon atoms have two stable crystalline forms at ordinary temperatures, whilst at similar temperatures corresponding odd acids exist in only one modification. One of us has found the same habit in the primary alcohols. In paraffins and alcohols the odd chains favour the form with the longer spacing, whilst the even molecules adopt the shorter modification. In acids this is reversed. Dr. Müller has given reasons on geometrical grounds for differences in the behaviour of odd and even chains (*Proc. Roy. Soc.*, A, 129, p. 317).

The spacings below are in agreement with Dr. Müller's values for the *A* forms, and the divergence of the *C* from the *A* values shows that if the *A* molecule is vertical to the planes the *C* chain must be inclined.

No. of Carbon Atoms.	Setting Point °C.	Spacings.	
			C
26	56·2	35·0	31·05
30	65·3	40·5	..
34	72·4	45·3	40·00

An important feature of the *C* spacings is their approximation to the *A* values of other paraffins. Tetracosane has an *A* spacing of 31 A. compared with 31·05 for the *C* form of hexacosane, whilst the *A* spacing of triacontane corresponds to the *C* of tetratriacontane. We have only found the *C* spacings in the best specimens we have examined, and believe their appearance to be a very good criterion of purity.

S. H. PIPER.
T. MALKIN.
H. H. Wills Physical Laboratory,
University of Bristol.

Raman Spectrum of Diamond.

IN the course of an examination of the infra-red and ultra-violet regions of the spectrum of a large number of diamonds, we have come across one which, unlike the others, is transparent both at about 8μ, and also in the ultra-violet so far out as $\lambda 2300$. This diamond was consequently well suited for determining the Raman effect throughout a much more extended region of the spectrum in which exciting mercury lines are available.

With this diamond we have in fact identified no less than 17 Raman lines originating from mercury lines within the range of spectrum from $\lambda 4358$ to $\lambda 2378$. The mean value of all differences is 1333 $cm.^{-1}$, a value lower than we reported in NATURE of May 10, p. 704, but agreeing with that of Ramaswamy in the same issue, and of Bhagavantam on Aug. 2, p. 168. This still corresponds to $7{\cdot}5\mu$, which is removed from the centre of the infra-red band at $8\ \mu$ found by us in most diamonds.

With a quartz spectrograph the diffuse band found faintly by Ramaswamy and by Bhagavantam is fairly strong, with its centre about $\lambda 4156$ as they report. If this diffuse line originates from $\lambda 4046{\cdot}6$, the value of $\Delta\nu$ is 651 $cm.^{-1}$ corresponding to $15{\cdot}4\mu$ about.

In NATURE of June 7, p. 855, Prof. F. Simon is inclined to identify this difference with Reinkober's band in the infra-red at 14μ, but in the examination of the infra-red spectra of a good many diamonds we have failed to detect a band there. Nor have we detected any other Raman line with this difference of frequency, although there are some places in the ultra-violet Raman spectrum where such a line might be overpowered by strong scattered unmodified mercury lines and the continuous spectrum accompanying them.

R. ROBERTSON.
J. J. FOX.

Government Laboratory,
Clement's Inn, London, W.C.1,
Aug. 7.

Sperms as Living Liquid Crystals.

IT is customary to draw the boundary between living organic and inorganic matter so that crystals represent the highest form of inorganic material and low organisms form the beginning of the organic world, with a definite and deep physiological gap between the two categories. In my opinion, this gap does not exist, since the sperms, which are undoubtedly living, are at the same time liquid crystals.

Stereochemically, Vorländer recognises the long straight stretched molecules as the chief principle in the building of artificial liquid crystals. The protein molecules of the sperms share with these the fine chain structure, and their nucleoproteins also, according to the most recent researches of Levene and London, possess a corresponding stereochemical type. The optical behaviour clearly demonstrates this stereochemical arrangement both in the artificial liquid crystals and in the sperms. The former are optically uniaxial and show positive or negative double refraction. The sperms have also long been recognised as optically anisotropic, and W. J. Schmidt has definitely proved that in the living seedthreads of *Sepia officinalis* L. the chromatin portion of the head exhibits double refraction of the type of an optically uniaxial crystal ($\omega = 1{\cdot}544$; $\epsilon = 1{\cdot}501$; hence $\omega - \epsilon = 0{\cdot}043$). In addition, it is important to note that the double refraction phenomena are the same both in the living sperms and in specimens which have been preserved in alcohol. Debye-Scherrer diagrams show, as well as the alcohol ring, an interference due to the sperms, which surrounds closely the spot of the primary beam, in agreement with the nature of liquid crystals. With regard to the morphological conditions, the moulding forces of surface tension together with the fine structure give rise to many corresponding forms.

F. RINNE.

University, Freiburg i/Br.

Mushrooms—Mineral Content.

SPECTROGRAPHIC analysis of mushrooms by the method described in NATURE of April 20, 1929, p. 601, has revealed a remarkable composition. A button mushroom from the Cromer district was divided into skin, white portion, gills, and stem and the parts were dried in a water oven at 100° C. The analyses prove that each part has a high potassium and a low calcium content; the skin contains lithium and it contains most iron. Phosphorus in the dried material varies from about one to three per cent, the gills containing most. The chief interest lies in the presence of silver and copper; all parts contain these, the stem containing least. The spectra of four standards, containing from 0·001 to 0·01 per cent of silver and from 0·002 to 0·02 per cent of copper, and other elements, were photographed on the same plate as the spectra of the parts of the mushroom. Comparison of the spectra proves that the skin, white, and gills contain somewhat more than 0·02 per cent of copper and that all the parts contain decidedly more than 0·01 per cent of silver; the silver content of the gills appears to be not less than 0·05 per cent.

The white portions and the gills of two other mushrooms, a button and a flat variety, from the Loddon district, 30 miles from Cromer, have been analysed with similar results.

The investigation is to be continued and extended with the assistance of Mr. H. J. Howard.

HUGH RAMAGE.

5 Carrow Hill,
Norwich,
July 26.

Photography on Copper.

THE interesting observation recorded by Dr. C. J. Smithells in NATURE of July 26 is not new. During the course of a long series of experiments on 'metal colouring' at the Birmingham Technical College about thirty years ago, it was found that copper articles, which had been coloured by immersion in a hot solution of cupric chloride, blackened rapidly on exposure to light. I made a number of attempts to fix photographic prints obtained from ordinary negatives by this process, but in every case the image itself suffered from attack by the reagents used.

The most satisfactory method of preparing the sensitive plates was found to be as follows. A sheet of brass or copper was first coated thinly with copper electrolytically and then it was immersed for a few seconds in a boiling solution of cupric chloride, or in a copper sulphate solution containing a little common salt. If the surface after this treatment was not perfectly uniform in appearance, the sheet was scratch-brushed and immersed again in the hot solution. It can then be washed and dried with a cloth. The coating is salmon-pink in colour, is perfectly adherent, and shows none of the white film mentioned by Dr. Smithells.

T. J. BAKER.

King Edward's School,
New Street,
Birmingham.

Distribution of some Oceanic Birds in the Waters East of New Zealand.

By Dr. P. Jespersen, Copenhagen.

THE Danish Research Ship *Dana*, sent out for a two years' expedition around the world by the Carlsberg Foundation in Copenhagen, under the leadership of Prof. Johs. Schmidt, director of the Carlsberg Laboratory, spent the months of December 1928 and January 1929 in New Zealand waters. From Jan. 2 to Jan. 13 investigations were carried out in the waters east of New Zealand on a cruise, going out from Auckland in a southerly direction to a position situated about 49° S. Lat. and 177° E. Long., from there going west to about 172° E. Long. and farther north along the east coast of the South Island to Wellington.

On the whole circumnavigating expedition of the *Dana*, observations of the bird-life were made on the high sea, but as we on the above-mentioned cruise in New Zealand waters had the New Zealand zoologist, Mr. R. A. Falla, a keen and clever ornithologist, on board the *Dana* as guest, the ornithological observations on this cruise were made with a higher degree of accuracy than in ordinary circumstances. In very few areas of the world are the birds belonging to the order Tubinares represented by so many different species as in the New Zealand waters, and as Mr. Falla has especially studied these birds, it is first of all due to Mr. Falla's knowledge about these oceanic birds that the ornithological observations were so extensive on this particular cruise.

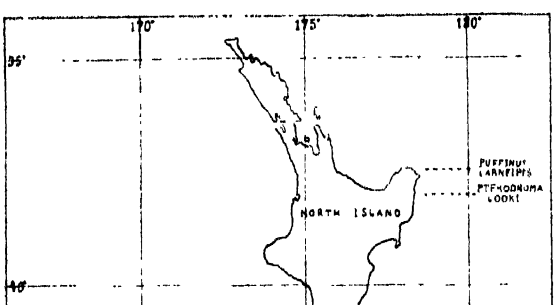


Fig. 1.—Map showing the southern limit for northern breeding species of birds.

Our most important task was to determine, so far as possible, the limits for the distribution of the various species of birds in the open sea, and in the following a brief account of the result of our investigations will be given, especially in regard to the distribution of the various species from north to south. It must, however, be remembered that the results apply only to the month of January,

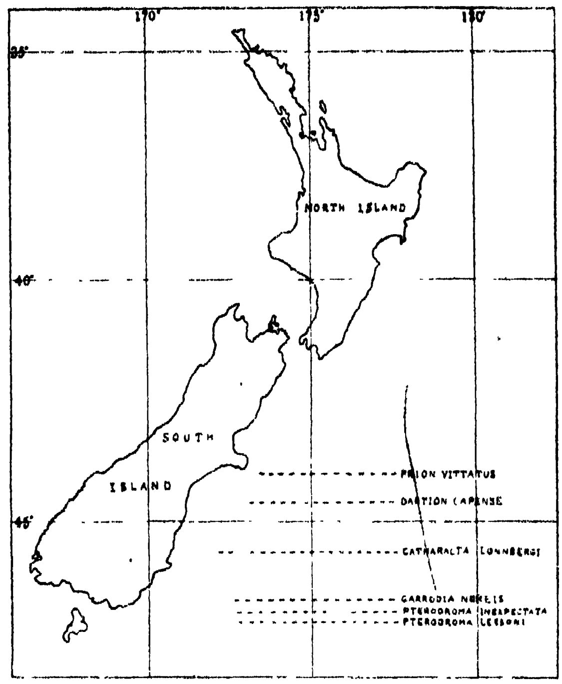


Fig. 2.—Map showing the northern limit for southern breeding species of birds.

which is the height of the breeding season, and that the position of suitable breeding islands must have some influence on distribution at this time.

The observed species will be divided into two groups, namely, the northern breeding species and the southern breeding species. To the first-named group belong birds breeding on the north island of New Zealand and the small islets lying north of this, and the last-named group comprises species breeding on the south island of New Zealand or on islands in more southern latitudes.

We will first consider the distribution of the northern breeding species, and the chart, Fig. 1, shows approximately the southern limit for the occurrence of these birds in the open sea.* North of the lines indicated the different species are seen more or less frequently, while these species are not observed south of the respective lines. It will be seen that the two species, the pale-footed Shearwater (*Puffinus carneipes*) and Cook's Petrel (*Pterodroma cooki*), both of which were observed in large numbers in the waters round the north coast of the north island, already ceased to appear when we passed off the East Cape (about 38° S.). Both species are also only known to breed on islets north of this point. Other northern breeding species extend their distribution more to the south. In Cook Strait we thus found the southern limit

* In regard to the systematic names I refer to "Birds of the Ocean" by W. B. Alexander (G. P. Putnam's Sons, New York and London, 1928), a book which has given me the most valuable assistance in my ornithological observations during this cruise with the *Dana*.

for the appearance of the white-faced Storm-Petrel (*Pelagodroma marina*), but in regard to this species it must be mentioned that its breeding area is not restricted only to the north island of New Zealand, as it is also noted as breeding on Chatham Island and Auckland Island (*cf.* W. B. Alexander, p. 92). The southern limit shown, therefore, apparently only accounts for the New Zealand breeding specimens of this species. A little more to the south (about 42° S.) we find the most southern occurrence of the great-winged Petrel (*Pterodroma macroptera*), and the grey-backed Shearwater (*Puffinus bulleri*) is observed so far south as off Banks Peninsula (about 44° S.). Both the two last-named species are in these regions only found breeding on the north island of New Zealand and surrounding islets.

As we gradually came more to the south we met several species of birds at sea, which we had not observed before, and all these species were breeding on the south island of New Zealand or in more southern latitudes. The northern limit of the southern breeding species in this month of the year was found about 44° S., as will be seen on Fig. 2.

Off Banks Peninsula we thus met the first specimen of the broad-billed Prion (*Prion vittatus*), which is recorded as breeding on Stewart Island and Chatham Island, but elsewhere on islands under more southern latitudes. A little more to the south we fixed the northern limit for the Pintado Petrel or ' Cape Pigeon ' (*Daption capense*), as this species is commonly called by sailors. The nearest known breeding-place for this species is Antarctica, although it probably occurs at the Snares and other sub-antarctic islands. About 45°-46° S. Lat. the first specimen of the dark Skua (*Catharacta lönnbergi*) was observed. This species, which is recorded as breeding on the south island of New Zealand, appeared always singly. In the most southern part of the area investigated —between 46° and 47° S. Lat.—we further noted other species, which are only known breeding on South Island or in the sub-antarctic islands of New Zealand. These were the following: the grey-backed Storm-Petrel (*Garrodia nereis*), Peale's Petrel (*Pterodroma inexpectata*), and the white-headed Petrel (*Pterodroma lessoni*), all of which only appeared as single specimens. In most cases the largest numbers of birds were observed during the morning and the forenoon, and nearly all were flying in an easterly direction, presumably indicating that it was breeding birds making seaward from land.

In connexion with the recorded observations of oceanic birds it is of interest to look at the surface temperatures in the waters east of New Zealand, as found during our trip in the month of January 1929.

It will be seen from the chart (Fig. 3) that the surface temperature is decreasing in a rather high degree from north to south, namely, in the investigated area, from more than 19° to less than 13° C. It is the cold antarctic water, which here advances along the east coast of New Zealand. The isotherms are based on rather few observations and only on this single cruise, but they seem to indicate that the temperature especially is quickly decreasing from 17° to 14° C. This is the case between 42° and 44° south latitude, and it is just in this area that we found in most cases the southern limit for the northern breeding species and the northern limit for the southern breeding species of sea-birds. The marine biological investigations on board the *Dana* along the east coast of New Zealand also demonstrated a very great difference in the composition and kind of plankton on the way from north to south. Thus we found

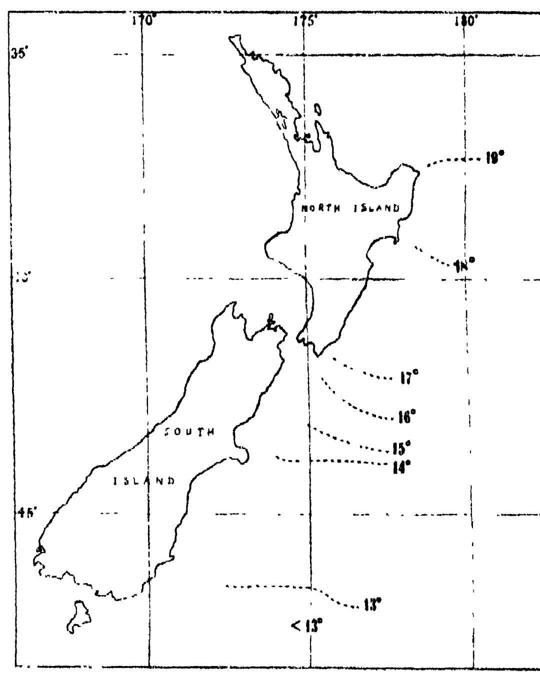


FIG. 3.—Map showing the surface temperatures in the waters east of New Zealand on the cruise of the Danish Research Ship *Dana*, Jan. 2-13, 1929.

the plankton more and more characteristic of the colder water when we were going south, and on the most southerly stations the plankton had in many ways certain resemblances to that in the waters round Iceland and the Faroe Islands in the North Atlantic. Due to the different temperatures in the water the food for the birds living over the high sea thus will be different in the various latitudes, and therefore the surface temperature of the water, in an indirect way anyhow, is a factor of great importance in regard to the distribution of various sea-birds in these waters.

From the above-mentioned observations it will be understood that the composition of the bird-life is quite different in the northern and in the southern parts of the investigated area, but for certain species of sea-birds it has not been possible within this area to determine limits for their distribution. Two species of Albatross (*Diomedea exulans* and *Thalassarche melanophrys*) and the Giant Petrel (*Macronectes giganteus*)—the nearest breeding-places for these are presumably the sub-antarctic islands south of New Zealand—we thus met a little north of New Zealand and within the whole investigated area, and the Fluttering Shearwater (*Puffinus gavia*)

which is found breeding both on North and South Island and on the Snares south of New Zealand was recorded rather near land along the coast of both the north and the south island. Furthermore, it may be mentioned that the Sooty Shearwater (*Puffinus griseus*), which is known to breed on both the New Zealand islands, on the south-going trip was seen about 44° south latitude, but during the following part of the route, as well as in Cook Strait, the species was observed daily and sometimes in large numbers.

To complete the list of more oceanic birds which were observed and determined with certainty during this cruise, it may be mentioned that several specimens of the Fairy Prion (*Pachyptila turtur*) and the Little Penguin (*Eudyptula minor*) were observed during the passage through the Hauraki Gulf as well as in Cook Strait.

Competition between Plants.*

THE recent publication of the work of Clements, Weaver, and Hanson, on "Plant Competition" reports the results of numerous experiments designed to analyse the competitive functions in plant communities. Many of these consisted of transplantations of species characteristic of one phase of a succession into a type of vegetation representing an earlier or later phase. In view of the fact that the major mortality amongst plants would appear to be in the juvenile stage of development (cf. NATURE, May 31, p. 817), conclusions based upon transplantations of established plants must obviously be accepted with considerable reservation when evaluating the competitive relations between species, but recognising these limitations such have considerable value.

In a recent address (*Journal of Ecology*, August 1929) the reviewer, dealing with the biological equipment of species in relation to competition, emphasised the importance as factors in the competition struggle of such features, *inter alia*, as potential height, rate of growth and spread, development of the root system, capacity for reproduction, and the mode and percentage of germination. The experiments of Prof. Clements and his collaborators furnish additional corroboration of these conclusions. They state that practically all the advantages or weapons of species are epitomised in the two words amount and rate. In competition between short and tall grasses the latter were successful under moist conditions, but under dry conditions or when the herbage was grazed the shorter grasses, as might be expected, more than held their own. *Sporobolus asper* was successful in competition with *Andropogon furcatus*, despite its shorter stature, a result attributed to its more efficient root system. *Elymus canadensis* is the victor in the struggle with *Panicum virgatum* owing probably to the earlier and more rapid growth of the former.

The importance of percentage germination was shown by cultures of *Andropogon glaucum* with *Andropogon scoparius*, in which it was found that either species became the dominant when the number of its seedlings had been considerably in excess of those of the other. The advantage of priority of occupation was shown by transplantation experiments, in which it was found that the species already established were almost always victorious over those introduced—a conclusion which supports the contention that mass migration rather than random inoculation is the important factor for successful establishment.

Experiments upon the competition between forest and prairie show the importance of moisture in favouring the arboreal vegetation. The transition zone between the grassland and forest is a broad one of fluctuating extent, and the hypothesis is put forward that the advance or retreat of the forest margin respectively corresponds to the wet and dry climatic phases which coincide with the sunspot cycle.

The observations of Cockayne in New Zealand, and of other experienced field botanists, have emphasised the absence of naturalised species from virgin climax communities in regions where disturbed vegetation has become invaded by an extensive alien flora. Denudation experiments also bear witness to the importance of priority of occupation in the plant world. Cornfields which have passed out of cultivation may still show remains of the weed flora thirty-five years after they have ceased to be arable land, whilst wood-anemones and other members of the shade-flora will persist long after a woodland area has been converted into pasture. Such persistence is indicative of the comparative stability of plant communities and shows that the pressure of competition may operate over a considerable period before its effects are manifest. For this reason the drastic changes involved in many competition experiments, such as those here considered, which operate within a brief period of but a few years at most, are probably not directly comparable to the competitive processes of Nature, which if sure in their outcome are often extremely slow in their manifestation. Nevertheless, the amount of experimental work bearing on the phenomenon of competition is so meagre that we welcome the publication of any such studies whilst recognising the caution necessary in applying conclusions based on these artificial conditions to the explanation of competition phenomena as they occur in Nature.

The work is more of a very detailed account of the experiments than, as might be inferred from the title, a general résumé of the subject, and indeed one is conscious of a sense of inadequacy due, in part, to a lack of coherence in the method of presentation and, in part, to the omission of data necessary to the proper appreciation by the reader of the real significance of these experiments.

E. J. SALISBURY.

* Plant Competition: An Analysis of Community Functions, by F. E. Clements, J. E. Weaver, and H. C. Hanson. Pp. xvi + 340, with 32 Plates, 30 Figs., and 133 Tables. (Washington, D.C.: Carnegie Institution, 1929.)

Some Scientific Instrument Makers of the 18th Century.*

By ROBERT S. WHIPPLE.

ADAMS appears to have given a great deal of consideration to the method of measuring magnification of microscopes, and illustrates in detail in the "Micrographia Illustrata" (Plate 14), fourth edition, various micrometers for this purpose, amongst others the micrometer he made in 1761 for the silver microscope of George III. This instrument originally formed part of the King's collection and is now in the Lewis Evans collection. It has been described by Messrs. Clay and Court at some length.[1] Although the details of workmanship in this instrument are excellent, the instrument as a whole must be regarded as an ornament rather than a serious contribution to microscopy. Such is not the case with the earlier instrument made for the King when Prince of Wales, and known as the "Prince of Wales" microscope (see Fig. 2). It is particularly interesting as embodying the method of mounting a microscope on trunnions; perhaps, as Clay and Court remark, the first microscope so supported. There are three stages, one of which (shown in the bottom of the illustration) is of great interest, having micrometers registering in two directions at right angles. The screws have 100 threads to the inch, and the scales on the heads are divided into 100 parts, so that the micrometers read to 1/10,000 inch. The stage shown in position on the microscope was intended to carry a frog for demonstrations of the circulation of the blood. It is a matter of general knowledge that King George III. was keenly interested in scientific matters, and wished that his family should be instructed in science. Dr. Demainbray commenced to teach the Royal family in 1754, and appears to have used for this purpose the apparatus which formed the major part of what is known as the King George III. collection. The instruments in the collection were catalogued in a manuscript book which is still preserved in the Kew Observatory, and also in a catalogue which is now in the Science Museum at South Kensington. The instruments were housed at the Kew Observatory until 1841, when they were transferred to King's College, London. In 1925 they were removed to the Science Museum at South Kensington, where the majority of them can be studied. The story of the collection was told in some detail in a paper before the Optical Convention of 1926.[2] The majority of the instruments intended for instructional purposes were made by George Adams, although few of them bear his name. Fortunately two books of instructions have been preserved, and it is by means of these that it is possible to state that the majority of the instruments were made by Adams.†

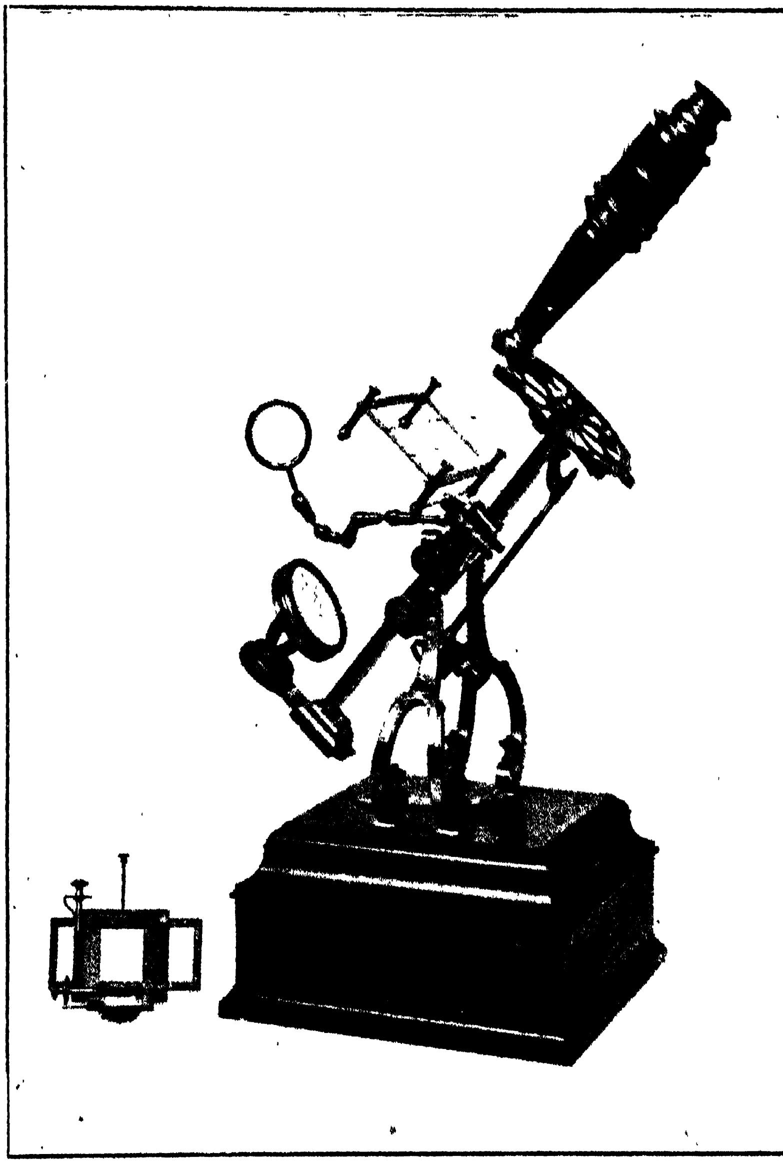


FIG. 2. —Microscope by Adams, generally known as the "Prince of Wales" microscope.

The instructions consist of two manuscript books about 19 in. × 13 in., with two small books about 12 in. × 9 in. The pages of the latter are of blue paper, on which are pasted white sheets on which the illustrations have been drawn. One book is entitled :

* Continued from p. 246.

† It is by the courtesy of the Delegacy of King's College and the Director of the Science Museum that I have been able to examine these books.

"A Description of an Apparatus for explaining the Principles of Mechanicks made for His Majesty King George the Third by George Adams, Mathematical Instrument Maker to His Majesty. In Fleet Street, London, 1762." The second book is entitled: "A Description of the Pneumatic Apparatus made by George Adams in Fleet Street, London, 1761." In the case of the "Mechanicks" the final sheets of drawings were in course of preparation, the outlines having been drawn, but the shading is incomplete and reference figures have not been inserted. It was evidently intended that the sheets of drawings should be bound as a book to accompany the instructions, and probably that the latter should be bound also when the drawings were completed, but these were never finished. In the case of the "Pneumatics", drawings on plates the same size as the manuscript (19 in. × 13 in.) were in course of preparation, and those that are finished are excellently drawn. In the case of both books it was no doubt intended to have the manuscripts bound—as they are now a series of loose leaves in rough covers—but this was never done. The two books containing the comparatively rough drawings appear to have been the centre around which Adams built up the experimental courses. In the case of the "Mechanicks" a little mathematical work is also included, although the course is essentially experimental and based on Desagulier's translation of the classical work of 's Gravesande, the distinguished professor of mathematics at Leyden.[3]

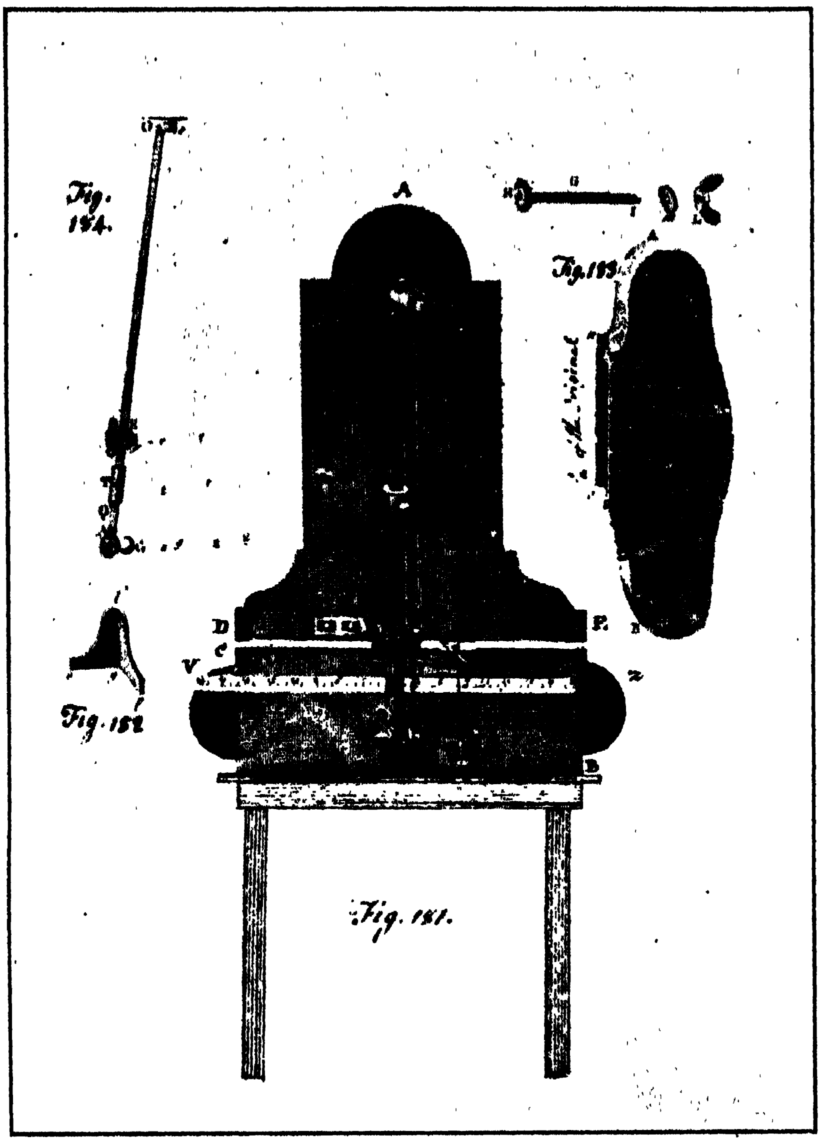


FIG. 3.—'s Gravesande table for pendulum experiments, as modified by Adams.

Adams apparently cut out many of the illustrations from Desaguliers' book, and added pencil or ink modifications to guide the workman. Fig. 3 is an example of a modification of this kind. The apparatus is intended to demonstrate experiments on pendulums and the impact of bodies; it is generally known as "'s Gravesande table". The central illustration in Plate 25 of Desaguliers' book has been cut out and modified. The additions are shown by the cross hatching, but the parts removed have been carefully cut away before mounting. The finished instrument can be seen at South Kensington, and comparing the original design with that made by Adams, one has to admit that the latter is more graceful than the original. The workmanship of the whole of this piece of apparatus is excellent. Adams evidently considered the cost of making apparatus, because several modifications are introduced with the view of reducing labour. The drawing of a table is shortened in pencil, with the words "Too long" written against it, and there are small pencil sketches at the side showing alterations. A ring is made to take the place of a fairly elaborate handle, and a simple glass basin is used instead of a brass bowl.

There can, I think, be little doubt that, judging from the large number of sketches that are dimensional, they must have formed the actual drawings from which the apparatus was built. Not improbably the workman had made some of the instruments previously for other customers, so that he did not require detailed drawings. The work of making the instruments may have spread over a few years. In the case of one of the pneumatic instruments mention is made of apparatus previously supplied and now "in one of the Cabinets of the Palace at Richmond".

All through both books references are made to various scientific authors; for example, when discussing the Archimedian screw five references are given.

One of the most interesting instruments shown in detail is the rotating speculum suggested by Searson as an artificial horizon. Full details of the construction are given, and a manuscript copy of Emmerson's paper in the *Philosophical Transactions*, vol. 47, p. 352, is included with the manuscript papers of the collection. Adams commences the description of the instrument with a short introduction :

"I received this invention from the late Sir Jacob Ackworth, first Commissioner of his late Majesties Royal Navy ; soon after the inventor Mr. Searson was unfortunately lost on board His Majesties Ship the 'Victory'."

Adams's mechanical ability shows itself in his instructions as to lubrication :—"It is necessary to put a drop of sweet Oil into the concave Steel polished segment of a sphere, for if the speculum be whirled without Oil it does not spin much above ten or twelve minutes, with Oil it will spin generally 36 minutes."

Only two of the illustrations are actually signed by Adams, although there is little doubt that the various notes are in his writing. There is a short four-page manuscript slipped into one of the books, which is a sheet of instructions with regard to some details of an instrument. Adams presumably wrote his notes out in this manner, and they were afterwards transcribed in the elaborate copy-book writing of the instructions.

The fourth edition of the "Micrographia Illustrata" is dated 1771, and Adams died in 1773. He must have lived a full life, as, judging by the large number of instruments that may be found bearing his name, and by the "Catalogue of Mathematical, Philosophical and Optical Instruments" published in the end of the "Micrographia Illustrata", he must have had a large and flourishing business. Adams left it to a son—George (born in 1750)—who added greatly to the prestige of the firm. He was a cultured man, and a favourite at Court. He wrote a large number of books, the majority of which passed through more than one edition. The most famous of his books was his "Essays on the Microscope" published in 1787. In the preface he states frankly that he had intended to confine himself to a republication of his father's work the "Micrographia Illustrata", but that knowledge of the subject had increased so much since his father wrote that he felt the book had to be rewritten. Discussing the natural history side of the subject, he states that he has endeavoured to correct some of the faults in arrangement, etc., "by arranging the subjects in systematic order, and by introducing the microscopic reader to the system of Linnæus, as far as it relates to insects". Chapter i. is an extremely interesting history of the microscope, as observed by one who lived close to many of the inventions. In it he mentions that he invented an improved form of the lucernal microscope in 1774. In Chapter iii. he mentions that "this microscope was originally thought of, and in fact executed by my father ; I have, however, so improved and altered it, both in construction and form, as to render it altogether a different instrument". He also mentions that "the great demand I have had for them, has fully repaid my pains and expences [*sic*] in bringing it to its present state of perfection". The lucernal was a simple compact form of projection microscope which met with general approval as an instrument which could be conveniently demonstrated to a number of people at the same time.

A second and enlarged edition of the "Micrographia Illustrata" appeared in 1798, edited with great care by F. Kanmacher. This editor in a footnote dwells on the fact that Adams had not given full credit to Benjamin Martin for what he had done to develop the microscope. Adams's "Geometrical and Graphical Essays", first published in 1790, was an extremely useful text-book for surveyors, civilian and military. The lectures on "Natural & Experimental Philosophy" first published in 1794, in five volumes, very nearly cover the range of physics as then understood—or in the words of the sub-title "describing in a familiar and easy manner the principal phenomena of nature and showing that they all co-operate in displaying the goodness, wisdom and power of God". One is much impressed with the immense amount of work involved in the preparation of these books, for they are all full of individuality. The lectures were evidently written under difficulties. In the preface the author mentions: "During the composition of these Lectures I have had to attend to the grateful calls of daily business, and have struggled with much weakness and langour". He passed away on August 14, 1795. We learn from an editorial note to the second edition of the "Essays on the Microscope" that Adams at the time of his death was preparing a new edition and that he had other books in view. After his death his books and instruments were sold by auction, and the stock and copyright of his books were purchased by the brothers W. and S. Jones. William Jones was responsible for the editorial work and the republishing of several editions of Adams's books. The firm also continued to make instruments to the Adams's design for many years.

The manuscripts and plates of Adams the elder were inherited by his widow, who gave them to her younger son Dudley. He edited a thirtieth edition of the treatise on the globes, published in 1810. It is said that he had intended to publish another edition of the "Micrographia Illustrata", but it is not improbable that the revised edition (1798) of his brother's "Essays on the Microscope" rendered this unnecessary. Dudley Adams appears to have continued in the instrument business, as Mr. Court possesses a statement written on the back of a shop print, about 1800, of the wholesale trade terms for telescopes. These were evidently of the short brass draw-tube type which Dudley Adams had developed. The note attached to the price-list states that "the object glasses not being single but achromatic" shows that non-achromatic glasses were sometimes sold.

Time has only allowed me to dwell in detail on

four instrument makers in this century so full of scientific development. Their names are not so well known to the general public as those of Dolland, Herschel, and Ramsden. Nevertheless, the men whose work I have briefly described did an immense amount to popularise science, and to raise the standard of scientific instrument craftsmanship. How world-wide this reputation for good work became is best seen by the number of instruments of English eighteenth century workmanship treasured in the Continental museums.

[1] "Two Microscopes made by G. Adams for King George III." By R. S. Clay and T. H. Court. *Jour. R. Micr. Soc.*, pp. 268-273; 1926; and Supplementary Note, *Jour. R. Micr. Soc.*, p. 255; 1927.

[2] "An Old Catalogue and what it tells us of the scientific instruments and curios collected by Queen Charlotte and King George III." By R. S. Whipple. *Proc. of the Optical Convention*, Part II., 1926.

[3] "Mathematical Elements of Natural Philosophy, confirmed by Experiments: or an Introduction to Sir Isaac Newton's Philosophy." Written in Latin by the late W. James 's Gravesande, LL.D., Professor of Mathematicks at Leyden and F.R.S. Translated into English by the late J. T. Desaguliers, LL.D., F.R.S., and Published by his son J. T. Desaguliers. Sixth Edition 1747.

Obituary.

MR. A. E. SEATON.

THE death of Mr. Albert Edward Seaton, which occurred at Hemel Hempstead on Aug. 8, robs British shipbuilding and marine engineering circles of one of its oldest and best known representatives. For nearly half a century Seaton's "Manual of Marine Engineering"—now in its twentieth edition—has been familiar to marine engineers, while his "Pocket Book," compiled in collaboration with Mr. H. M. Rounthwaite, is to be found in every drawing office. His "Manual" would alone cause his name to be remembered, but he had an almost lifelong association with the Institution of Naval Architects, and during the course of his long career enjoyed the friendship of many of the most distinguished members of his profession.

Born at Padstow, Cornwall, in 1848, Seaton entered Devonport Dockyard in 1864 as an engineer student with the object of following a naval career, and four years later, as a result of his success in a severe competitive examination, he gained a scholarship to the once well known Royal School of Naval Architecture and Marine Engineering at South Kensington, which had been established by the Admiralty in 1864. During its existence of nine years, the School occupied a unique position in Great Britain, and from it came not only future chief constructors and engineers-in-chief of the Navy, but also men who rose to important positions in private firms. In Seaton's time, Woolley, Merrifield, Cotterill, and Unwin were members of the staff; the occasional lecturers included Airy, Froude, Rankine, and Scott Russell, while among the students were Elgar, White, Watts, Biles, Sennett, Durston, Pratten, Corner, and others, whose important work during the last decades of the nineteenth century and the first of this century were of the greatest value to the country in building up our great naval and mercantile fleets.

Passing out in 1872, Seaton immediately left the public service and became technical secretary to Reed (afterwards Sir Edward Reed), who in 1870 at the age of forty had resigned his position as Chief Constructor at the Admiralty. Through Reed, Seaton became associated with Earle's Shipbuilding and Engineering Co., Hull, and during the next twenty-nine years was responsible for the design and construction of not only the machinery of many vessels but also of the ships themselves.

Leaving Hull in 1901, Seaton set up in Westminster as a consulting engineer, and in 1905 succeeded his former fellow-student and lifelong friend, Alfred Morcom, as chairman of the well-known Birmingham engineering firm, Messrs. Belliss and Morcom. But much of Seaton's best work was done in connexion with the Institution of Naval Architects and other societies. He was elected a member of Council of the Institution in 1888, a vice-president in 1919, and represented it on various important committees. His knowledge of the progress of marine engineering design was probably unique, and for some years he was chairman of the British Marine Engineering Design and Construction Committee. He also took part in public life, served as a County Councillor for Hertfordshire, and was made a Justice of the Peace. His funeral took place on Aug. 12, at St. Marylebone Cemetery, East Finchley.

THE issue of the *Physikalische Zeitschrift* for June 1 contains a short account by Prof. F. A. Schulze of the work of Prof. Wilhelm Feussner, who died in 1928 at the advanced age of eighty-five years. He was born in Hanau in 1843, and studied at Heidelberg under Kirchhoff and at Marburg under Gerling. He took his doctor's degree in 1867 and became lecturer, in 1880 additional professor, and in 1908 honorary professor of theoretical physics at Marburg. He retired in 1918, but still kept in touch with modern research, and contributed to the section on interference in the new "Handbuch der physikalischen Optik".

WE regret to announce the following deaths:

Prof. A. R. Crook, for many years chief of the Illinois State Museum at Springfield, Illinois, known for his work on Cretaceous fossil fishes and geology generally, on May 30, aged sixty-five years.

Dr. J. Walter Fewkes, fellow of the U.S. National Academy of Sciences, who was chief of the Bureau of American Ethnology from 1918 until his retirement in 1928, on May 31, aged seventy-nine years.

Dr. W. S. Franklin, who retired last year from the professorship of physics and electrical engineering at the Massachusetts Institute of Technology, vice-president (Section B) of the American Association for the Advancement of Science in 1902, on June 6, aged sixty-six years.

Capt. J. T. Ainslie Walker, widely known by his work on disinfectants, who was associated with the late Dr. Samuel Rideal in perfecting the Rideal-Walker test for potency, on July 27.

Sir William Walker, C.B.E., late Director of Health and Safety in Mines Department, Board of Trade, and formerly Chief Inspector of Mines at Home Office, on Aug. 17, aged sixty-six years.

News and Views.

THE voyage of the *R100* from Cardington to Montreal and back is a definite popular success. On the technical side, a large amount of invaluable information must have been obtained from both design and operational points of view. The efficacy of the mooring mast in particular is the satisfactory reward of original ideas well worked out. The previous failure of the tail fairing, the stripping of fabric, and the dislodgment of a fuel tank seem trivial in themselves; only those in possession of all the facts can judge whether they are minor mishaps with no serious implication or symptoms of a graver nature. The framework has resisted considerable buffeting, and here again, information should be yielded as to whether the structure has an effective margin of safety or has been stressed to an excessive degree. It is clear that the best meteorological service cannot enable an airship to avoid all stress of weather during the speediest passage across the Atlantic.

ON the more general question of a regular airship service, it can scarcely be held by the most optimistic that much has been added to the stock of knowledge by the recent voyage of *R100*. Referring to the analysis of Zeppelin figures given in NATURE of Oct. 11, 1924, p. 548, it is seen that their expectation of life falls far short of eighteen voyages in eighteen months. It is by no means clear that the great increase in size of *R100* and *R101*, and the further increase now proposed, will diminish these risks, and a cautious experimental programme seems a more reasonable policy than any hasty endeavour to make good the claims of the airship's partisans. The projected flight of the *R101* to India will bring further knowledge, and those who are most critical will join in congratulating the courageous exponents of airship construction on their great technical efforts to overcome the inherent defects of size and fragility.

THE Anglican bishops, recently assembled at Lambeth, have embodied the results of their deliberations in an Encyclical Letter, and in a number of Resolutions. These appear to be inspired predominantly by a rational and enlightened spirit, and students of science will read large portions of them with interest and sympathy. Very noteworthy are the sections which deal with the relations of Christian doctrine with modern scientific and philosophic theories, which are said to provide "a climate more favourable to faith in God than has existed for generations". "New interpretations of the cosmic process are before us which are congruous with Christian Theism. The great scientific movement of the nineteenth century had the appearance, at least, of hostility to religion. But now, from within that movement and under its impulse, views of the universal process are being formed which point to a spiritual interpretation. We are now able, by the help of the various departmental sciences, to trace in outline a continuous process of creative development in which at every stage we can find the Divine presence and power. Thus scientific thinking and discovery seem to be giving us back the sense of reverence and awe before the sublimity of a Creator Who is, not only the cause and ground of the universe, but always and everywhere active within it." The Encyclical goes on to declare that "we must school ourselves to include in our habits of thought about the Creator God as much as we can of the beauty and order of the world, and of everything in life that evokes the awe, the loyalty, and the self-sacrifice of men and women at their best".

IT is all to the good that the bishops should express themselves in this way, but, as everyone knows, it is the rank and file of the clergy whose conversion to a more modern outlook must be achieved if the ideals of the Encyclical are to be fulfilled. The ordinary Christian teacher, who expounds his message Sunday by Sunday from the pulpit, must be encouraged to think out his position afresh, and to impart to others the convictions to which his studies and reflections have led him. When we remember that the average age of the Anglican clergy has been authoritatively stated to be fifty-five years, we shall realise the difficulty of the situation. The hope would appear to lie with the younger clergy. "We especially desire to impress upon the younger clergy that the Church requires the service of men who will devote themselves to the study of theology in all its branches. The Church needs learning, as well as spiritual power and practical ability in its clergy." But it should be remembered that men will not think well unless they are allowed to think with freedom. Will the young theological student enjoy the same latitude as the young scientific student? Do the bishops really mean business? In view of the importance of giving an adequate education to candidates for ordination, it is encouraging to note that the bishops express a strong preference for university training as against that given in the seclusion of a seminary. "It is essential that Christian theology should be studied and taught in universities in contact with philosophy, science, and criticism." If the gap should widen between the Church and those standards of intellectual integrity recognised in universities, it would soon cease to play any effective part in English life.

THE opportunity of the meeting at Cambridge of the fifth International Botanical Congress was utilised for the unveiling of a tablet to the Hookers in the church at Halesworth, Suffolk, on Sunday, Aug. 17, to which reference was made last week (p. 249). The inscription explains the circumstances it was desired to record; it is as follows: "This Tablet records the connection with Halesworth of the botanists, Sir William and Sir Joseph Hooker, father and son, who became in succession directors of the Royal Botanic Gardens, Kew. Sir William lived here 1809–1820, and here Sir Joseph was born 1817. Erected 1930." The tablet (of stone) is the work of the sculptor, Mr. A. H. Gerrard, of the Slade School, and is beautifully executed. The dedication service, arranged by the Bishop of St. Edmundsbury and

Ipswich, and by the Rev. H. C. Newbery, rector of Halesworth, was fully choral. The actual unveiling was performed by Sir David Prain, a successor to the Hookers at Kew, and the bishop delivered an address.

A large party came over from Cambridge, and together with other botanists and naturalists from East Anglia, about a hundred visitors were entertained to tea after the ceremony at Halesworth Church. Two members of the Hooker family were present, Mr. Reginald Hooker and Mr. Richard Hooker; the old home of the Hookers (the Brewery House) was shown by the courtesy of Miss Parry, the present owner. The visitors, who came from many countries, were delighted with the charm of Halesworth and its welcome, and with the beauty and admirable rendering of a well-designed service. It was generally felt that the tribute paid to these former citizens of Halesworth, in which so many participated, was entirely fitting. The arrangements for the execution and erection of the tablet were made by a small committee under the chairmanship of Viscount Ullswater, whilst the funds required were contributed partly by individual botanists and others contemporary with Sir Joseph Hooker, and by representative institutions, including the Royal Society, the Linnean Society, the Norfolk and Norwich Naturalists' Society, the Royal Horticultural Society, the Court of the University of Glasgow, the *Annals of Botany*, the staff of the Royal Botanic Gardens, Kew, and of the Department of Botany, British Museum, and the Ipswich Naturalists' Field Club.

America dallies with the thought of its own antiquity. While the Boston Society of Natural History has celebrated its centenary by the publication of impressive "Milestones", reviewed by Prof. Stanley Gardiner in our issue of Aug. 9, p. 195, the Philosophical Society of Washington commemorated more modestly its thousandth meeting on Jan. 18 last. The foundation of the Society was due in some measure to the Civil War, for it was the recurrence of normal times, after a disturbance which had disorganised the meetings of scientific men in the capital, that led to the setting up of a formal organisation at the regular meetings of which all the sciences, save those of speculative thought, might play a part. Previous to the foundation of the Philosophical Society on Mar. 13, 1871, the capital had been served from 1810 onwards by a series of agricultural, medical, and botanical societies, and finally by the National Institute, which was disbanded near the beginning of the Civil War. The Philosophical Society has seen many changes, from the time in 1874 when it was minuted that its members should appear in the records under no title other than plain "Mr.", and when formality of debate, associated with full evening dress, was the rule, but it has throughout been supported by a noble band of 'intellectual giants' and has made many contributions to the progress of science, reaching far beyond the confines of its meeting room. Since 1911 its *Bulletin* has ceased publication, and it has supported and published in the *Journal of the Washington Academy of Sciences*.

In the Italian National Park of Gran Paradiso the numbers of wild goats and of chamois have increased beyond reasonable limit, the former being reckoned to number 2800-2900, the latter 1600-1800. Accordingly the Royal Commission which controls the Park has decided that during the coming autumn permits will be granted to hunters, for a consideration, to shoot these animals. The licence is stated by the Italian sporting journal, *La Caccia e la Pesca* of June 15, to cost 10,000 lire for each goat the sportsman desires to shoot, and 600 lire for each chamois, and accredited hunters will be accompanied by a warden. In order to ensure the continuance of healthy stock upon the mountains, a breeding enclosure for goats is to be constructed in the Valsavaranche, whence young goats will be distributed, and Bardonecchia deer and mouflon from Sardinia are to be transported to suitable localities so that, so far as possible, the typical fauna of the Park may be restored.

That considerable progress has been made at the Rubber Research Institute of Malaya is evident from the annual report for 1929, increased co-operation between the Institute and other cognate institutions in Malaya, Great Britain, and elsewhere being worthy of special mention. Advisory work on behalf of the estates continues to increase, and in consequence the research programmes have of necessity been curtailed. It is anticipated, however, that much valuable information will accrue from such work, much of which may be regarded as applied research. With regard to soil investigations, special attention is being paid to the development of more rapid methods of analysis, and the value of 'bunding' in the conservation of soil moisture is becoming more generally recognised. On the botanical side, numerous problems are arising as to the most economical method of tapping, the question of the optimum length of the rest period and the possibility of stimulating the yield over a short period, in connexion with old trees prior to their removal, being among the points upon which information is being collected. Increased yields have already been obtained by the practice of completing the tapping earlier in the day. In addition, fundamental research is in progress on the chemical and bacteriological aspects of latex and rubber. It has been shown that the presence of yellow pigment in latex does not affect the quality of sole crepe although owing to the demands of fashion it lowers the market value. Unfortunately, fractional coagulation, which adds considerably to the cost of preparation, is necessary for the production of the white form of crepe. The possibility of producing air-dried sheet as a substitute for smoked sheet and the questions of temperature and ventilation etc. of the drying sheds are also under investigation. Extensions in the field work have been made, and several lectures and conferences held with encouraging results.

The second International Congress of Soil Science was held in Russia on July 20–31, the first week at Leningrad and the second at Moscow. The countries from which members came included Chile, Czechoslovakia, Denmark, France, Germany, Great Britain,

Holland, India, Japan, Malaya, Palestine, Rumania, Spain, Sudan, Sweden, Switzerland, and the United States. The Congress was entertained at receptions and banquets by the provincial administration in Leningrad and by the central government in Moscow, and the hospitality shown left no doubt as to the desire of the authorities to make the visit as pleasant as possible. Three concerts and a cinema performance were specially arranged for the delegates, and a day in each city was set aside for sight-seeing. At the opening meeting in Leningrad, it was announced that Prof. K. K. Gedroiz, president of the Congress, was prevented by ill-health from attending, and it fell to Dr. D. J. Hissink, of Groningen, to act as president throughout the meetings. Apart from a few addresses of a more general nature, the work of the Congress was done by the six commissions into which it is divided, for soil mechanics and physics, chemistry, biology and biochemistry, fertility, classification and mapping, and applications to cultivation. Abstracts of the papers were distributed at the beginning of the Congress, and the full text will be printed in the *Proceedings* of the Congress, which are to be published by the Russian organising committee.

A SPECIAL feature of the Congress was the number of joint meetings of commissions on such subjects as physical properties, reaction, organic matter, soil utilisation, and alkali. The international soil map of the world has made considerable progress since the Congress of 1927, and further steps were taken for the mapping of the Mediterranean region, Africa, and South America. Visits were paid to a number of institutions in or near Leningrad and Moscow, and the foreign delegates were impressed by the energy with which these are being developed and by the generous financial provision for their equipment and support. Of special interest was the Dokuchaev Institute for soil science, containing a collection of hundreds of monoliths representative of the soil types of European and Asiatic Russia. At the conclusion of the Congress on July 31, many of the delegates left for a three weeks' tour arranged to cover the most important soil zones of European Russia. It was decided to hold the next Congress in 1935 in England, and Sir John Russell was elected president. Amongst other new officers, Prof. Robinson, of Bangor, succeeds Prof. Novak, of Brün, as president of the commission for soil mechanics and physics, and Dr. Joseph, of the Imperial Bureau of Soil Science, succeeds Prof. Marbut, of Washington, as president of the commission for soil classification, mapping, and morphology.

THE British Non-Ferrous Metals Research Association has secured a leasehold factory property in London, where it is proposed to centralise its offices and provide accommodation for a laboratory and workshops for its research and technical development departments. A special appeal for increased annual support and contributions to a headquarters' fund has recently been launched. The Association, founded ten years ago, has made steady progress under the direction of Dr. R. S. Hutton, and now carries out work for all sections of the non-ferrous metals industry on a scale of expenditure of £20,000-£25,000 per annum. It already has to its credit the discovery of new engineering materials and of methods of increasing efficiency of production, which should commend it to the metal and engineering trades. Dr. D. H. Ingall has just been appointed assistant-director and research manager of the Association, as from January next. Dr. Ingall is well known for his metallurgical research and administrative work, and as first principal of the Constantine Technical College, Middlesbrough, has been largely responsible for its equipment and organisation. Dr. O. F. Hudson will continue as senior metallurgist of the Association. Mr. G. L. Bailey, of the Metallurgy Section, Research Department, Woolwich, has been appointed, from Sept. 1, as development officer to fill the position recently vacated by Mr. S. J. Nightingale, who resigned to take up a post in industry.

SINCE Dr. John Hopkinson first suggested novel methods of charging for the electric light in his presidential address to the Junior Institution of Engineers in 1892, many such systems have been adopted in practice. In the journal for July issued by the A.E.G. Electric Co. of Victoria Street, London, a description is given of a 'two part tariff' prepayment meter which automatically records the consumer's payments and his consumption of electricity. This type of meter receives the two payments of the consumer, namely, his fixed monthly or quarterly payment and his payments for the energy taken. The latter charge is rated very low, so that once the fixed charge is paid the consumer finds that he can use his lighting or heating appliances most extravagantly at small cost. The objections urged against a one-part tariff is that the takings of the company in the summer time do not cover the running costs and that the consumers find that their winter bills are very high. From the supplier's point of view this system is very attractive, as he receives an appreciable revenue in the summer and the consumer finds that the winter bills are no longer too heavy. If the company ever desires to alter the price the meter can be easily adapted by simply changing the gear wheels. The only objection urged against this two-tariff method of charging is that it tends to make the consumer extravagant in his use of light.

THE chapter on the number of electrical accidents which have occurred during 1929, which is given in the chief inspector's report (Cmd. 3633, London: H.M. Stationery Office, 2*s*. 6*d*.), is instructive. Compared with the period 1910-14, there is no doubt that installations have been made very much safer and that devices that in certain circumstances can become dangerous are seldom used. We agree with Mr. Scott Ram, the senior electrical inspector of factories, that this is largely due to the making and enforcing of stringent regulations and also to the increased inspection by qualified officials. Although the use of electricity last year was four times as great as its average annual use during the period 1910-14, the number of accidents diminished. The maximum number of

recorded accidents during a year was 512 in 1913. Unfortunately, however, the number of fatal accidents from shock or burns with low voltages seems to be increasing. The number of accidents with pressures not greater than 250 volts last year happens to be the same with both direct and alternating current, but the latter are much more dangerous to life; whilst 21 of the a.c. accidents were fatal, none of the d.c. accidents were fatal. As the standard system of electric supply is now a.c., it will be seen how important it is that the regulations be enforced and the inspectorate strengthened. Several extraordinary accidents due to recklessness or absentmindedness are given, but in several cases employees have taken totally unwarranted risks in order that the supply to a few consumers may not be cut off for a brief period. In some cases they may possibly have done this with the connivance of their superiors. It has to be remembered that dangerous shocks occur with low pressures when the body makes contact with conductors of opposite polarity or more often with a live conductor and a good earth such as a water or gas pipe, the water in a bath or a damp wall or floor.

The Safety in Mines Research Board has just issued its eighth Annual Report, for the year 1929. Apart from the suggestion that this report should have been published at an earlier date, it may be looked upon as a satisfactory statement of a year's work. As usual, the bulk of the work is chemical and microscopic; there is no doubt that a thorough knowledge of the constitution of coal may lead to important results in the future, though its direct effect upon the prevention of accidents in mines may be but small. It is, however, highly satisfactory to see that the Board has at long last come to the conclusion that a number of the problems concerning safety in mines are not chemical but mechanical, and that it has accordingly appointed a highly qualified mining engineer to commence the investigation of such problems. The researches upon wire ropes that have been carried on under Prof. Dixon are another step in the right direction. The value of free international communication and collaboration in these matters is shown by the fact that the work at Sheffield, where they had the advantage of the presence for a considerable period of one of the workers of the United States Bureau of Mines, has resulted in a very satisfactory new apparatus, a modification of a well-known American apparatus, which is likely to prove very useful in rescue work. It is satisfactory to see that such international cooperation has been extended to France, and, although it does not appear in the present report, it is well known that similar arrangements are being concluded with Belgium. It need scarcely be said that most of the matters referred to in this report have been dealt with at length in the Safety in Mines Research Board Papers, issued during recent years.

According to a report in the *Daily Telegraph* of Aug. 12, Mr. Lansbury has announced the appointment of a Committee representing the Board of Education and the Office of Works to consider the question of the establishment of an open-air folk museum in London. The sum of £50,000 is promised towards the cost of the scheme. The terms of the report, while making no definite statement, suggest that the land in Regent's Park now held by the Royal Botanic Society under a lease which terminates in April 1932, but then to be added to the Park and, as announced in the House of Commons, thrown open to the public, may be available for the purpose. This land was one of two alternatives suggested by the Royal Commission on our National Museums in its report. Its suitability in situation and character has been strongly urged by the Committee appointed by the Royal Anthropological Institute with the object of securing the establishment of such a museum for England. It would appear that the proposal to be considered is on the lines suggested in the article on this question which appeared in the issue of Nature of Aug. 24, 1929, p. 289, and will follow the plan of the Continental folk museums in which exhibits are housed in peasants' dwellings typical of various periods re-erected in the museum grounds for that purpose.

In Great Britain it is difficult and costly to obtain for use before such bodies as field clubs and schools good educational films of Nature subjects. In California the State considers it to be good propaganda for fish and game conservation to issue free of charge, to responsible organisations within its territory, films depicting the natural history of the State. The reels are 1000 feet long, and illustrate great variety of fish, bird, and mammal life in its natural haunts, as well as commercial fisheries, trout cultural operations, and other human aspects. Not only does the Division of Fish and Game lend the films, but it is prepared also to supply lectures describing the pictures, many of which are designed for school use. A list of these motion picture films appears in *California Fish and Game* for April, pp. 152-156. It is full of interesting items and makes us wish that for our own information we could have the privilege of seeing many of them. Would that we could imagine the Ministry of Agriculture and Fisheries or any other British Government Department developing educational activities on lines so interesting and effective.

The Ministry of Agriculture and Fisheries has taken advantage of the recent meeting of the International Poultry Congress in London to recast the form of its agricultural publications. The majority of these will now appear as *Bulletins*, printed in good type and bound in attractive stiff paper covers with the titles overprinted in contrasting colours. Most of the volumes will be illustrated. We have received half a dozen of the *Bulletins*, which appropriately deal with various aspects of poultry-keeping, from general principles of poultry feeding to special instructions for the rearing of birds for the table or for egg production, and for the treatment of the most common diseases. In appearance and in the quantity and quality of their matter, these publications are a

vast improvement on the earlier pamphlets of the Ministry, and the prices, which vary from 6*d.* to 1*s.* 6*d.*, are very moderate. Since it is impossible even for the interested person to keep in touch with all the *Bulletins* as they appear, we suggest that a useful addition would be a list of the titles of such as have been published, printed on one of the cover blanks.

We have received from Mr. W. J. Lewis Abbott a friendly criticism of the paragraph in our issue of July 19 referring to Tertiary man in East Anglia. In pointing out the occurrence of a redundant 's' in 'lithoclasiology', he deplores our implied criticism of the term; but at the same time imputes to us a failure to appreciate the importance of the study which it designates that is far from the fact. He goes on to point out that all the examples of early man's handiwork to which he referred in his previous communication were his own discoveries. The flints found and accepted by Mr. H. B. Woodward at Thorpe, Norwich, were subsequent to Mr. Abbott's finds, as were Mr. Savin's discoveries in the Cromer Forest-Bed, *begun*, not renewed, in 1895, and it was Mr. Abbott's collection and not that of Mr. Savin that was exhibited at Burlington House. We regret that the facts were not clearly stated; but for this, we fear, Mr. Abbott's characteristically modest phrasing of his communication must be held responsible.

In the *Journal of the National Institute of Industrial Psychology* for July, Dr. A. Macrae discusses some of the problems involved in the selection of a career. He says that it is frequently assumed, if a child shows a definite vocational interest, he will necessarily have a real aptitude. Actually the facts are that while many people have been successful by following their inclinations, many others have failed. Practically every occupation makes many varying demands on the worker at it, and it is impossible for a child to feel drawn to some aspect of a particular kind of work which may, or may not, be the most important. To select, for example, the occupation of commercial traveller because one likes seeing new places is not of necessity to guarantee success, nor is a fondness for arguing a criterion of legal proficiency. In a study of a hundred boys leaving a secondary school, it was found that ten had no vocational inclination, forty-six seemed reasonably fitted for the work they had selected, and the others seemed definitely unfitted on the grounds of temperament, general intelligence, special mental capacities, health, and physique.

The one hundred and eleventh annual meeting of the Swiss Society of National Sciences will be held at St. Gallen on Sept. 11–14, under the presidency of Dr. H. Rehsteiner. The work of the meeting will be distributed over sixteen sections covering pure and applied science and medicine. The general programme includes addresses by Prof. Emil Abderhalden, of Halle a. S., on the significance and mechanism of ferments in Nature, Prof. P. Niggli, of Zurich, on ten years' work of a mineralogical and petrographic institute, Prof. R. Chodat, of Geneva, on the symbiosis of lichens and the problem of specificity, and Prof. C. Wegelin, of Berne, on endemic cretinism. Correspondence respecting the meeting should be addressed "Jahresvorstand der Schweizerischen Naturforschenden Gesellschaft in St. Gallen, Postfach St. Fiden No. 17".

The centenary of the opening of the Liverpool and Manchester Railway will be celebrated at Liverpool during the week Sept. 13–20. The celebrations have been arranged on a scale appropriate to the occasion by a committee under the joint presidency of the Lord Mayors of Liverpool and Manchester and Sir Josiah Stamp, the chairman of the London, Midland and Scottish Railway. Included in the programme is a great pageant of transport referred to as "probably the most ambitious pageant ever attempted in Great Britain". Some 3500 performers will take part in the pageant, the aim of which is to illustrate the progress of transport from the earliest times. A train of 1830 will convey visitors around a circular track specially laid down, and there will be an exhibition of models and historical material in St. George's Hall. The Libraries and Museum Committee of Liverpool has also arranged lectures for both adults and children. Mr. C. J. Allen will lecture on a century of railway travel; Mr. Dendy Marshall on the Rainhill locomotive trials of 1829, while Engr.-Capt. E. C. Smith will lecture on two hundred years of steam power on land and sea.

The eighteenth annual meeting of the Indian Science Congress will be held in Nagpur on Jan. 2–8, 1931. His Excellency Sir Montagu Sherard Dawes Butler, Governor of the Central Provinces, has consented to be patron of the meeting, and Lieut.-Col. R. B. Seymour Sewell, director of the Zoological Survey of India, will be president. Copies of papers to be offered to the Congress must reach the president of the section concerned not later than Oct. 15 next. The sectional presidents are as follows: Sir T. Vijayaraghavacharya, vice-chairman, Imperial Council of Agricultural Research, Simla (Agriculture); Dr. C. W. B. Normand, Director-General of Observatories, Poona (Mathematics and Physics); Prof. K. G. Naik, professor of chemistry, Baroda College, Baroda (Chemistry); Principal B. L. Bhatia, Government Intermediate College, Hoshiarpur, Punjab (Zoology); Prof. T. Ekambaram, professor of botany, Teachers' Training College, Saidapet, Madras (Botany); Dr. G. de P. Cotter, superintendent of the Geological Survey of India, Indian Museum, Calcutta (Geology); Rai Upendra Nath Brahmachari Bahadur, 82/3, Cornwallis Street, Calcutta (Medical and Veterinary Research); Mr. K. P. Chattopadhyay, Education Officer, Calcutta Corporation, Calcutta (Anthropology); Prof. G. C. Chatterji, professor of psychology, Government College, Lahore (Psychology). The General Secretaries of the Congress are Prof. S. P. Agharkar, 35, Ballygunge Circular Road, Calcutta, and Dr. H. B. Dunnicliff, Government College, Lahore. The Local Secretaries are Principal M. Owen, Victoria College of Science, Nagpur, and Rao Saheb S.N. Godbole, Victoria College of Science, Nagpur.

The eighth International Congress of the History of Medicine will be held in Rome on Sept. 22-27, with His Excellency Benito Mussolini as president of honour, Prof. Pietro Caparoni as president, and Profs. Bilancioni and Castiglioni as vice-presidents. The principal subjects for discussion will be (1) How Europe protected herself against leprosy in the Middle Ages, introduced by Prof. Jeanselme of Paris; (2) the medical and scientific relations between Italy and other European countries during the scientific renaissance in the sixteenth and seventeenth centuries, introduced by Prof. Karl Sudhoff of Leipzig and Prof. Arturo Castiglioni of Padua; (3) the necessity of making the study of the history of medicine a compulsory subject in all universities, introduced by Prof. Ladislaw Szumoski of Cracow. Numerous papers on miscellaneous subjects are also included in the programme, such as the problem of medical historiography, by Prof. Siegerist; van Helmont, by Prof. Ostachowski; Girolamo Cardano and Leonardo da Vinci, by Prof. Bilancioni; plastic surgery in Italy and Europe at the time of the Renaissance, by Dr. G. Sansevero-Roselli; and the influence of folk-lore on medicine, by Dr. Dan Mackenzie. The subscriptions, which should be sent to the treasurer, Prof. Vincenzo Rocchi, Corso Vittorio Emanuele 173, Rome, are 100 lire for members of the International Society of the History of Medicine and members of the Italian Society of the History of Medical and Natural Sciences, 150 lire for all other members of the Congress, and 50 lire for members of the families of those taking part in the Congress and medical students.

The sixth annual Norman Lockyer lecture of the British Science Guild will be given by Sir William Pope on Thursday, Nov. 13, at 4.30 P.M., in the Goldsmiths' Hall London (by permission of the Goldsmiths' Company). The president of the British Science Guild, the Rt. Hon. Sir Samuel Hoare, Bart., will take the chair at the lecture, the title of which will be announced later. The second annual Alexander Pedler lecture will be given by Lt.-Col. Sir David Prain on Wednesday, Oct. 22, at 5.30 P.M. "Science Discipline" is the general subject of this lecture, which will be given in Liverpool under the joint auspices of the University of Liverpool and the British Science Guild.

It is announced that two of the sectional presidents, Lord Eustace Percy and Prof. T. E. Gregor, who were to have presided over the sections of Education and Economics respectively at the Bristol meeting of the British Association next month, are unavoidably detained by business abroad. Their presidential addresses will be read in their absence.

We have received the annual report of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases, 1929. The Director, Lieut.-Col. H. W. Acton, details the teaching and research work of the School and reviews recent advances in tropical medicine. This review, together with the reports of the work of the various departments, constitutes a valuable survey of the progress of tropical medicine. The attendances at the Calcutta Pasteur Institute for anti-rabic treatment numbered 10,219 for the year, a record, probably, for any Pasteur Institute in the world.

Applications are invited for the following appointments, on or before the dates mentioned:—An assistant at the Road Experimental Station of the Ministry of Transport, Roads Department, at Harmondsworth, near Colnbrook, Middlesex—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Aug. 25). A full-time assistant lecturer in chemistry at the School of Mines, Treforest—The Director of Education, Glamorgan County Hall, Cardiff (Aug. 26). Entomological and mycological posts in the Cambridge University School of Agriculture, in connexion with a survey and other investigations on sugar beet pathology—The Secretary, Appointment Committee, School of Agriculture, Cambridge (Aug. 30). A biochemist in the Pathological Department of the Royal Victoria Infirmary, Newcastle-upon-Tyne—The House Governor and Secretary, Royal Victoria Infirmary, Newcastle-upon-Tyne (Aug. 30). Assistant lecturers in agriculture under the Education Committee of the Cornwall County Council—The Secretary for Education, County Hall, Truro (Sept. 5). A junior scientific officer in an Admiralty Establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Sept. 6). An assistant lecturer and demonstrator in botany at the West of Scotland Agricultural College—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (Sept. 8). Nautical surveyors under the Board of Trade—The Senior Staff Officer, Establishment Department (Mercantile Marine Branch), Board of Trade, Great George Street, S.W.1 (Sept. 12). An advisory entomologist at the South Eastern Agricultural College—The Secretary, South Eastern Agricultural College, Wye, Kent (Sept. 13). A registrar of the University of Birmingham—The Secretary, The University, Birmingham (Sept. 15). A head of the gas engineering and supply department of the Westminster Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (Sept. 30). Test assistants at the Royal Aircraft Establishment for, respectively, calculation and experimental work in connexion with aero-engine investigations, work in connexion with the technical development of aeronautical instruments and small precision apparatus, and work in connexion with strength tests and experimental work on aircraft structures and materials—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A full-time teacher of woodwork and pattern-making at the Smethwick Junior Technical School—The Director of Education, 215 High Street, Smethwick. A whole-time radiologist at the General Hospital, Wellington, New Zealand—"Radiologist, Wellington", c/o The High Commissioner for New Zealand, 415 Strand, W.C.2. A senior clinical assistant and clinical tutor and a non-resident clinical assistant in the department of ophthalmology of the Royal Infirmary of Edinburgh—The Superintendent, Royal Infirmary, Edinburgh.

Research Items.

A Cypriote Threshing Sledge.—In *Man* for August, Mr. J. Hornell describes a very ancient type of implement known as a *dukani* or 'threshing sledge' used by the Cypriote farmer for threshing grain. This is a broad board about six and a half feet long, of which a length of nearly five feet is straight, the remaining portion at the forward end being inclined upward at an angle of 18°-20°. The breadth varies in different dukani from 24 in. to 27 in. The board is made up of two planks joined lengthwise edge to edge. Except for a margin of eight inches at either end the bottom surface is studded with many rows of sharp-edged flints inserted by their bases in long and narrow triangular slots. In one example there were twenty-two rows in one plank and twenty-three in the other. Each row consisted of ten flints in each plank, each row being set alternately to the one in front and the one behind. The total for the two planks was 450 flints. The thickness of the two boards is 2½ inches, but the thickness is cut down slightly from the fore-end and the size of the flints for a short distance anteriorly is smaller. They range from 1¾ in. to 2¼ in. in length and from 1⅛ in. to 1⅞ in. in height. The shape of the flints is roughly triangular with two long knife-edged sides and a thick and massive butt. The projecting edge is arched and one face is always convex, the other keeled. The slots into which the flints are inserted are made by a chisel of peculiar form. When all the flints have been inserted in the slots, hot pitch is poured along the rows just as the ancient Egyptians fastened the flints in their sickles with a plaster setting. The sledges are drawn by two oxen flint side downward over the threshing floor, which is thickly strewn with sheaves. The driver sits on a chair placed midway between the transverse battens. This form of threshing appliance is a survival of the Roman tribulum which persists in Syria, Asia Minor, Georgia, and Greece. In some parts of Spain and the Canary Islands it is in use without the flints as the straw is required whole.

The Physiology of Hibernation.—In a useful summary of results bearing upon the hibernation of animals, P. A. Gorer regards hibernation and æstivation as manifestations of the property of living organisms of withdrawing from an unfavourable environment (*Biol. Rev. and Biol. Proc.*, Cambridge Phil. Soc., vol. 5, p. 213, July 1930). However, since it is impossible to regard any one condition of the environment as being responsible, he turns to the physiological condition for the common factor, and examines the various suggestions which have been made from this point of view. The metabolism of hibernators, which is the lowest metabolism required to maintain the existence of protoplasm, is bound up with a marked decrease in oxygen consumption, but cannot be explained, as has been argued, by the varying solubility of carbon dioxide at different temperatures. In the metabolic changes the nervous system is involved, and a résumé of results shows that it is of primitive structure and remarkable adaptivity in hibernating mammals, in which decerebration causes comparatively slight effects on the heat-regulative and postural reactions. Apart from the nervous system, the endocrine system, and particularly the pituitary, must be looked upon as the governor of metabolism amongst the higher animals, and a general truth appears to be that hibernation is associated with a change in the water content. The conclusion of hibernation, like its onset, varies from animal to animal, even amongst related species, and is associated with accumulation of waste products and sometimes with changes in moisture, the energy required being obtained perhaps by shivering, perhaps from the activity of the liver.

Type Specimens of Myctophine Fishes.—Mr. Albert Eide Parr, in his paper "Notes on the Species of Myctophine Fishes represented by Type Specimens in the United States National Museum" (*Proc. U.S. National Museum*, vol. 76, Art. 10, No. 2807, 1929), gives a detailed account of the fishes belonging to the sub-family Myctophinæ which are deposited in the United States National Museum. The result of this investigation is a thorough revision and partial or complete redescriptions, with diagrammatic figures, of a large number of fishes belonging to this group. The whole is based on Lütken's and Brauer's system of classification by the photophores which has recently been used by Tåning (1918, 1928) in his "Mediterranean Scopelidæ" and "Synopsis of the Scopelids of the North Atlantic". The work of Tåning and that of the present author fit in well together, dealing as they do with fishes chiefly from very different areas. Mr. Parr is of the opinion, however, that the subdivision of the *rafinesquei*-like forms of the genus *Diaphus* into entirely separate species according to the definitions rendered by Tåning is absolutely impracticable, although it may be of great value for differentiating ecological races or local subspecific forms within restricted oceanographical areas.

Nematode Parasite of the Frit-Fly.—In the *Philosophical Transactions of the Royal Society*, B436 (June 28, 1930), Dr. T. Goodey describes a new genus and species of Nematoda, namely, *Tylenchinema oscinellinae* from the frit-fly (*Oscinella frit*) of oats. It appears that ensheathed larvæ and the young adults of this worm occur in oat stems. The male worms ultimately die after impregnating the females, while the latter enter the frit-fly larvæ, most probably by boring their way through the skin. They remain in this host during the time the latter completes its metamorphosis, and are afterwards to be found in the body-cavity of the newly emerged flies. The female worms grow within their host into comparatively large sausage-shaped organisms: their gonads occupy most of the body space and reproduction is viviparous. Large numbers of motile larvæ of both sexes are discharged into the hæmocœl of the fly, and these creatures bore their way into the gut of that insect, finally reaching the exterior via the anus. The presence of the *Tylenchinema* within the fly inhibits the normal growth of the gonads to a very marked degree and the sex cells, both male and female, fail to develop. In the few cases that were observed in which the gonads of the host were normal, the parasite proved to have been degenerate. The parasitisation does not directly entail the death of the host, and infected individuals fly about and visit their host plants (oats and grasses). It is during this period that the Nematode larvæ become deposited on the plants. They make their way into the stems where the frit-fly larvae are feeding, and here they undergo moulting, and become young adult males and females. The latter, after impregnation, enter the frit-fly larvæ, and so the cycle is carried on. This interesting Nematode has been found by Dr. Goodey to have a wide distribution in England and Wales. Frit-flies of the stem generation were found to be parasitised to about 14 per cent and those of the panicle generation about 5 per cent. This Nematode, therefore, is to be regarded as an organism the relation of which to agriculture is of a beneficial character.

Bryozoan Fauna of the Galapagos Islands.—Dr. Ferdinand Canu and Dr. Ray S. Bassler have described a particularly interesting collection from the dredgings of the United States Fish Commission steamer *Albatross*, preserved in the United States National Museum, from a few stations in the vicinity of the Galapagos Islands (No. 2810, *Proceedings of the United States National Museum*, vol. 76, Art. 13, 1930). Amongst the many species described ten are common to the Gulf of Mexico and to the Galapagos, indicating an ancient communication between the Pacific and Atlantic and the recent formation of the Isthmus of Panama. There are not many of these forms common to the two regions. In the Galapagos the great southern current has modified considerably the nature of the plankton and all the marine fauna. Simple forms, such, for example, as *Aplousina filum*, which are indifferent to the thermic influences, have alone been able to persist. Sometimes species so far only found fossil in the Gulf of Mexico are found living in the Galapagos Islands. Of fifty-three species determined and studied, twenty-nine are new, and four new genera belonging to the Cheilostomata are here created, three of which are peculiar to the region. So far no species occurring in South America have been recognised in the Galapagos Islands.

Recent English Earth-movement.—The widely adopted conclusion that the British Isles have undergone no change in level since Roman times has been frequently confronted by the claim for recent subsidences along the coast. The existence of Roman sites and pottery below sea-level is not conclusive of a general movement, since the land surface may be lowered by the shrinkage of water-logged ground after drainage. Mr. C. J. Gilbert has summarised in a short paper—"Land oscillations during the closing stages of the Neolithic depression" (Second Report of the Commission on Pliocene and Pleistocene Terraces, Union Géographique Internationale, Florence, 1930, pp. 93-101)—evidence of changes of level of Romney Marsh, the Thames Estuary, and the Arun Valley in Sussex, indicative of a marked post-Roman subsidence. The Roman settlements are now 8-9 ft. below ordinary high tide level at Westminster, 16½ ft. at the Albert Dock, 17 ft. at Crossness, and 14-15 ft. at Tilbury. Mr. Gilbert concludes that at Romney Marsh there have been three well-marked subsidences. The first was part of the widespread and well established Neolithic depression; it was during the Neolithic, as it was followed by an uplift that produced surfaces occupied by Neolithic man. The second subsidence was post-Neolithic and pre-Roman. The third was from the eleventh to the thirteenth centuries A.D. and led to the final submergence of the Goodwin Sands, the devastation of the south-western part of Romney Marsh, and the destruction of Broomhill and of the older outlet of the Rother. Mr. Gilbert claims the agreement of these movements with those on the coast of Flanders and those recently adduced by Mr. R. D. Oldham from the Rhone delta. Nevertheless, despite the wide range of these changes, he regards them as local and as due to oscillations of the land. If they were due to changes in ocean level parallel phenomena would be widespread around the British shores and on the Continent; such he concludes "manifestly do not exist". The earth movements of Scandinavia, he states, have been fundamentally divergent from those of Britain.

Peat Profiles in North America.—An investigation of thirty-four peat bogs in the region from Niagara to Nova Scotia has been made by V. Auer, and his results appear in *Mem.* 162 of the Geological Survey of Canada, 1930. The materials described include inorganic, organic, limy, and jelly-like oozes and *Carex*, *Amblystegium*, *Sphagnum*, grass, and forest peats. The stratigraphical succession indicates that the lower layers were formed during a warm dry (Boreal) period; this was followed by moister conditions with deciduous trees (Atlantic); then a dry period succeeded (sub-Boreal); and finally a moist and comparatively cool climate is suggested (sub-Atlantic). In a general way, as indicated by the terms in brackets, the changes correspond to those of post-glacial Europe. Peat profile studies in Maine (*Jour. Wash. Acad. Sci.*, April 4, 1930), and in the Puget Sound Basin of Washington (*Ibid.*, June 4, 1930), are recorded by A. P. Dachnowski-Stokes. The South Lubec peat of Maine is a member of the 'highmoors', and is characterised by a three-layered succession derived from marsh, forest, and sphagnum moss plant communities. The marginal soils show that podsolising processes are now active. The Washington peat-lands are of two groups: low moor, with two- or three-layered limnogenic profiles, with a reed and sedge assemblage at the surface; and acid oligotrophic peats with sphagnum moss at the surface.

Geology of Queensland.—Some interesting problems of Queensland geology are discussed by J. H. Reid in "The Queensland Upper Palæozoic Succession" (*Pub.* 278, Queensland Geol. Surv., 1930). It is concluded that between the base of the Devonian and the top of the Permian there is evidence of three effective folding movements with trends nearly parallel to the present coast. The first of these was probably in the Lower Devonian, but determination of the age depends on correlations that have not yet been satisfactorily established. There followed a Middle Carboniferous movement without thrusts, and still later a more intense orogeny of late Permian age which led to thrusting from the oceanic side. This was accompanied or succeeded by intense igneous activity, to which the origin of the metalliferous deposits of the Queensland copper-gold province is reasonably thought to be related. Glacial formations of three distinct, though not well determined, ages are established: Upper Carboniferous, Lower Permian, and Middle Permian. It is important to notice, however, that the deposits are all apparently the result of material transported by floating ice from a land area lying to the south. The suggested periods correspond to those in New South Wales, where terrestrial glacial deposits occur in the 'Permo-Carboniferous'.

Oil-well Deviation.—The subject of oil-well deviation, or 'crooked holes' as it is known in the industry, is one which has come very much into the limelight since the technique of deep drilling attained its present high standard. With a shallow well, deviation from the vertical either mattered little or, if it was a bad case, it could be corrected by various devices known to the driller. But where wells reach to a mile or more in depth, the cumulative error of deviation becomes too great to be ignored; hence the necessity of careful control on drilling wells and of survey of those or existing wells where deviation is thought to be excessive. Actually a straight hole of any depth is almost an impossibility, even with the most modern plant, since the attitude and nature of the rocks penetrated influence the run of the bit; for example, if a hole already 15°-20° from the vertical is suddenly continued in soft shale, dipping 60°-65°, no check being placed on behaviour and tendencies, the probability is that the bit will run down dip, that is, at increased deviation, so that not only is there a serious error in supposed depth of the well from the surface, but also important horizons such as oil sands may be missed

altogether, to say nothing of the consequent straying of subsurface calculations. This subject was dealt with ably at some length by Mr. D. P. Rees at a meeting of the Institution of Petroleum Technologists in May last. Apart from the engineering factors involved, the author showed that the method now generally adopted to counter the effect of deviation of wells in oilfields is to run a survey in those wells which are being drilled, where there is any chance of the deviation being sufficient to upset calculations of oil and water horizons. Although the time taken to survey a well being drilled may interfere somewhat with progress, this is more than made good by the value which increased accuracy of record has in the economic working of the field as a whole.

Variometer for Measuring Vertical Magnetic Force. - The Danish Meteorological Institute has recently issued a further part (Nos. 8, 9) of its *Communications Magnétiques*; No. 8 consists of an extremely able article by the Director, Dr. la Cour, on a new form of variometer for the vertical magnetic force. He has called this the 'Godhavn' balance, in celebration of the institution, by Denmark in 1928, of the observatory at that station in Greenland (69·2° N., 53·2° W.). The principal features of the new instrument are: (1) the magnet, mirror, and knife edges consist of a single piece of tungsten steel, the length of the magnet being about 6 cm. and the total weight about 2·5 grams; (2) the magnet is placed in a sealed vessel in dry clean air at a low pressure (about 100 mm. of mercury), thus preserving it from any influence of moisture or dust: (3) the influence of temperature changes on the magnet is compensated optically, by a prism supported by a bimetallic suspension and placed outside the vessel containing the magnet, thus enabling the prism to be adjusted without affecting the magnet; (4) the price of the instrument is relatively low, being about £25 without the compensator, or £33 with it. The detailed account of the instrument is full of examples of careful thought and ingenuity in its design and use.

Gyromagnetic Effect for a Paramagnetic Substance. --When a body is magnetised, electron theory requires that it should simultaneously acquire a mechanical spin, small even for ferromagnetic substances, about the magnetic axis. The extremely difficult experimental determination of the spin generated in a specimen of the paramagnetic substance dysprosium oxide by this effect is described by W. Sucksmith in the July issue of the *Proceedings of the Royal Society*. The methods used for iron and nickel were too crude to be applied directly in this case, and it was found necessary to set up a resonant torsional vibration of the specimen by applying an alternating magnetic field of the same period, and to take great precautions both to avoid ferromagnetic impurity and to obviate electrostatic and other disturbances. Even then, with a logarithmic decrement of about 10^{-3}, and magnetic fields of some hundred gauss, the amplitude of vibration was only about ten minutes of arc. The result obtained is that the Landé splitting factor (g) of spectroscopic theory is $1{\cdot}28 \pm 0{\cdot}07$ for the ion Dy^{+++} in dysprosium oxide, in excellent agreement with the value 4/3 which corresponds to the state ${}^6H_{15/2}$ predicted by Hund to be the most probable for this ion.

Soft X-Rays and Electrons in Crystals.—When soft X-rays are excited by bombarding solids with electrons or when the secondary electrons emitted from the surface are examined, evidence is obtained that a complex system of energy levels exists which cannot be correlated with the Bohr systems for the atoms of the solid. The experiments are difficult, and the results obtained by different investigators not very consistent, but it is pointed out by Prof. O. W. Richardson, in a paper in the July issue of the *Proceedings of the Royal Society* (p. 63), that if it is assumed that there is present in a crystal a class of structure electrons which are neither free nor associated with individual atoms, frequencies of the observed order of magnitude can result. Pursuing the analogy that a crystal is like a large molecule, Prof. Richardson remarks that the structure electron levels should be built up in a very similar way to that of the levels to which the source of a system of vibration bands in molecular spectra is attributed, and shows that there is in certain cases a relation between the magnitudes of the energy levels observed, and the integral numbers. The quantum mechanics of electrons in crystals has also been developed recently by P. M. Morse (*Physical Review*, June 1, p. 1310), but although it accounts well for many details of the experiments of Davisson and Germer, it has still to be considered in relation to soft X-ray phenomena.

Design of Radio Receivers. An excellent report containing a review of recent literature on the design of radio receivers has just been published by His Majesty's Stationery Office (price 5*s*. net). It has been prepared at the National Physical Laboratory for the Radio Research Board. It gives a clear indication of the lines along which future research may be profitably undertaken. It will be of special use to workers who are studying the properties of radio receivers. All the abstracts of papers given are critically examined, and so workers will be able to tell whether it will be useful for them to make more detailed examination of the papers or not. The bibliography is practically complete from 1916 to 1929. Only those parts of the early literature of the subject prior to 1916 are included which are of outstanding importance. Periodic phenomena do not completely represent the operation of a receiver which is constantly being acted on by complex waves of non-periodic form. We know, however, that from a practical point of view, a knowledge of the steady state phenomena suffices for practical purposes in a great many cases. Unfortunately, the design of short wave amplifiers is as yet almost entirely empirical. The behaviour of a three-terminal thermionic tube at very high frequencies gives rise to phenomena which have not been satisfactorily explained. All the work on audio frequency amplifier design has been directed towards obtaining a linear frequency characteristic. Recent improvements of loud speakers are in the direction of obtaining a uniform frequency response and this is the ideal solution. The operation of the loud speaker might also be corrected by using suitable electrical filter circuits, but this would only be a partial solution. If we design the amplifier to correct the defects of the loud speaker, then the two would form an inseparable combination and so this solution would not be advisable.

Estimation of Water in Methyl Alcohol.—A method for the detection and estimation of small quantities of water in methyl alcohol is described in the June number of the *Journal of the Chemical Society* by D. C. Jones and S. Amstell. It depends on the fact that the critical solution temperature in the system methyl alcohol *cyclo*-hexane is very sensitive indeed to the presence of water in the alcohol. *Cyclo*-hexane is readily obtained, can be purified easily, and has in its melting point a very sensitive criterion of its own purity. A quantity of 0·01 per cent of water in the alcohol produces a rise in miscibility temperature of 0·15°.

The Topographical Changes Accompanying Earthquakes and Volcanic Eruptions.*

THE twenty-sixth, and nominally the last, part of the *Publications* of the Earthquake Investigation Committee appeared in 1908. Though we have had to wait more than twenty years for the number that should have preceded it, it may be said at once that geologists have gained greatly by the delay, for Prof. Imamura, the well-known secretary of the Committee, has been able to avail himself of many valuable recent observations, and especially of those of the Kwanto earthquake of 1923 and the Tango earthquake of 1927, and the eruptions of the Usu-san in 1910 and the Sakura-jima in 1914. It is not too much to say that his memoir is likely to prove one of the classics of seismology. In these pages Prof. Imamura has described the changes that have occurred about the times of so many as 26 Japanese earthquakes, in 12 of which (from 1891 to 1927) the changes have been measured by one or more series of subsequent precise levellings. As might be expected in a young country like Japan, the changes are of two kinds, which he terms chronic and acute. The latter, of course, are associated with earthquakes. The chronic changes may prepare the way for the acute earthquake changes, but an example of remarkable interest, investigated by the late Prof. Yamasaki, is given in which chronic changes occur apparently alone.

The district in question lies along the coast of the Japan Sea in the provinces of Etigo and Sinano, and extends about fifty miles to the east of the lofty Hido range. It consists of two large blocks separated by a deep depression. The series of precise levellings were carried out first in 1894, and they have been repeated in 1927. During this interval, in 1897 and 1918, there were two strong shocks, but with neither was there any formation of new clefts or fault-lines. Yet a comparison of the two surveys has revealed the facts that, with a few trifling exceptions, both blocks have subsided, and that in each the amount of subsidence decreases gradually from west to east. In the western block, it is 94 mm. at the west end and 38 mm. at the east end, where, along an old fault, it suddenly increases to 113 mm. In the eastern block, the subsidence is 96 mm. at the west end, while at the east end there is a rise of 4 mm., succeeded, again along an old fault, by a sudden depression of 70 mm.

In the present notice, it is only possible to refer briefly to some of the interesting conclusions at which Prof. Imamura arrives. While most of the earthquakes with which topographical changes were associated were of destructive strength, a few (such as the Susaka earthquake of 1897 and the Oomati earthquake of 1918) resulted in no loss of life. As a rule, elevations of the land are confined to formations of Tertiary or more recent age, depressions to formations of pre-Tertiary age. The changes considered consist, for the most part, of discontinuous tiltings of consecutive mosiac blocks, but, in some earthquakes, as in the Kwanto earthquake of 1923, there is also a rotational movement about a vertical axis or bodily displacement in a vertical direction. Discontinuous tiltings of contiguous blocks result in the formation of faults or flexures along their boundaries. In local earthquakes, such a fault-system is simple, but, in great earthquakes, it may be extremely complex. Sometimes, as in the Mino-Owari earthquake of 1891, it consists of several segments arranged *en échelon*, in the earthquake mentioned crossing the whole of the Main Island. In others, as in the Kwanto earthquake of 1923 and the Tango earthquake of 1927, it is distributed over the epicentral area along pre-existing tectonic lines.

In the Kwanto district, there have been four great earthquakes during the last two thousand years, shortly after the beginning of the Christian era, and in 818, 1703, and 1923. Prof. Imamura summarises the changes at the last epoch and probably at each of the other epochs, as consisting of the following stages: (1) a practical absence of any tilting for a century or so; (2) slight chronic tilting for a few decades in the direction opposite to that in which it afterwards occurs, accompanied by many local earthquakes; (3) slight reversed tilting, with more frequent and stronger local earthquakes; (4) pronounced acute tilting accompanying a disastrous earthquake; and (5) a repetition to and fro of the tiltings, which gradually diminish in magnitude until they cease.

The changes that precede, accompany, and follow volcanic eruptions have been measured in only two eruptions. The earlier changes are similar to those that occur before earthquakes. In the immediate neighbourhood of the volcanoes, they consist apparently of an upward bulge of the land, but essentially they are discontinuous tiltings of mosaic blocks as in great earthquakes. The principal difference lies in the leisurely way in which the volcanic changes take place as compared with the quick and sudden changes that occur with earthquakes. C. Davison.

* *Earthq. Inves. Com. Publ. in For. Langs.*, No. 25, pp. 1-143, 1930.

Estimating Stream Flow from Evaporation.

MR. FOLSE'S monograph referred to below * embodies the data and results of a research begun in 1912 and continued until 1925 by the late Dr. John F. Hayford and completed by the author. To a certain extent, as stated by the author, it overlaps *Publication* No. 317 by Dr. Hayford.

The object of the investigation was to formulate laws governing the flow of streams and rivers on the basis of more specific laws of evaporation. The numerous intensive studies of evaporation pans of small area have been supplemented by an examination on the full scale of Nature and under natural conditions. For this purpose, each of the Great Lakes was considered as an evaporation pan and from day to day evaluations were made of the change of content, the income and outgo including evaporation. From these observations it was found possible to segregate that part of the outgo which is evaporation, and to determine the laws of evaporation, and their application to the problem of stream flow.

The observations consisted of the daily mean elevations of the water surfaces, barometric pressures, wind velocities, temperatures, vapour pressures, and rainfalls.

The outcome of the investigation claimed by the author is briefly as follows:

(1) An evaporation formula has been derived which enables one to estimate the daily evaporation from any free, open surface of water in terms of air temperature, vapour pressure, and wind velocity.

(2) An estimate has been made of the constant part of the run-off into each of the Lakes Michigan, Huron, and Superior, from their respective drainage areas, and

* A new Method of estimating Stream Flow: based upon a new Evaporation Formula. By J. A. Folse. (Publication No. 400.) Pp. xi+237+22 plates. (Washington, D.C.: Carnegie Institution, 1929.) 5 dollars.

certain knowledge with reference to the variable parts of the run-off in each case has been obtained.

(3) A reasonably accurate numerical expression has been obtained from the effects of barometric pressures on the elevation of the water surface at the Marquette Station on Lake Superior, and constants enabling one to compute the hourly or daily effect of a wind of any velocity and direction upon the water-surface at the same station.

(4) The knowledge gained in (1) and (2) has been applied to the estimation of evaporation losses from land surfaces, and the combined effects upon stream flow.

Space does not permit any detailed description of the investigation or of the evaporation formula. They have, however, involved an immense amount of work and many thousands of calculations.

In applying his conclusions to stream flow in the second part of the treatise, the author assumes that the evaporation from a land surface follows the same laws as, and bears a constant ratio to, the evaporation from a free open water surface in each watershed. In his expression for the 'normal' flow of any stream there appear eleven terms, one of which is termed the 'constant' part of the flow, and the remaining ten terms functions of the rainfall in varying periods extending to 257 days preceding the day of the observation. The coefficients for these terms have been determined and the results tested against actual stream flow records.

The impression gained by a study of this work is that the author has unquestionably advanced the study of the laws of evaporation from water surfaces, but that in its application to stream flow he has devised a process on assumptions which are not fully justified by results. H. L.

The Origin of the Irish Fauna and Flora.

WHILE the flora and fauna of Ireland are essentially those of Great Britain, differing chiefly in the absence of Germanic species, the occurrence of the so-called Lusitanian and American elements has made Ireland an area of special interest to biologists and geologists who have sought to trace the history and origin of its floral and faunal life. The Lusitanian flora, as is well known, has its continental centre in the Iberian Peninsula, while a correspondingly small faunal group, comprising no large animals, has a somewhat similar distribution. In Ireland most of these Lusitanian plants and animals are found in the south and south-west, although some extend northwards. The American element, even smaller than the Lusitanian, is separated from its main area of distribution by the Atlantic Ocean. Reference may be made also to an Arctic-Alpine element which, although better represented in Britain, is fairly widely distributed in Ireland. The absence of certain British species and the presence of Lusitanian, American, and Arctic-Alpine species are some of the outstanding facts which any complete theory of the origin of the Irish fauna and flora must explain.

So long ago as 1846, Edward Forbes, in a paper dealing with the geographical distribution of plants and animals in the British Isles, was among the first to inquire into the geological changes affecting their area, and since then biologists have repeatedly attacked the problem from different angles. In seeking a solution to the problem it has always been recognised that the most important factor was the intervention of the glacial period, but the effects of the changes thus brought about have been very variously estimated. Some have advocated complete extermination of the Irish fauna and flora; others have believed in a considerable survival dating from Miocene times. In these discussions the voice of the geologist has not been sufficiently heard, and biologists will welcome, therefore, the authoritative views recently expressed by Prof. J. Kaye Charlesworth.[1] The author describes the complete burial of Ireland beneath the Pleistocene ice-sheet at the maximum of glaciation as an indisputable fact, and the possibility of survival during glacial times of even the smallest part of the Irish fauna and flora as we know it to-day must be definitely excluded from our calculations.

Survival in some unknown southern or western asylum beyond the limits of the ice has been, however, frequently postulated and commonly accepted among biologists. This question is largely a geological one, and Prof. Charlesworth enters into it fully, examining critically the evidence regarding changes of sea-level during the Pleistocene, and the climatic conditions of the ice-free strip, if any such existed. The problem of the glacial sea-level is complicated, but obviously of fundamental importance. When glacial conditions set in, Ireland was an island with a coast line very similar in position and level to that of the present time. During glacial times the sea-level did not remain constant, otherwise all possibility of survival could be "most categorically denied". From all the available evidence, too detailed to summarise, the conclusion is reached that during the glacial period the sea-level around the Irish coasts was lowered by about 50 fathoms. To the south of Ireland this line encloses an extensive area which might provide a place of refuge, but taking the most favourable view for survival, Prof. Charlesworth thinks that probably only arctic and boreal species persisted on the southern ice-free strip. To the west there was no ice-free area.

Immigration of the present Irish flora and fauna took place, therefore, subsequent to maximum glaciation. The view is held that a considerable fauna and flora, including Lusitanian species, reached Ireland during the "Aurignacean Oscillation" when the ice-sheet withdrew from the southern half of the island. Prof. Charlesworth leaves to biologists to decide what species may have survived the ensuing Early Magdalenian Glaciation when the ice readvanced to the line of the 'South Irish End-moraine' running from Wexford to the mouth of the Shannon. For immigration into Ireland a post-glacial land connexion with Great Britain existed, but the connexion was never complete. The 'bridge' between Ireland and the Scottish mainland was severed by the Sound of Jura, while the more southerly 'bridge' between Ireland and Wales was broken by a narrow strait or wide river west of Anglesey. Over this broken drift plain the greater part of the Irish fauna and flora seems to have entered, and clearly some accidental dispersal would be necessary to effect the crossings. The later submergence during the "Atlantic Period" prevented further immigration, and those forms which continued to extend their range westwards in Britain after that date could enter Ireland, if they did so at all, only by chance dispersal.

Prof. Charlesworth's exposition of the geological factors which must be taken into account is of the greatest importance to biologists and provides a much safer starting-ground than any hitherto available for tracing the history of Irish plant and animal life.

J. R. MATTHEWS.

[1] "Some Geological Observations on the Origin of the Irish Fauna and Flora." By Prof. J. Kaye Charlesworth. *Proc. Roy. Irish Acad.*, 39B, pp. 358-390; 1930.

University and Educational Intelligence.

THE emphasis laid by American educationists to-day on the importance of relating institutions, whether university, college, or school, as closely as possible to the actual daily life of the people, may be seen in the rapid increase (to which attention is directed in *Education Bulletin*, 1929, No. 30) in the number of schools adopting the form of organisation known as the 'general shop' for providing in the school curriculum instruction in a number of different manual activities for pupils of twelve to fifteen years of age. The bulletin points out that modern life has become so complex and production so highly specialised that the consumer has, apart from some such school instruction, little opportunity to learn much about trade operations, materials, or manufacturing processes. The 'general shop' training is not for actual skill in the trades represented, but rather for an understanding and appreciation of values in the final product, and incidentally for the acquisition of a certain amount of unspecialised 'handyman's' dexterity.

NATAL University College celebrates this year the twenty-first anniversary of its foundation. In a handsome commemoration number of the College magazine appears an interesting retrospect by Prof. J. W. Bews, chairman of the College Senate and Dean of the Faculty of Science of the University of South Africa, whose connexion with the College has been continuous since 1910, except for a break of two years, 1925–27, when he held the chair of botany in the University of Durham. The progress of the College since the War has been rapid, the number of students (420 in 1930) having been multiplied nearly tenfold. It was established in Maritzburg, the old capital of Natal, but its work was in 1922 extended to Durban in co-operation with the staff of the Natal Technical College. Durban as a commercial city and seaport has developed at such a pace that it has far outgrown Maritzburg in importance, and seems destined to have a great future in which the College will take a prominent part.

THE Department of Agriculture for Scotland has approved the following appointments at the Hannah Dairy Research Institute, Ayr: *Director*, Dr. Norman C. Wright; *Secretary*, Mr. T. W. Gibson; *Research Assistant in Physiology*, Mr. S. Morris. Dr. N. C. Wright was educated at Christ Church, Oxford, and at Gonville and Caius College, Cambridge. He received the degree of Ph.D. at Cambridge for work on the calcium metabolism of dairy cows. In 1924 Dr. Wright joined the staff of the National Institute for Research in Dairying at Reading, and in 1926 he was awarded a Commonwealth Fund Fellowship, working for two years in the United States, first in the Department of Dairy Industry at Cornell University, and later in the Bureau of Dairying of the United States Department of Agriculture. He was the first member of the staff of the Hannah Institute and has been largely responsible for the general development of the work of the Institute. His research work has been largely in the field of applied physiology. With Mr. W. L. Little he demonstrated for the first time the reduction in the lime content of the blood in cases of milk fever, an observation which forms the basis of the new calcium treatment of this disease. He has also published papers on the physiology of milk secretion, the significance of 'bulk' in the rations of dairy cows, and the occurrence of tuberculosis in cattle. Dr. Wright succeeds Prof. E. P. Cathcart, who will retain his active connexion with the Institute in the position of vice-chairman of the Committee.

Historic Natural Events.

Aug. 24, 358. Great Storm in Black Sea.—A violent storm, accompanied by a great inundation of the sea, occurred in the Black Sea; at noon the sky was quite dark. Macedonia and Asia Minor suffered severely. The storm was followed by a great earthquake.

Aug. 24-26, 1905. Rainstorm in Eastern Ireland.—Rain began to fall shortly after 9 P.M. on Aug. 24 in Dublin, and continued steadily for 34 hours, during which period about 4 inches of rain fell generally, the amount increasing to 5·50 inches on high ground at Bray. Floods caused a great deal of damage to roads and bridges, while part of Bray was submerged to a depth of 4 feet, and the electric light generators were put out of action.

Aug. 25, 1839. Red Snow.—Although the occurrence of patches of red colour in old snow had been known for long, one of the earliest detailed determinations of the true nature of the colouring matter was that made by R. J. Shuttleworth in 1839 (*Edinburgh New Philosophical Journal*, 1840, p. 54). He examined microscopically melted red snow from the neighbourhood of the Hospice du Grimsel, and found that the red colour was due to a number of minute organisms, both Flagellata and Algæ. The snow was described as having a rosy hue, like very pale blood; being old, it was granular, and the colouring matter was contained in the intervals between the particles, giving the surface a veined appearance. The colour extended to a depth of several inches or a foot.

Aug. 25, 1890. Thunderstorm in Eastern Alps.—At about 4 P.M. a thunderstorm occurred at Pesaro in north-eastern Italy, travelling very rapidly north-eastwards across the Adriatic and eastern Austria so far as Vienna. The rainfall was not especially heavy, the largest total being only 3·5 in., partly in the form of hail, but the storm was notable for the sharp rise of pressure, at Pesaro more than 5 mb., which accompanied the onset of the storm, and the violent winds. At Pesaro the wind velocity reached 80 miles per hour, and at Pola 62 miles per hour. Much damage was done, trees uprooted and houses unroofed; many ships were wrecked. The violent winds blew from the south-west, parallel with the track of the storm and at about the same speed.

Aug. 25, 1925. Lightning at San Joaquim Valley, California.—On Aug. 25, 1925, a lightning storm broke over the valley. A flash of lightning struck a 750,000-barrel oil reservoir of the Shell Company at Coalinga and caused an immense fire. The heat developed by the fire was sufficient to raise 1000 cubic kilometres of air through 10° C. Owing to this intense heat, whirlwinds were formed over the fire, and D. Brunt found that the energy supplied by the fire was ample to account for the formation of violent tornadoes. This lightning stroke cost the fire insurance companies more than one million dollars.

Aug. 26, 1346. Crécy Storm.—It is related that just before the battle of Crécy a shower broke over the French and English armies, and largely disabled the Genoese crossbowmen with the former by wetting their strings. The English archers, keeping their bows in cases, were not affected, and it has been said that this incident influenced the course of the battle.

Aug. 26-28, 1883. Great Eruption of Krakatoa.—The great eruption of Krakatoa, in the Sunda Strait, attained its maximum phase during these days. In a series of great outbursts, two-thirds of the island disappeared. The sounds of the explosions were heard at Diego Garcia (2375 miles) and Rodriguez (3080 miles). Waves of longer period cracked walls at

Batavia (100 miles), and others, registered by barographs, travelled at least three times round the earth. Sea-waves, causing the loss of 36,500 lives in Java and Sumatra, were registered by tide-gauges in French and English ports. The dust drifting in the upper atmosphere gave rise for months afterwards to sunset glows of great brilliancy.

Aug. 26, 1912. The Norwich Floods.—Heavy rain began to fall in East Anglia in the early morning of Aug. 26 and continued until the morning of Aug. 27. The total period was not much longer than twenty-four hours, but in Norwich and neighbouring parts the fall exceeded 7 in. and reached 8·09 in. at Brundall and 8·25 in. at Sprowston. The fall of 7·31 in. entered to Aug. 26 is the heaviest known in a day in the east of England. The area with more than 5 in. was estimated as 1039 square miles, and in an area of 1939 square miles the volume of rain exceeded 150,000 million gallons. Serious floods occurred in several of the eastern counties, and particularly in Norwich, where the water level in the flooded part of the city reached a higher level than on any previous occasion. Many bridges were destroyed, and road and rail traffic was dislocated over a wide area.

Aug. 28, 1722. Hurricane in Jamaica.—This was the greatest hurricane on record in Jamaica, and devastated the whole island. It began at Port Royal at 8 A.M. and lasted fourteen hours, during which time the rain was incessant and the storm veered all around the compass. In Kingston most of the buildings were thrown down or much shattered, including the church. The fort suffered very much, and some of the guns were washed into the sea. Out of fifty vessels in port only four men-of-war and two traders were saved, and about 400 lives were lost. After the hurricane there was a calm and the air was so poisoned by the smell of decaying bodies that an epidemic broke out.

Aug. 29, 1776. Fog at Long Island.—After the defeat of Washington's army by the British in the battle of Long Island, the Americans were apparently caught in a trap, for their retreat was cut off by a British fleet in East River. That night, however, a dense fog blinded the British look-outs, and the American army was able to escape across the river to New York.

Aug. 29, 1885. Sirocco at Palermo. An intense sirocco began at Palermo at 1 A.M. with a strong hot wind. At 9 A.M. the temperature had risen to 104° F., and at 1 P.M. the thermometer in the shade stood at 121° F., by far the highest ever recorded in the town. The distribution was, however, very irregular, differing by 20° in different parts. The air was very dry, the relative humidity being only 10 per cent.

Societies and Academies.

EDINBURGH.

Royal Society, July 7.—**A. J. Clark, C. P. Stewart, and R. Gaddie**: The metabolism of the heart. The frog's isolated heart, perfused with Ringer, maintained a regular contraction for 48 hours, and more than 90 per cent of the energy was derived from a non-carbohydrate source. The sugar consumption of the heart could not be increased materially by addition of glucose, serum, and insulin to the perfusion fluid. There was a small but steady excretion of nitrogen from the heart, and the oxidation of the protein equivalent of this nitrogen would have corresponded to about half the oxygen consumption of the heart. The respiratory quotient of hearts perfused with Ringer's fluid lay between 0·80 and 0·85, and did not rise above 0·90 when insulin and sugar were added. The results suggested that the isolated frog's heart used proteins as its chief source of energy.—**E. T. Copson**: The definite integrals of interpolation theory. The cardinal function of interpolation theory, introduced by Prof. Whittaker, has been represented by definite integrals in two distinct ways, the first due to W. L. Ferrar, the second to Ogria and J. M. Whittaker. In this note the relation between these representations is discussed.—**J. Geronimus**: On some persymmetric determinants.

PARIS.

Academy of Sciences, June 30.—**Bigourdan**: The observatory of Méchain, in the rue Vieille-du-Temple.—**A. d'Arsonval**: An X-ray tube of the Coolidge type working at 400,000 volts.—**G. Cerf**: A class of Backlund transformations leading to partial differential equations of the second order with double characteristics.—**Mme. N. Samoïlowa-Jachontowa**: The calculations of planetary perturbations by means of a new independent variable.—**Raoul Gautier**: Concerning Tempel's first periodic comet, 1867 II.—**H. Muraour** and **G. Aunis**: The comparison of calculated explosion pressures with experimental explosion pressures. In a previous paper the authors have shown that there is good agreement between the experimental explosion pressures, corrected for cooling by the walls, and the pressures, starting with the Nernst-Wohl specific heats. This work has now been supplemented, working with a powder giving a very high explosion temperature (3600° C.). Bearing in mind that a large extrapolation was necessary for the specific heats, and that the calculation of the amount of dissociation was somewhat uncertain, the differences between the calculated and observed pressures, −0·6 per cent to +3·4 per cent, are satisfactory.—**Horia Hulubei**: A photo-electric cell for the ultraviolet. Method of sensitising. Palladium was chosen for the metal, sensitised by active hydrogen. With an accelerating potential of 120-480 volts, the threshold was about 2850 A.—**Henri Marcelet** and **Henri Debono**: Spectrographic analysis of the various types of fluorescence of olive oil, observed in ultra-violet light.—**Marcel Guillot**: The relation of several reactions carrying down polonium with the existence, in the form of colloidal precipitates removable by the centrifuge, of insoluble derivatives of this radio-element. In all cases, where more than 97 per cent of the polonium can be carried down by a foreign precipitate, it is possible by centrifugation, without the addition of a foreign element, to prove the precipitation of an insoluble compound of the radio-element.—**A. Sanfourche** and **L. Rondier**: The irreversible reduction of the oxides of nitrogen by sulphurous acid.—**A. Astruc** and **M. Mousseron**: The microanalysis of the calcium ion. The method is based on the precipitation of the calcium as the double nitrite $CaK_2 . Ni(NO_2)_6$, washing with aqueous acetone (20 per cent) and alcohol-ether, and reduction of the nitrate to ammonia. The method gives good results for amounts of 0·3-1·0 mgm. of calcium.—**P. Brenans** and **K. Yeu**: Bromo-diiodophenols, symmetrical trihalogen compounds.—**G. Darzens**: Styrallyl-allylacetic acid and its conversion into a tetrahydronaphthalene derivative.—**Wyart**: The study of heulandite by means of the X-rays.—**Pierre Bonnet**: The thrust in the south trans-Caucasian geosyncline.—**Marcel Roubault**: The glacial formations of the Néoubielho massif (Hautes-Pyrénées).—**P. Russo**: The dipping of the Middle Atlas under the plain of Moulouya (North Morocco).—**H. Derville**: Lunel marble: its varieties.—**C. Dauzère**

and **J. Bouget**: The influence of the geological constitution of the soil on the points where hail falls. In a hailstorm near Bagnères, the heaviest fall of hail was on siliceous schists and metamorphic rocks: limestones are protective against hail. These results confirm the views previously published by the author on the influence of the constitution of the soil on the distribution of hail.—**Pierre Dangeard**: Observations on the living protoplasm of Algæ.

CRACOW.

Polish Academy of Science and Letters, May 5.—**T. Wazewski**: Asymptotic Jacobians and the change of the variables in multiple integrals.—**S. K. Zaremba**: Remark on the singularities of systems of differential equations not solved with respect to the differentials.—**J. Pagaczewski**: The provisional elements of the variable stars Algolides, 40, 1929 Eridani and 43, 1929 Orionis.—**Wl. Gorczyński**: The degrees of transparency of the atmosphere for solar radiation on several oceans and some other regions.—**W. Swietoslawski** and **S. Bakowski**: Some experiments on the velocity of evaporation of liquids on a surface of heated platinum.—**Mme. H. Blaszkowska-Zakrzewska**: The velocity of evaporation of liquids on heated metallic surfaces.—**K. Dziewoński** and **A. Obtulowicz**: The benzoyl derivatives of fluorene.—**M. Ramult**: The Cladoceran fauna of Pomerellie.—**M. Ramult**: A case of gynandromorphism in the species *Alona affinis*.—**Wl. Szymonowicz**: The innervation of the tactile hairs of the seal.—**B. Petschenko**: The grafting of Jensen's rat sarcoma on the mouse.

GENEVA.

Society of Physics and Natural History, May 22.—**Th. Tommasina**: The experimental proof of the existence of the ether given by that of the ultra-red dynamical rays. The author recalls the phenomena observed on a radiometer with triple glass walls; he attributes the motion to the action of ultra-red rays which he calls dynamic, and considers that his experiments prove the existence of the ether. The latter is the agent conveying the energy which, in contact with matter, can take any of the forms known in physics.—**R. Galopin**: Some new minerals in the scoria of blast furnaces. One of the minerals studied, from its optical properties, belongs to the peridote group; the other suggesting the mixtures in variable proportion of gehlenite and akermanite studied by Fergusson and Buddington.

June 5.—**L. Duparc**: The molybdenite deposit of Azegour (Morocco). The molybdenite is contained in grenatites, a product of contact metamorphism of a granite. From the research work on this deposit, it would appear that there are important quantities of this mineral, in proportions reaching more than 3 per cent.—**E. Briner** and **J. Deshusses**: Researches on the formation and decomposition of cyanogen. Study of the chemical action of electric discharges. Submitting the carbon-nitrogen system to heat and to electric discharges of various kinds, the authors have been unable to prove the production of cyanogen. The velocity of decomposition of cyanogen at various temperatures has been measured; it is insufficient to lead to the complete destruction of any cyanogen which might have been formed. The absence of the formation of this substance can be explained by the peculiarities of the chemical action of electric discharges.—**N. Danoz**: The calculation of the Newtonian potential of a certain heterogeneous sphere. The author establishes a formula giving the value of the potential at a point inside the sphere.

SYDNEY.

Royal Society of New South Wales, June 4.—**F. W. Booker**: A review of some of the Permo-Carboniferous Productidæ of New South Wales, with a tentative reclassification. The several forms comprised in *Productus Brachythaerus*, G. B. Sowerby, 1844, were reviewed in the light of recent researches. They belong to a distinct genus *Terrakea* containing at least four species.—**H. G. Raggatt** and **H. F. Whitworth**: The intrusive igneous rocks of the Muswellbrook-Singleton District. (1) Introduction. Three groups of intrusive igneous rocks are recognised as follows: (1) Alkaline basic sills; (2) plugs; (3) dykes and small sills. The alkaline sills include the Savoy, Plashett, Carrington, and Fordwich intrusions, each containing acid and basic phases and presenting an interesting study in magmatic differentiation. The plugs consist of basaltic types of rock poor in felspar and rich in ferro magnesian minerals. Many contain nepheline. The dykes and small sills are numerous. The former include porphyritic and non-porphyritic types of rocks. The sill rocks resemble very closely the latter type. The age of the first two groups is almost certainly Tertiary; the third group requires further study before the age can be stated. Apart from their scientific interest, a study of the intrusive igneous rocks has considerable economic interest in relation to coal reserves, and the possible occurrence of oil and gas.—**A. R. Penfold**: The essential oils of *Zieria Smithii* (Andrews) and its various forms. This Rutaceous shrub grows in moist situations throughout New South Wales, Victoria, and Queensland. The chemical composition varied according to the locality from which plant material was obtained. Yield of oil from Queensland material is about 0·5 per cent on fresh material or 0·9 per cent on air-dried leaves. The principal constituents are safrol with a little methyl eugenol (70-80 per cent), together with d-a-pinene, sesquiterpenes, etc. Material from Narrabeen, New South Wales, contains 95 per cent methyl eugenol, and the phenol esters from Toronto material are a mixture of elimicin and safrol.

Official Publications Received.

BRITISH.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 5, No. 3, July. Pp. 177-271. (Cambridge: At the University Press.) 12s. 6d. net.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iv+100. (London: H.M. Stationery Office.) 2s. net.

City of Leicester Museum and Art Gallery. Twenty-sixth Report to the City Council, 1st April 1929 to 31st March 1930. Pp. 24. (Leicester.)

Journal of the Chemical Society. July. Pp. iv+1518-1711. (London.)

FOREIGN.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 19, Nos. 4 and 5: Some Rissoid Mollusca from the Gulf of California, by Fred Baker, G. D. Hanna and A. M. Strong; Some Mollusca of the Family Epitoniidae from the Gulf of California, by Fred Baker, G. D. Hanna and A. M. Strong. Pp. 23-56+3 plates. 25 cents. Vol. 19, No. 6; Pliocene Deposits North of Simi Valley, California. By W. P. Woodring. Pp. 57-64. 25 cents. Vol. 19, No. 7: Geology of Sharktooth Hill, Kern County, California. By G. Dallas Hanna. Pp. 65-83. 50 cents. Vol. 19, No. 8: Fossil Bird Remains from the Temblor Formation near Bakersfield, California. By Alexander Wetmore. Pp. 85-93. 25 cents. Vol. 19, No. 9: The Killifish of San Ignacio and the Stickleback of San Ramon, Lower California. By George Sprague Myers. Pp. 95-104. 25 cents. Vol. 19, No. 10: Contributions to Oriental Herpetology. By Joseph R. Slevin. Pp. 105-108. 25 cents. (San Francisco.)

Department of the Interior: U.S. Geological Survey. Monograph 55: The Titanotheres of Ancient Wyoming, Dakota and Nebraska. By Henry Fairfield Osborn. Vol. 1. Pp. xxiv+701+plates 1-42. Vol. 2. Pp. xi+703-953+plates 43-236. (Washington, D.C.: Government Printing Office.) 9 dollars.

SATURDAY, AUGUST 30, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Eugenic Sterilisation.

SOME of the young people of Germany would have us believe that much of the time that can be spared from their more materially fruitful exploits is given over to singing a song which they call "Deutsche Jugend, heraus". Its language, borrowed from historical romanticism, permits, if it does not foster, a certain diversity of interpretation, and some lines with a frankly Christian significance may even be omitted at the discretion of the singer. Claim to popularity is thus made more catholic.

> Wollt Ihr ein neues bauen
> mit Händen stark und rein,
> in gläubigem Vertrauen
> lasst dies die Losung sein:
> Den Feind in eigner Mitte
> gefällt in ernstem Strauss. . . .

Moralists, it is easy to see, may use these lines to assist them in focusing attention upon that enemy in their midst distinguished as the *beam*, while the nationalist may recognise more immediately its particular referability to the communistic *mote*.

We are assured, however, that the resiliency of this *credo* unites rather than divides, and such demonstrations as we have enjoyed tend to reinforce the assurance audibly. But we cannot help wondering what will happen in the world when the youth of one country or another not only present accessible enemies in their patriotic songs but also define them with scientific precision.

The real enemies of mankind are made, yearly, more and more accessible to attack by science, and if it were not for the protective screens, intangible and often fantastic, thrown up by the unscientific for whom nakedness, even the enemy's, still seems to possess terrible powers, mankind might subjugate very speedily its worst foes. But if, as Sir Walter Fletcher has lately pointed out, a mere ailment, like cancer, has only been made accessible to scientific study through the lifting of foolish and superstitious taboos, how can we expect the direr social maladies to be approached courageously? A protective hedge of errors and superstitions hems them in on every side, so rank and poisonous that it seems that even science is infected and intimidated while it attacks.

How else is it possible to explain the demand just put forward * by a committee of the Eugenics Society for permissive legislation which would take a whole generation to achieve a reduction in the incidence of mental defect not of a hundred, not of fifty, not of twenty-five, but, problematically,

* Committee for Legalising Eugenic Sterilisation. Eugenics Society, London, 1930.

of seventeen per cent ? Between our people and the realisation of this slender benefit stands " an ambiguity of the law " which the Society proposes to remove. A person may, with consent, be sterilised in the interests of his *own* health. In the interest of the public health, present or future, he may not be sterilised. By a curious legal inversion, the 'willing mind' of the individual cannot take away the offence against the public even should he be prepared to save it from all possibility of contamination by his own progeny. The offence consists in a 'maim' which deprives the individual, or so it may be contended, of martial courage, and the State of a vessel, however unsuitable otherwise, for this same virtue. To contentions of this sort, surely the monosyllabic genius of Mr. H. G. Wells's latest novel has supplied the only effective answer.

To meet the practical situation, the committee proposes a Bill legalising eugenic sterilisation. This would authorise the mental deficiency authority or superintendent of an institution to sterilise a mental defective, subject to the consent of the parent or guardian and of the Board of Control, and of the spouse if the defective is married. In the case of defectives deemed capable of giving consent, sterilisation would not be performed otherwise than with this consent. It would authorise the voluntary sterilisation of a person about to be discharged from a mental hospital for the insane as recovered, again with the added consent of Board and of parent, guardian, or spouse; and it would legalise voluntary sterilisation for the sole purpose of preventing the transmission of hereditary defect seriously impairing physical or mental health or efficiency.

Five members of the committee and another contributed to the *Lancet* for July 19 a letter defending this policy. The defence combats the assertion that if every certifiable mental defective had been sterilised twenty or thirty years ago it would have made little appreciable difference to the number of mental defectives existing to-day. It repeats a sentence of the committee's report urging that " if all the defectives in the community could be prevented from having children the effect would be even on the most unfavourable genetic assumptions with regard to defectiveness, to reduce the incidence of mental defect by as much as 17 per cent in one generation ".

Obviously a 17 per cent reduction in the incidence of mental deficiency is more desirable than a 17 per cent increase. But do the committee's proposals ensure this reduction ? Clearly, no. The words quoted promise at least that reduction if the fertility of *all* living mental defectives is prevented. The committee's proposals, with their emphasis upon the voluntary principle, by no means ensure that the 300,000 certifiable mental defectives in England and Wales would be sterilised. Who must consent ? (1) The patient, if he is capable. (2) The parent or guardian. (3) The spouse if the patient is married. (4) The Board of Control. The calculation, it is true, is based on two assumptions " highly unfavourable " to the effectiveness of the proposals—that the genetic factor responsible for defectiveness (primary amentia) would be much 'carried' and would only rarely produce manifest defectives, and that defectiveness is uniformly distributed throughout the community. (The fertility of defectives also is assumed to be that of the average of the population.)

How unfavourable, on the other hand, are the chances of permission ? Nothing is gained by attempts to write off opposing assumptions. A figure is a figure, right or wrong.

Again, is a 17 per cent reduction all that eugenic science can promise ? Disregarding altogether those so-intelligent defectives who will strive to serve the country by seeking this minor mutilation, is it the institutional class that constitutes the chief danger to society ? Prof. MacBride (NATURE, Jan. 11, 1930, p. 40) says emphatically that this but touches the fringe of the problem. " The defectives most dangerous to society are those who are never confined in institutions at all ! The high-grade defectives are just able to support themselves in the lowest paid and most unskilled occupations, and no civilised government would take the responsibility of confining them, and so they go on propagating large families as stupid as themselves." His idea of penal sterilisation, a punishment " for the economic sin of producing more children than the parents can support ", is one which becomes more and more difficult to apply as more and more ways are devised by the State for screening the individual from biological estimation.

Is there not a real danger that the advocates of such legislation as here may mistake the assent of the political machine for victory ? If assent were gained, would it not be much more accurately determined as the hall-mark of failure ? It is not the assent of the State, but the initiative and creative power of the State, that is needed to secure essential progress, and that will not exist until our legislators of all parties or of any party derive their inspiration from the cultivation of natural knowledge.

Biochemistry for Students.

(1) *The Essentials of Chemical Physiology: for the Use of Students.* By Prof. W. D. Halliburton, Dr. J. A. Hewitt, and Dr. W. Robson. Twelfth edition. Pp. xii + 383. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 9*s*.

(2) *A Text-book of Biochemistry: for Students of Medicine and Science.* By Prof. A. T. Cameron. (Churchill's Empire Series.) Second edition. Pp. xi + 482 + 2 plates. (London: J. and A. Churchill, 1929.) 15*s*.

(3) *A Course in Practical Biochemistry: for Students of Medicine.* By Prof. A. T. Cameron and Prof. Frank D. White. (Churchill's Empire Series.) Pp. x + 222 + 4 plates. (London: J. and A. Churchill, 1930.) 8*s*. 6*d*.

(1) AFTER more or less of a dependent career, biochemistry has at last attained what one might call 'Dominion status' among the community of the biological sciences, and the three small volumes under review are a token of this attainment. One of them, "The Essentials of Chemical Physiology", which was first published in 1893, now appears in its twelfth edition, the original author, Prof. W. D. Halliburton, the pioneer of biochemistry in Great Britain, being assisted in its production by two representatives of the modern school, Dr. J. A. Hewitt and Dr. W. Robson. For training medical students in what will be of real value to them in their professional work as physicians, the book is excellent. The guidance by the experienced teacher of a difficult subject is seen in the selection and arrangement of the experiments, and these are described in such a way as to give the student opportunity of testing for himself the broad principles of the subject, as well as of acquiring some practice in those quantitative methods which are used as aids in clinical diagnosis.

To acquire perfect accuracy in the use of quantitative methods would take much more time than the already overcrowded medical curriculum can afford. Nor, indeed, were the time available, would it be of much value to try to do so; nevertheless, it is most important that the physician should learn enough about how the methods are carried out, so that he may be in a position to know what emphasis to place upon the results submitted to him by the clinical chemist. It is through a lack of this knowledge that many physicians fail to put a proper value on the assistance they can derive from the biochemist. They are apt to look upon him merely as a technician whose work is done when he has reported the results of the often laborious, and sometimes useless, chemical analyses assigned to him. They fail to realise that intimate collaboration between physician and biochemist, not only in the diagnosis but also in the conduct of the case, would be invaluable. It is this principle that a modern course in biochemistry should teach, and the present volume furnishes an admirable stepping-stone leading to its realisation by the student.

The theoretical matter is sufficient in scope to connect the purely chemical with the physiological aspects of the subject. Occasionally, as is a common fault with all elementary texts in a growing science, dogmatic statements are made, when really the truth is not known with certainty. For example, it is stated on p. 149 that regurgitation of the duodenal contents is the *normal* method by which the acidity of those of the stomach is prevented from rising too high. Is this proved?

The printing of the experiments in bold type is an excellent idea.

(2) The other two volumes are of a somewhat different type. One of them is the second edition of a "Text-book of Biochemistry", and the other, which now appears for the first time, a practical manual to go with it. The text-book differs from Halliburton's "Essentials" in being not restricted to the needs of the medical student. It treats the subject on somewhat broader lines, and will be found most useful as an introductory text for those who may be looking forward to a career in biochemistry itself, or are studying it with the view of entering one or other of the many non-medical sciences (agriculture, bacteriology, food chemistry) in which its principles are applied.

By a judicious use of small print, much of the more advanced matter is kept by itself and may be omitted without disturbing the sequence of the text. Although the author is a chemist by training, he has succeeded admirably in incorporating with the purely chemical material the biological and the medical applications of his subject. Here and there, however, the physiological teaching is somewhat unorthodox, as, for example, on p. 143, where we are told that the intestinal juice is largely secreted by the glands of Brunner.

The book is clearly written, the subject matter very well selected and arranged, and sufficient attention is given to the discussion of unsolved problems of biochemistry to arouse the interest of the better type of student, for whom also a short bibliography at the end of each chapter affords a guide to further reading. The early appearance of a second edition is evidence of the demand for

such a book, and the author may justly be proud of his success.

(3) The " Practical Biochemistry ", by the same author in association with F. D. White, contains a series of laboratory exercises requiring at least fifty-six periods of three hours each to carry out. This exceeds considerably the time available for such work in the great majority of the medical schools of Great Britain, so that, if the text were adopted, considerable pruning would be necessary by the teacher. The course is arranged in two parts; the first dealing with qualitative procedures and the second with quantitative. In the latter, only one approved method has been selected for detailed description of each substance estimated, brief references being also given to other methods. As an accurate and useful laboratory guide to the fundamental experiments of biochemistry, the book is excellent.

An Optical Miscellany.

(1) *Introduction to Physical Optics.* By Prof. John Kellock Robertson. Pp. vii + 422 + 6 plates. (London: Chapman and Hall, Ltd., 1930.) 20s. net.

(2) *Traité de polarimétrie.* Par Prof. Georges Bruhat. Pp. xvi + 447. (Paris: Éditions de la *Revue d'optique théorique et instrumentale,* 1930.) 65 francs.

(3) *Guide de l'ouvrier en verres d'optique de précision.* Par Col. Charles Dévé. Pp. xvii + 258. (Paris: Éditions de la *Revue d'optique théorique et instrumentale,* 1930.) 36 francs.

(4) *Zur Geschichte der Zeissischen Werkstätte bis zum Tode Ernest Abbes.* Von Moritz von Rohr. Mit Beiträgen von Max Fischer und August Köhler. Pp. viii + 120 + 10. (Jena: Carl Zeiss, 1930.)

THESE four books represent some aspects of the widespread domain of 'Optics'. (1) Prof. Robertson's " Introduction to Physical Optics " will appeal more to the theoretician than to the experimentalist. Its tendency is to present an idealised picture in which mundane difficulties disappear, as is no doubt quite necessary if some slight ideas of relativity and wave mechanics are to be introduced before the end of a not-too-long book. It is, however, a very lucid and direct treatment in which the modern developments of the subject of the interaction of radiation and matter receive their due balance of attention. The early parts comprise a clear discussion of lens and mirror optics (treated on the 'wave' basis), interference, and diffraction. The mathematics is limited to simple algebra and trigonometry.

While it is good to find that the sign conventions used in the lens and mirror problems are in agreement with those of technical practice, it is greatly to be desired that authors would not alarm students by remarks such as " in any problems dealing with refraction at a spherical surface, it is better not to work from a formula but from fundamental considerations ". If the use of unsymmetrical formulæ such as

$$\frac{n}{p} - \frac{1}{q} = \frac{n-1}{r}$$

were only replaced by the symmetrical form

$$\frac{n'}{q} - \frac{n}{p} = \frac{n'-n}{r}$$

the need of injunctions about "fundamental considerations" would not dismay people whose time is limited.

We wish that it could be realised that the physical difficulties, over which books such as this glide so easily, have an educational value in themselves. Let the student realise that the slits actually used in Young's experiment may be big enough to contain thousands on thousands of atomic sources of light in their breadth (let alone their length), and what becomes in his mind of the " well defined wave fronts " which spread out (according to this book) from a single slit? These conceptions really are a little too facile, in view of the matters dealt with in the concluding chapters. Do we really understand 'interference' so well; more especially interference under large path differences?

(2) Prof. Bruhat in his " Traité de polarimétrie " writes for serious experimenters who are interested in exact measurements. To make the subject intelligible to a wider circle, he includes a discussion of the principles of the wave theory. His experience evidently allows him to assume very little exact and systematic knowledge on the part of most beginners in this field, so that all points in connexion with instruments and their functions are explained with the greatest thoroughness and care. As he admits himself, some parts of the book are " over-developed " with respect to the requirements of certain classes of reader, but, as new applications of polarimetric measurements are continually being described, the collection of cognate material in a single volume will find few to condemn it.

After dealing at length with instruments and sources of light, he discusses the chief phenomena of rotary polarisation and measurements in this connexion. Some attention is given to the theories of stereo-chemistry; then normal and anomalous

rotary dispersion and dichroism are discussed. The treatment is introductory and non-mathematical. After this preparation a special section is naturally devoted to the determination of sugar contents, and some final sections deal with the rotary effects of crystals and magnetic rotary polarisation.

This book illustrates in a most striking manner the vast developments of such special subjects which have taken place within the last half-century. The comprehensive bibliography is a very useful feature. We may envy Prof. Bruhat the catholicity of his reading and knowledge, especially when his well-known works on electricity and thermodynamics are remembered.

(3) Col. Charles Dévé's little guide for the worker in optical glass is one of the latest of the useful series published by the Institut d'Optique, to which Prof. Bruhat's "Polarimétrie" also belongs. It should be very useful to those who have to control the grinding and polishing of glass. The section on the mechanical theory of the grinding process is very original and suggestive. This subject is a matter which has received very little systematic attention (at least, if it has, the results have never been published), so that this analysis and explanation should appeal to the practical worker who can arm himself with the necessary technical dictionary and thus make shift to overcome the language difficulties, which are somewhat more formidable in connexion with workshop and commodity terms than in ordinary scientific literature.

While the chapters on practical tests for optical glass and finished prisms, etc., will offer some useful hints, they by no means exhaust the subject. We are surprised to hear that the "méthode des ombres portées" is "incomparablement plus sensible" than a suitable form of the Foucault test. The "vérifications à l'atelier" include many useful methods, but include no mention of the interferometer, which has long since ceased to be a purely laboratory instrument. The auto-collimator is important enough in practice to receive more attention. These suggestions are, however, not made to minify the value of a book on a subject in which the available literature is so scanty.

(4) Turning to an item of greater human interest, Prof. M. von Rohr writes an interesting history of the Zeiss Optical Works up to the time of the death of Abbe. It will appeal to all who have even a slight knowledge of optics, and are also interested in the development of technical industry.

Here we trace the early influences surrounding the founder of the firm, Carl Zeiss, which doubtless led to his desire for the co-operation of such a partner as he found most fortunately in Ernst Abbe.

Abbe himself was indifferent to publicity, and but little of his scientific work is published; but these pages give some glimpses of his unremitting activity and painstaking thoroughness—especially in the account of his early experiments on the mode of the formation of the image in the microscope. This firm found the secret of success in team-work by competent individuals under adequate leadership. If this was a singularly effective recipe in the latter half of last century, it is now a *sine qua non*.

L. C. Martin.

Law, Causation, and Reality.

Identity and Reality. By Émile Meyerson. Authorized translation by Kate Loewenberg. (Library of Philosophy.) Pp. 495. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1930.) 16s. net.

Identität und Wirklichkeit. Von Émile Meyerson. *Deutsch von Kurt Grelling nach der 3 Auflage des Originals.* Eingeleitet und mit Anmerkungen versehen von Prof. Leon Lichtenstein. Pp. xl + 534. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 21 gold marks.

THE publication of English and German translations of Dr. Meyerson's work (1908) is a somewhat tardy recognition of its importance. The present versions are based on the third edition of 1926, which is practically that of 1912 with notes on subsequent developments in science. Although this may seem to restrict the value of the book, the additions accord sufficiently well with the author's analytical investigation of the two cardinal principles which research has once again thrust into the forefront of debate—universal causation, and universal conformity to natural law. What constitutes the ultimate ground of their presumed universality? Is it the inductive outcome of observation and experiment, always imperilled, therefore, by the Damoclean sword of revolutionary discovery or even the negative instance? Or does its validity consist in some quite irrefutable, and in a sense *a priori*, characteristic of thought, which finds an adequate foundation in the very structure of reality?

Most scientific workers would unhesitatingly reject the second suggestion as a mere vestige of antiquated speculation, discredited equally by its anthropomorphism and by every sound principle of methodology. On the other hand, it must be clearly realised that the deductive, and again in a sense *a priori*, proofs of mathematics are acquiring

a steadily expanding applicability within almost every field of research; and this to such a degree that Prof. Whitehead, in "Process and Reality", regards his own survey of science as ample justification for appealing to rationalism and metaphysics. Similarly, Dr. Meyerson maintains that the scientific concepts of conservation, mechanism, and inertia arise not only from the two sources of 'lawfulness' and '*scientific causality*', but further, as regards causation, from *a priori* factors which, though they certainly remain concealed by science, must not, therefore, remain ignored. On the contrary, it is precisely these factors which, like an 'unconscious' incessantly though invisibly directing scientific activities, have actually determined their slow historic meanderings from their Ionian origins to to-day, alike in the purely mechanical and the non-mechanical spheres. Thus all the dominant concepts "rest upon what constitutes the foundations of the human mind" (p. 409).

From this point of view Meyerson explicitly affirms that "metaphysics penetrates all science, for the simple reason that it is contained in its point of departure. We cannot even isolate it in a precise region." It follows, therefore, that "the ontological character of scientific explanation is ineffaceable" (pp. 377, 385); and although Hume's scepticism and Kant's agnosticism are outstanding anticipations of the prevailing scientific reaction to this contention, recent correspondence in these columns clearly expresses the suspicion (to say the least) that the science of to-day, and still more of the future, must criticise its own self-denying ordinances if it is to do itself justice by securing adequate self-consistency. The ultimate issues are undeniably debatable and profoundly subtle and involved; nevertheless, it is the expansion of science that is forcing them more and more irresistibly into consideration. Now, however unexpected the advances may be, they still retain an ineradicable element of continuity; and this implies that earlier developments may illuminate future problems to an important degree. Certainly the present volume is an inquiry into the nature of knowledge as such; but the author possesses an unusually wide and detailed acquaintance with past scientific theory and research, which he has incorporated in a systematic and impartial critique of current principles directly pertinent to reigning controversies.

It appears to be rapidly becoming a vital question whether experiment and induction may not tend to make science too extremely Baconian; and Meyerson cites a frank opinion of Liebig's in support of his own plea, favoured among others by Poincaré and Duhem, for pure theory with all its epistemological implications. He begins with an important distinction between the concept of natural law, postulating determined changes in properties, and the idea of causation, implying the constant equality of original properties to the final, when changed conditions are duly taken into account. Thus causality comes to involve "the principle of identity applied to the existence of objects in time"; it is, therefore, "profoundly different from that of lawfulness" (p. 43).

In its instinctive search for adequate explanation, then, science has consciously or unconsciously pursued this ideal of absolute identity, as expressed in increasingly intelligible forms of atomism, conservation, and inertia; and this raises the fundamental problem as to how far this principle must be carried. Meyerson proceeds to maintain that, despite all attempts to displace explanation by description, or to employ symbolism, science remains "profoundly impregnated with the search for causality" in the foregoing sense. It is, of course, obvious that all constants and relativistic absolutes are immutable identities; hence the further crucial issue whether these constants must be progressively reduced to a minimum. If not, how are they interrelated? And how reconciled with the patent diversities of Nature, with teleology and indeterminancy?

Here also Meyerson is insistent that "only the foundation of mechanism, the explanation of phenomena by motion, is and will be really eternal" (p. 415). Yet though science seems committed to an endless transition to more and more refined types of mechanism, no mechanism can ever be final; all mechanical hypotheses ultimately become self-contradictory and even absurd; while to carry the causal principle to its conclusion involves "the annihilation of the phenomenon"—a tendency visible in the reduction of natural process to pointer readings and equations. Equations, again, are essentially reversible, conflicting therefore with the irreversibility inseparable from Carnot's principle. Finally, "the end of the reduction can only be irrational" (p. 409), even though scientific instinct demands the minimum of an irrationality it can never evade. Yet can we agree that reason leads only to irrationality? Is not 'super-rational' a more fitting term? To conclude with a simple analogy, is the calculus irrational to the child mind, or is it not rather super-rational? And may not this best describe the aspect which reality must ever present to scientific thought?

J. E. TURNER.

Our Bookshelf.

American Civil Engineers' Handbook. Editor-in-Chief: Thaddeus Merriman; Associate Editor-in-Chief: Thos. H. Wiggin. Fifth edition, thoroughly revised and enlarged. Pp. iii + 2263. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 40*s.* net.

FOR the past twenty years or so "Merriman's Pocket Book"—to give its original title—has been familiar as a useful compendium of American practice in civil engineering, sharing the field with Trautwine and some others across the Atlantic and following in the footsteps (more or less) of Molesworth, Kempe, and other British publications. Now it has reached a fifth edition, and in consequence of the lamented death of Mansfield Merriman, the original compiler, it is issued under the names of his successors, Thaddeus Merriman and T. H. Wiggin. As in the case of previous editions, a number of associate editors have assisted in dealing with separate sections.

Naturally there are changes—partly in the material and partly in its disposition. The new edition contains 2263 pages, or 268 more than its immediate predecessor. The order of the sections has been modified somewhat to suit an alternative arrangement by which the book can be obtained, if desired, in two volumes instead of one. The present number of sections is 22, and they comprise all departments of civil engineering work and even encroach in some measure, as is inevitable, on the neighbouring domains of mechanical and electrical engineering; but, except in a few casual and fragmentary paragraphs, they do not intrude appreciably into aeronautics.

The difficulties of selecting and arranging material for inclusion in a handbook (the term pocket book is no longer applicable to "Merriman" and has been discarded since the third edition) are considerable if not almost overwhelming, and the nineteen associate editors have, not unnaturally, had different views on the matter. The critical reviewer can find here and there examples of what he may consider as superfluities and inadequacies, but he must admit that neither his own, nor perhaps any, selection would be likely to meet with universal and unqualified acceptance. It can be said, and said cordially, that "Merriman" in its fifth edition maintains the high standard of previous issues and should have the same popularity; though, as affects British engineers, in quite a number of respects its outlook is definitely coloured by American conditions and American methods of practice.

B. C.

Aquatic Mammals: their Adaptations to Life in the Water. By A. Brazier Howell. Pp. xii + 338. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1930.) 22*s.* 6*d.* net.

WHALES are fashionable at present, both among scientific men and the public, on account of their supposed forthcoming extinction by large steam whalers working upon the high seas away from all territorial control. A comparative anatomy of aquatic mammals based mainly on them, the sea cows, the seals, and the otters is hence opportune. Thirty-five other genera of aquatic mammals are mentioned, most being rodents or insectivores. The head with special sense organs, mouth, and skull come in for treatment, our author then passing to neck, trunk, tail, and limbs in turn. We feel that these chapters would be much more informative if the habits of aquatic animals had been reviewed at greater length, especially their food and feeding as closely affecting teeth and head. Theories are provided as to the fatty tissues, respiratory, digestive, and vascular systems, but we would have liked these studied more closely in relation to the author's Lamarckian views on evolution. Why he should state that "the porpoise has less need for intelligence than almost any other living mammal" is a mystery to us.

This book is necessary to libraries and will be useful to anatomists, for they will find in every section theories with which they disagree. They are possible explanations inserted by the author to stimulate his readers, and they are successful. He himself is only wedded to his Lamarckism as his introduction shows. We do not know how variations that can be selected by Nature arise, but we would like to know what percentage of each generation of his white mice "made to dig industriously in the ground for each and every day", with outcome a race with specialised digging feet, have died because they could not stand our author's drastic compulsion through "twenty or a hundred thousand generations". However, the functioning of all organs is the important study here, not the method of an evolution, which might just as well have been assumed.

The Passion for Life. By Rev. John Lewis. (Published on the Foundation established in Memory of James Wesley Cooper of the Class of 1865, Yale College.) Pp. x + 123. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1928.) 9*s.* net.

THESE five lectures have a certain interest as illustrating the contemporary tendency to strengthen older feelings and institutions by an infusion of science. Mr. Lewis is a student and a tutor of anthropology and also minister in a Welsh church. The last generation tended to shut the door of the laboratory when it went to the oratory: this one, including Mr. Lewis, tries rather to make passages between them. It is a wholesome change, but difficult to carry out, and liable to deform one or other of the structures thus connected. In this case the account of religion which results would not satisfy the more thoroughgoing students of religion. Mr. Lewis tells us that he is more and more convinced that the "premier motive of religion is the passion for life", but this definition, though containing a large element of truth, is both too wide and too narrow. The 'passion for life', being a general animal, or even biological, characteristic, can scarcely be taken as the differentia of the religious impulse in man, while, on

the other hand, the study of religion reveals other, perhaps equally potent, elements in its genesis—fear, for example, awe, and, above all, the social nexus, which, though cognate, cannot be identified with 'the passion for life'.

The book, however, contains a good deal of suggestive matter, rather of the hortatory than the scientific kind, and an interesting and more detailed account of the cult of the 'Great Mother', especially among the Babylonians. Mr. Lewis ranks first the Sumerian-Babylonian stage of civilisation, then the Egyptian, Indian, and Chinese, followed by Greece and Rome, the Arabian, the Mayan, and the British-American. F. S. M.

A Text Book of Dairy Chemistry, Theoretical and Practical: for Students of Agriculture and Dairying. By Edgar R. Ling. Pp. vii + 213. (London: Chapman and Hall, Ltd., 1930.) 6*s*. net.

THIS book is divided into two main parts—theoretical and practical. The theoretical part evidences very careful preparation and an appreciation of modern views in dairy science. In almost every section recent investigations are referred to, and at the end of each chapter there are references to the publications cited.

The chapter on the constituents of milk contains a short account of the vitamins and of the part they play in nutrition. Chapter ii. deals with the composition of milk, and the factors which influence composition. In the following chapter attention is directed to the physiological and legal considerations which are associated with variation in composition, and reference is made to abnormal milk and the applicability of methods used for the detection of adulteration.

Milk products, condensed milk, dried milk, and cream are discussed, and in the same chapter are sections treating of the rising of cream, mechanical separation, reconstituted cream, etc. The conditions affecting the making of butter and the methods used in the detection of adulteration are referred to in Chapter v., whilst cheese and dairy by-products are dealt with in the following chapter. Mention should be made of the chapter on the action of heat on milk and the action of milk on metals. The treatment throughout the theoretical part is uniformly good; the subject matter is quite up-to-date and is presented attractively.

The second part deals with the practical operations used in the separation and examination of milk, and the methods of analysis of milk and milk products. Naturally there is not in this part the same opportunity for the exercise of individuality, but the details are fully and clearly given.

The Quantitative Analysis of Inorganic Materials. By Norman Hackney. Pp. xv + 378. (London: Charles Griffin and Co., Ltd., 1930.) 30*s*. net.

THE aim of the book, which is largely fulfilled, is to give sound, practical, and commercially accurate methods of analysis in a form suitable for use by advanced university students and graduates. Included in the scope of the work are sections dealing with the use of apparatus, the theoretical considerations underlying the more important analytical operations, the determination of the commoner elements, volumetric analysis, the more commercially important separations of the elements referred to, and the complete analysis of ferrous and non-ferrous alloys, and of a few selected ores and other materials.

The separation and determination of the metals are given in the order in which they are met when the analysis is carried out according to the usual group method, and are fully and clearly described, volumetric methods being given due emphasis. The importance of the application of most, though not all, of the newer organic reagents in the separation and determination of the elements is rightly stressed.

The book is free from printing errors and has a satisfactory index. In view of the recommendation of the Joint Committee for the Standardisation of Scientific Glassware, that standard volumetric glassware shall be graduated in terms of the litre (l.) and millilitre (ml.), it is undesirable to perpetuate the use of the symbol 'c.c.'. On the whole, however, the book can be recommended for use by students and young chemists in commercial laboratories. A. G. F.

Einführung in die theoretische Physik: mit besonderer Berücksichtigung ihrer modernen Probleme. Von Prof. Arthur Haas. Band 1. Fünfte und sechste, abermals völlig umgearbeitete und wesentlich vermehrte Auflage. Pp. x + 396. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 15 gold marks.

THE new edition of the first volume of Prof. Haas's summary of mechanics and physics contains so many alterations that it is almost a new book. The main change, however, is the inclusion of two chapters on classical thermodynamics, the first on general principles and the second on their applications. In these chapters, as elsewhere, exact formulation of fundamental ideas and typical results is insisted upon rather than detailed analysis of specific problems, the general standard being rather above that of most honours courses in physics. Other important changes are additions to the section on generalised equations of motion, and the insertion of a section on diffraction. As a coherent account of classical work, this book, which is in the clear and precise style characteristic of all Prof. Haas's publications, is invaluable; it is to be hoped that the appearance of a new edition of the second volume, on more recent work, will not be unduly delayed.

Birth Control: Why and How. By George Whitehead. Pp. iii + 174. (London: John Bale, Sons and Danielsson, Ltd., 1929.) 6*s*. net.

MR. G. WHITEHEAD gives us a trenchant account of the arguments in favour of limiting the size of families, and also gives us an account of the mechanisms thereof. The author rightly points out that most of the arguments against birth control are based on sheer ignorance and prejudice, or the use of the subject for political propaganda.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Giant English Oysters (*O. edulis*).

IT is commonly believed that old individuals of *O. edulis* are incapable of spawning as females, and as the matter is of some importance economically, an interest is thereby added to the following observations.

On Sept. 20, 1929, Miss E. T. Nicol and Mr. W. Searle each collected a giant oyster (*O. edulis*) near low water mark on muddy gravelly ground in Salcombe Estuary, near the Salstone (east of the Salstone and south of Wareham Point). These oysters were kindly given to one of us (J. H. O.) for examination, and were kept in dishes in the hope that natural spawning might occur. Apart from size, these individuals were in all macroscopic respects similar to the common oyster (*O. edulis*). On Sept. 26, as spawning had not occurred, and observations could not be continued after the following day, the oysters were measured and weighed, and then placed in a strong solution of T.N.T. (trinitrotoluene) to narcotise them. On Sept. 28 the oysters were not sufficiently narcotised to permit careful opening, but Mr. Amirthalingam arrived at the laboratory and continued the observations on the living animal. The oysters were carefully extracted on Sept. 30 and both were found to be females. The larger oyster, *B*, had in fact spawned a few ripe eggs into the mantle cavity and was found to be a very fine well-fished individual with its gonad and gonoducts full of ripe eggs ready to be spawned. The eggs are of the same size, *c.* 150μ,

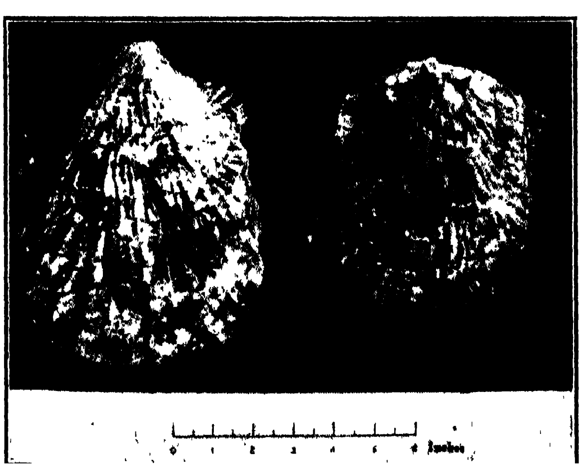


FIG. 1.—Giant oysters from Salcombe Estuary.

as those in smaller *O. edulis*. The smaller individual, *A*, was a well-fished maturing female and contained developing eggs 80-100μ in diameter. The gonoducts were empty.

The flesh of each oyster was rough dried with blotting-paper and weighed: *A* weighed 67 gm., and *B* 94 gm. As a fine oyster meat weighs only 8-8½ gm. these weights offer a good criterion of size. The entire giant oysters weighed respectively 731 gm. (= about 1⅝ lb.) and 1265 gm. (= about 2¾ lb.), and their shells were very 'deep' as well as large (see Fig. 1). A large entire eating-oyster weighs 2-2½ oz. and has a subcircular shell 8-9 cm. in diameter and depth about 3 cm. The shell *A* had the dimensions: Length and breadth, each = 15·8 cm., and depth = width = 4·3 cm.; *B* had length = 17·6 cm., breadth = 19·8 cm., and depth = 5·9 cm., as shown with other dimensions in Table I. Both individuals were therefore undoubtedly giants, and not merely large thin specimens such as are sometimes produced from a flat habit of growth—as on a flat surface of attachment.

Similar giants have occurred in other localities. On June 4, 1927, one of us (J. H. O.) examined a sample of 17 large deep oysters (4-4½ inches subcircular) originating from Poole Harbour. These observations were made at the beginning of the breeding season, when four individuals were found to be ripe or nearly ripe females, seven ripe or nearly ripe males, two others indifferent males and four individuals in a neuter condition. Similar large individuals are said to have been common at one time in the upper reaches of the Fal River, and fossil forms of apparently the same species are known to attain a length of about 10 inches.

TABLE OF DIMENSIONS OF GIANT SALCOMBE OYSTERS (*O. edulis*).

	Length in cm.	Breadth in cm.	Width in cm.		Weight entire (gm.).	Weight of Dry Shell (gm.).	Weight Oyster Meat (gm.).	Approx. Wgt. of Liquor (gm.).	Approx. Vol. of Liquor (c.c.).	Sex.
			External.	Internal.						
A	15 8	15·8	4·3	3·0	731	574	67	70	68	Maturing female
B	17·6	19 8	5·9	3·8	1265	1038	94	133	130	Ripe female

It is difficult to estimate the ages of specimens *A* and *B* owing to the possibility of two increments of shell occurring in one season, but it is certain that the age would be expressed in double figures. The observations recorded above, however, show clearly that large or giant oysters do retain the capacity to function as females. From what is now known about *O. edulis*, there is therefore every probability that individuals may change sex annually from female to male and back again to female from the age of about three to at least twelve years, if left undisturbed on good oyster beds. There is also little doubt that the oyster *B*, mentioned above, would have produced at least 10 c.c. and possibly 20 c.c. of eggs, which if developed would have yielded a minimum of about three million larvæ. Hence the value of large oysters of this kind not only for adding to the stock on good beds, but also for replenishing those beds which have apparently been fished out. It is indeed possible that the sudden repopulating of old beds may be due to a spatfall obtained under favourable conditions from relatively few giant individuals tucked away in inaccessible places. The shells of *A* and *B* are retained in the museum of the Marine Biological Laboratory at Plymouth.

J. H. ORTON.
C. AMIRTHALINGAM.

The University, Liverpool, and
University College, London.

Measurement of Space-Potential in High Frequency Discharge.

MEASUREMENTS of the space potential as well as the concentration and the average velocity of the ions and electrons in the different parts of a discharge tube have been greatly facilitated by the elegant method developed by Langmuir and Mott-Smith (*Phys. Rev.* 28, p. 727; 1926). This method has already been

successfully employed in the study of d.c. discharges, but, so far as we are aware, it has not yet been used in a.c. discharges. In the latter case, a number of difficulties have to be overcome before it can be successfully applied.

In dealing with d.c. discharge, the space-potential is generally referred to that of one of the electrodes maintaining the discharge; it cannot be so referred in the case of an a.c. discharge. Moreover, in high frequency discharges obtained with external sleeve electrodes—a subject of many recent investigations—the volt-ampere characteristic of the Langmuir 'exploring electrode' cannot be obtained when one of the external electrodes is used in the circuit.

We have been able to overcome this difficulty by using an extra bobbin-shaped internal electrode to complete the circuit through the 'exploring electrode'. This internal electrode is kept outside the region of the main discharge so as not to affect it in any way. A typical volt-ampere characteristic as obtained by us in oxygen at a pressure of 0·14 mm. of mercury is plotted in Fig. 1 with the logarithm of the current to the 'exploring electrode' as ordinate and its voltage as abscissa. It is to be observed that the nature of the curve is similar to that obtained in d.c. discharges as described and fully discussed in "Conduction of Electricity through Gases" (Methuen's Monograph Series) by K. G. Emeléus.

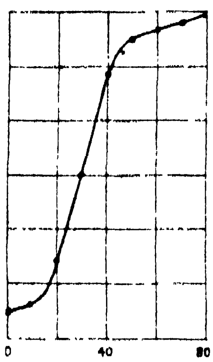


FIG. 1.—Characteristic log I, V curve.

From such characteristic curves we have measured not only the variation of the space-potential but also the concentration and the average velocity of the electrons in different parts of the discharge. A typical set of results is given below:

Oxygen under pressure 0·14 mm. of Hg.
Distance between electrodes, 15 cm.
Frequency, $1{\cdot}2 \times 10^6$.

Distance from left electrode.	Space potential.	Average electron velocity (volts per cm.).	Concentration of electrons.
4·5 cm.	24 volts	7·83	$2{\cdot}62 \times 10^8$ per c.c.

A detailed description of the method with discussion of the results is being published elsewhere.

Incidentally, it may be mentioned that C. J. Brasefield (*Phys. Rev.* 35; 1930) has carried out measurements of electron velocities in high frequency discharge by a spectroscopic method, remarking that it is extremely difficult, if not impossible, to employ Langmuir's 'exploring electrode' method for measurements in high frequency discharge. The above application of Langmuir's method, the success of which is evidenced by the agreement of some of Brasefield's results with ours, was developed by us before Brasefield's paper came to our notice and shows that his remark regarding the difficulties apprehended, but not specifically mentioned in the paper, is not warranted.

D. BANERJI.
R. GANGULI.

Wireless Laboratory,
University College of Science,
Calcutta, July 4.

The Possibility of Separating Two Forms of the Ammonia Molecule.

A FEW years ago it was observed by Baly and Duncan (*Jour. Chem. Soc.*, **121**, 1008; 1922) that ammonia gas drawn quickly from a cylinder containing liquid ammonia was less rapidly decomposed on a hot platinum wire than gas drawn slowly from the same cylinder, or obtained in certain other ways. They offered as a possible explanation that ammonia molecules may exist in two forms of different reactivity, which may be separated or perhaps converted entirely into one form under suitable conditions.

Since that time, spectroscopic evidence has indicated the existence of two, or perhaps several, kinds of ammonia gas molecule, which presumably differ in certain symmetry properties, and it has been suggested by Tronstadt (*Z. f. Phys. Ch.*, Abt. B, **5**, 355; 1929) that a separation of such forms may have been achieved by Baly and Duncan.

Although this explanation of the different decomposition rates observed by these experimenters seemed to me rather improbable, it would be a very important fact if such a separation can occur under the conditions of ordinary chemical experiments, especially if the forms separated should have appreciably different reactivities. Consequently the question has been put to a spectroscopic test by a study of three of the absorption bands of ammonia gas in the red and near infra-red, making comparisons on gas obtained under varying conditions. The bands chosen were those at 8800 A., 7920 A., and 6474 A., which have been analysed by Badger and Mecke (*Z. f. Phys. Ch.*, Abt. B, **5**, 333; 1929) and Badger (*Phys. Rev.*, **35**, 1038; 1930). Though they are perhaps not yet understood in all their finer details, it seems quite certain that all these bands give evidence for two forms of ammonia molecule.

In the case of the bands at 8800 A. and 6474 A., ammonia gas drawn rapidly from a cylinder (a 10-litre vessel was filled in 3 sec.) was compared with gas drawn slowly from the same cylinder, and with gas which had stood five days in the absorption vessel. In the case of the band at 7920 A. a similar comparison was made, and in addition a sample of liquid ammonia was fractionated and the gas obtained from the first and last fourths was compared. The gas evaporated from solid ammonia which had been kept at liquid air temperature twenty-four hours was also studied.

In every case the same absorption spectrum was obtained. Neither the intensity of the bands as a whole nor the relative intensities of the various band lines was appreciably different from the usual in the case of any of the gas samples.

Consequently it is very unlikely that the results of Baly and Duncan are to be explained by a separation of two forms of ammonia molecule, or that such a separation occurs under ordinary experimental conditions.

RICHARD M. BADGER.

California Institute of Technology,
Pasadena, California,
July 9.

Isomorphism and Chemical Homology.

THE ions of the formula AX_4 (for example, SiO_4, CrO_4, etc.) have been studied, and their fundamental vibration frequencies can be accounted for by simple molecular models: the polarisability of the oxygen ion in all these cases where it enters is of the same order as that given by the refraction of the crystalline oxides. It is admitted that in these cases the linkages are ionic.

Now, considering the ionic radii of the following as given by Goldschmidt and Pauling :

$\overset{++}{Be} = 0·34A.$	$\overset{+}{NH_4} = 1·43A.$	$\overset{+++}{B} = 0·20A.$	$\overset{++++}{Ti} = 0·64A.$
$\overset{++++++}{S} = 0·34A.$	$\overset{+}{Tl} = 1·43A.$	$\overset{+++++++}{Cl} = 0·26A.$	$\overset{+++++}{Nb} = 0·69A.$
$\overset{+++++}{P} = 0·35A.$	$\overset{--}{O} = 1·32A.$	$\overset{++++}{Th} = 1·10A.$	$\overset{++++++}{Mo} = 0·62A.$
	$\overset{-}{F} = 1·33A.$	$\overset{++++}{U} = 1·05A.$	$\overset{++++}{V} = 0·61A.$

predictions of certain cases of chemical analogy and isomorphism are possible.

For example : $\begin{cases} \overline{\overline{BeF_4}} & BF_4 & [\overset{IV}{Ti}F_6]^{--} \\ SO_4 & ClO_4 & [NbOF_5] \\ & SO_3\overline{F} & [\overset{VI}{Mo}O_2F_4] \end{cases}$ $\longrightarrow$ observed by (Magignac).

$\left.\begin{matrix} [\overset{VI}{Mo}O_2F_4] \\ [\overset{V}{Mo}OF_5]^{--} \end{matrix}\right\}$ Mauro and Scacchi (*Rend. R. Accad. Lincei*, 1888). $\begin{cases} [\overset{V}{V}O_2F_4]^{---} \\ [\overset{IV}{V}OF_5]^{---} \end{cases}$

For the realisation of these predictions, other factors such as the deformability of the constituent negative ions must be considered. The easiest way is to see whether the molecular volumes of the simple salts of the corresponding complex ions are sufficiently close (isomorphic tolerance being of the order of 10 per cent) and then whether they form mixed crystals in all proportions. Once assured of this, it is possible to extend the predictions to more complex cases. Search of the literature shows that in recent years similar examples have been observed by Wilke-Dörfurt and Günther Balz (*Z. Anorg. Chem*, **159**, 197 ; 1927) in the cases of $\overline{BF_4}$, (SO_3F) , and $\overline{ClO_4}$ ions. All simple and complex salts of the corresponding ions are isomorphous.

In continuation of his work on the homology of fluoroberyllates and sulphates, Dr. P. B. Sarkar has recently obtained further interesting examples of chemical analogy and isomorphism of the monofluorophosphate ion (PO_3F) with the SO_4 ion. Both SO_4 and PO_3F ions are likewise isosteric and isoelectric. Having determined the molecular volumes of K_2SO_4 and K_2PO_3F, which are very close, he found that they formed mixed crystals in all proportions.

Working on this analogy, he has been able to isolate the following compounds :

Series (i) MSO_4, $(NH_4)_2PO_3F$, $6H_2O$
where M = Ni, Cu, Co, Zn, Mn, and Mg.

Series (ii) $NiPO_3F$, $(NH_4)_2PO_3F$, $6H_2O$
$CoPO_3F$, $(NH_4)_2PO_3F$, $6H_2O$ } isomorphous with the double sulphates of Locke.

Series (iii) $NiPO_3F$, $7H_2O$ isomorphous with $NiSO_4$, $7H_2O$
$CuPO_3F$, $5H_2O$ „ „ $CuSO_4$, $5H_2O$
$CoPO_3F$, $6H_2O$ „ „ $CoSO_4$, $6H_2O$

Series (iv) Am_2PO_3F, $Al_2(SO_4)_3$, $24H_2O$
Am_2PO_3F, $Al_2(PO_3F)_3$, $24H_2O$ } isomorphous with alums.

Thus a close chemical analogy of ions composed of elements belonging to widely different groups of the Periodic Table is possible.

A detailed study of these will be published in the *Journal of the Indian Chemical Society*.

P. C. RÂY.

Department of Chemistry,
University College of Science,
Calcutta, June 24.

Spike Disease of Sandalwood.

IN NATURE of June 14 a short account is given of the work on spike disease of sandalwood in progress in the Biochemical Department of the Indian Institute of Science, Bangalore. This disease had previously been investigated in the laboratories of the Mysore Agricultural Department under the direction of Dr. Coleman, whose transmission experiments indicated the probability of a virus infection. In view of the very extensive damage caused by the disease not only in Mysore State but also in the Madras Presidency and Coorg, proposals were considered for a joint investigation by Mysore, Madras, and Coorg. For various reasons the Mysore Government preferred to continue on independent lines, but arrangements were made by the Government of Madras and the Administration of Coorg for an investigation to be carried out at the Indian Institute of Science under my general direction. Under this scheme the two authorities named have made an annual grant for the employment of a special staff which has enabled two whole-time assistants to be employed on this research, assisted by various research students in the Department. At the same time facilities were granted for extensive field experiments to be carried out in the Salem district of Madras and in Coorg with the co-operation of the forest officers concerned. In these circumstances it has been possible to arrange for an investigation of wide scope both in the laboratory and in the field.

Results of very considerable interest have already been obtained not only in the comparative study of diseased and healthy sandal but also in regard to the transmission of the disease. The view put forward by Dr. Coleman as to the infectious nature of the disease has been fully confirmed, and by an improved technique the disease can now readily be transmitted by bud or patch grafting, by the latter term being meant the simple implantation of a small patch of stem tissue from a diseased specimen in the stem of a healthy plant. The success of this method has much facilitated the inquiry by rendering available for study plants of various ages in all stages of the disease, grown under controlled laboratory conditions.

Sandal is of course a parasite, and the inquiry has already demonstrated that the nature of the host plant probably exerts a considerable influence on the susceptibility of sandal to infection. There is in evidence a marked variation in susceptibility, and it seems likely that a study of the factors responsible for such variation may open up an important line of advance in the practical amelioration of the disease.

Shortly before I left Bangalore in August last, arrangements were put in hand for a further entomological survey of sandal areas in view of the possibility of an insect vector being concerned, the circumstances in which the disease spreads lending considerable support to such a theory. It is understood that such a survey will shortly be undertaken.

ROLAND V. NORRIS.

Tea Research Institute of Ceylon,
Nuwara Eliya, Ceylon,
July 7.

Control of Mites Attacking Stocks of Insects and Fungous Cultures.

MITES have long been a great hindrance to the experimental entomologist and mycologist. Successful efforts have recently been made at the Imperial College Biological Field Station to kill mites and their eggs by fumigation, without harming to any considerable extent insects or fungi.

Pyridine and ammonia, recommended by Jewson

and Tattersfield (*Ann. Appl. Biol.*, 9, 213; 1922), for removal of mites from fungous cultures, were found to be harmful to insects and to their food. Pure acetylene, shown to be harmless to the larvæ of *Plodia interpunctella* Hb., although toxic to the adults of *Ephestia kuhniella* Zell., unfortunately proved to be harmless to mites at any concentration. Finally it was decided to try carbon tetrachloride and trichlorethylene, since both compounds have most of the properties desirable in a fumigant but are effective against the more resistant stages of most insects only at high concentrations.

At ordinary room temperature and humidity, exposure of infested cultures of the following groups of *Aspergillus*, *flavus*, *fumigatus*, *tamarii*, *terrens* and *niger* and of a species of *Syncephalastrum*, to carbon tetrachloride at a concentration of 0·5 c.c./litre for twenty-four hours, killed the mites but left the fungi unharmed. Exposure to trichlorethylene for the same time but at half the concentration gave the same result. Fumigation of infested stocks of *Calandra granaria* L. in barley and maize, and of stocks of *Rhizopertha dominica* F. in maize, with carbon tetrachloride at a concentration of 0·5 c.c./litre for four hours killed the mites while, after thorough aeration, the bulk of the adult insects recovered.

Trichlorethylene used at a concentration of 0·225 c.c./litre for twenty-four hours for the fumigation of stocks of *Calandra granaria* and of *Sitotroga cerealella* Ol. in barley freed the stocks of mites while allowing a useful percentage of the insects to survive.

Experiments with these insects in tubes when removed from their food have shown that:

(1) Adult beetles survive the fumigation; (2) moths and eggs of *Sitotroga* are killed but the larvæ and pupæ survive; (3) adult mites are killed by exposure to carbon tetrachloride at a concentration of 0·35 c.c./litre for only four hours or to trichlorethylene at a concentration of 0·225 c.c./litre for the same time; (4) eggs of mites are killed by exposure to trichlorethylene at the concentration of 0·225 c.c./litre for twenty-four hours.

Determination of the mites used is not yet completed.

Further details together with the results of fumigation of other insects will be published shortly.

M. SHAFIK.
A. B. P. PAGE.

Imperial College,
Biological Field Station,
London Road,
Slough, Bucks., Aug. 1.

Sunspots and Pressure Distribution in Monsoon Regions.

THE excellent collection of "World Weather Records" affords an opportunity to examine the mutual relation between the sunspot period and air pressure distribution over the globe. This relation I have studied by computing the difference between mean annual air pressure (for three years) near sunspot minimum and that for the following maximum. This difference I call 'effect', as does Dr. Mecking, who introduced this expression (*Annalen der Hydrographie und maritimen Meteorologie*, 1918). I have used all pressure material published in the above-mentioned collection, computed the differences for years: 1911-13-1917-19; 1900-02-1905-07; 1888-1890-1892-94; 1877-79-1882-84; 1866-68-1870-72; 1855-57-1859-61; 1842-44-1847-49; and so far as it was possible, plotted charts showing lines of zero effect separating the areas of positive and negative effect. These charts show slight differences from one sunspot period to another; a discussion of them will be published elsewhere.

While drawing the charts, the question arose whether there is on the earth an area where the air pressure effect is related always in the same way to increasing spottedness, that is, where on the earth is increase of sun spottedness associated always with an increase or always a decrease of air pressure (annual mean for three years)? The charts have shown that such an area of positive effect actually exists and it covers roughly the following regions: The first area is Central Asia about south of latitude 55° N., east of Caspian Sea, Mesopotamia, Persia, Afghanistan, Baluchistan, east Turkestan, plains of the Indus. The second area lies north of latitude 10° and extends from the Arabian Sea across south-east India, Bay of Bengal to Burma and Siam, and the third area embraces nearly the whole of Australia, Java, and extends probably across the Indian Ocean to southern Madagascar and Natal.

These three fields cover approximately the greater part of the Indian monsoon area within the tropics. The fact that the sunspot period manifests itself always in the same way within this area suggests that sunspots affect the general circulation of the atmosphere through pressure conditions in the monsoon regions. Further discussion of the data computed for the successive months of the year will show how far this conjecture is justified. The area where the effect of the sunspot period is always negative was difficult to determine; examination of the maps seems to point to the fact that if there is any place it lies probably in a long strip across the Pacific, north of the equator and south of the latitude of Hawaii.

S. HANZLÍK.

Meteorological Institute,
Charles University, Prague.

Oviparity in a Sea-Snake (*Laticauda colubrina*).

IN view of the fact that all sea-snakes (*Hydrophiidae*) are generally regarded as viviparous,[1] the following occurrence seems worthy of note.

A few days ago six specimens of *Laticauda colubrina* were presented to the Raffles Museum, where they were put into a tank of sea-water.

On the morning of June 5 it was noticed that several eggs had been deposited overnight; the number appeared to be six, but owing to the cloudy nature of the water it was difficult to say with certainty. Two were removed for examination and the remainder left in the water. It will be interesting to observe if any of these eggs hatch out. It seems uncertain whether they would usually be laid on land or in the water. The former seems probable,[2] as oviparity is usually associated with a terrestrial habitat, and *Laticauda* is known to spend much of its time out of the water, its broad ventral shields adapting it to shore-going. It frequently climbs fishing-stakes, insinuating itself under the blanket of the tenant, the warmth of whose body it appears to appreciate. On the other hand the eggs have not the usual leathery shell of those of land reptiles, but are covered with a thick skin through which the yolk and germinal disc are visible. Possibly this skin will harden on exposure to the air.

Of the two eggs examined, one measures 80 mm. × 25 mm., the other 68 mm. × 27 mm. It was of course impossible to tell definitely which of the snakes was the parent, but it was probably the largest specimen, calculated as well over five feet in length.

Keepers from the various lighthouses in the vicinity of Singapore report that *Laticauda* becomes numerous at this time of the year. This might be interpreted as a shoreward migration for breeding purposes, but it would be curious to find such a habit in reptiles so essentially tropical in habitat, in an area which is

characterised by the absence of seasonal change; and where there are very few organisms, plant or animal, terrestrial or aquatic, with definite reproductive periods.

This evidence of oviparity seems to support the view that the Laticaudinæ are the most primitive of the sea-snakes, for although the ventral shields might be regarded as an advantageous redevelopment, the egg-laying habit can scarcely be viewed in the same light, and must therefore be regarded as a legacy from an ancestral terrestrial form.

NORMAN SMEDLEY.

Raffles Museum, Singapore,
June 5.

[1] Malcolm Smith ("Monograph of the Sea-Snakes", 1926, p. xlv) reiterates this statement of previous authors.

[2] Semper (quoted by Gadow: "Camb. Nat. Hist. Reptiles", p. 637) observed that the young of this species were born amongst the rocks on the shores of low islands, and guarded for some time by the female.

The Dissociation Theory of Solutions.

IN Dr. S. C. Bradford's letter on this subject in NATURE of Aug. 2, he says "that the vapour pressure of salt solutions is determined by the attractions, volumes and motions of the particles only". This statement is obviously what should obtain; for, given any three suitable physical properties, a fourth should, theoretically, be calculable from them. Hence hypotheses such as that of dissociation, or of association between solvent and solute, should only be introduced when other phenomena are contemplated.

Working on the assumption that three physical properties are sufficient and that the areas of solute and solvent are involved, I have found several formulæ connecting osmotic pressures (and therefore the ratio of the vapour pressures of solution and solvent) with the volumes, areas, and concentrations. Two of these, which embrace aqueous solutions of cane sugar α methyl glucoside and isodulcite, both at 0° C. and 30° C., give a constant, the extreme variations of which are about 5 per cent. These two (omitting, for simplicity, the temperature function which is within 10 per cent of unity) are:

$$(1)\ P\omega s_1^2 s_2^2/N\left\{\left(\frac{s_2}{s_1}\right)^{\frac{2}{3}}+\left(\frac{s_2}{s_1}\right)^{\frac{4}{3}}+\left(\frac{s_2}{s_1}\right)^{\frac{6}{3}}+\ \right\}=\text{constant}.$$

$$(2)\ P\omega^2/A\left(1-\tfrac{1}{2}A^{\frac{2}{3}}+\tfrac{1}{4}A^{\frac{4}{3}}\right)=\text{constant},$$

where P is the osmotic pressure, ω the specific volume of the solution, s_1 is the change in the volume of a large quantity of solution when 1 gram of solvent is withdrawn, s_2 is the corresponding volume for the solute, N is the number of gram molecules in 1000 grams of solvent. If c_2 and c_1 are the grams of solute and solvent, respectively, in 1 gram of solution, then $A=\frac{c_2 s_2}{c_1 s_1}\times\frac{M_\omega}{M_s}$ (where M_ω and M_s are the molecular weights of solvent and solute respectively).

I hope to publish elsewhere a fuller discussion than is possible in the columns of NATURE.

BERKELEY.

Berkeley Castle, Gloucestershire.

Photo-Electric Cells.

THE merit of a theory is so easily distinguished from the merit of a book in which it is adopted that we are not debarred, as authors, from asking "F. C. T." for the grounds of his "most serious" criticism of our volume on "Photo-electric Cells" reviewed in NATURE of July 19, p. 90. He says that the theory that photo-electrons are the free electrons of the metal is "not one which is generally accepted"; and "generally" must surely refer to the weight rather than to the number of opinions. But what authority can have greater weight than that of Sommerfeld, Fowler, Nordheim, and all who are developing with such success a theory of the metallic state? They take it for granted that the photo-electric effect is one of the interconnected properties characteristic of the metallic state, and that this state represents the presence of electrons free in Drude's original sense, because their kinetic energy is determined by the temperature and much greater than any potential energy they may derive from atomic fields. There are doubtless a few antiquarians still fumbling with ideas of the era before quantum mechanics; but it seems to us that the theory to which "F. C. T." objects is by now one of the commonplaces of modern physics.

NORMAN R. CAMPBELL.
DOROTHY RITCHIE.

Wembley, July 21.

THE wording I adopted was perhaps a little unfortunate, as it might imply that I regarded my criticism as a most serious one, whereas on the contrary I felt that of the few small criticisms that occurred to me, the only one worth mentioning was the point about the photo-electrons being only free electrons.

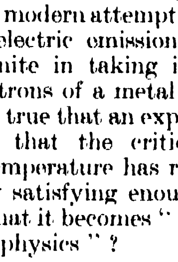
What I meant by the sentence to which the authors object, and what I still feel, is that, despite the success which has met the modern attempt to correlate thermionic and photo-electric emission, the authors were unjustifiably definite in taking it for granted that only the free electrons of a metal are emitted photoelectrically. It is true that an explanation of the very serious difficulty that the critical wave-length is independent of temperature has recently been given, but is that really satisfying enough to establish the theory so surely that it becomes "one of the commonplaces of modern physics"?

F. C. T.

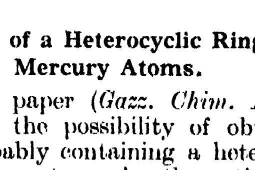
The Formation of a Heterocyclic Ring containing Mercury Atoms.

IN an earlier paper (*Gazz. Chim. It.*, **58**, 712; 1928) I showed the possibility of obtaining some compounds probably containing a heterocyclic ring closed on mercury atoms, by the action of sodium thiosulphate on bimercuriated anilines.

In order to complete this series of investigations, I have treated *o*-dibromobenzene, in petroleum solution, in presence of acetic ester, with 2 per cent sodium amalgam, obtaining a crystalline substance to which I have been able to assign the following structural formula:



On boiling the substance with glacial acetic acid, it gives, by decomposition of the molecule, *o*. diacetylmercuribenzene and benzene.



LUIGI VECCHIOTTI.

Institute of General Chemistry of the
R. University of Bologna.

The Ninth International Horticultural Congress.

THE long history and proud record of the Royal Horticultural Society is sufficient evidence that horticulture has long been highly regarded in Great Britain, and that British horticulturists have known how to organise themselves in the promotion of their common interests. Nevertheless, until the meeting of the International Horticultural Congress in London, on Aug. 7–15 last, as the result of an invitation delivered at the previous congress in Vienna in 1927, no international horticultural congress has previously met in Great Britain. Whilst the congress provides opportunity for the mutual discussion of problems which are often of great scientific interest and are presented at the formal sessions of the congress, these meetings, and the excursions with which they are interspersed, are perhaps still more valuable as providing opportunities for personal contact between workers, from many countries, interested in various phases of horticulture; at the same time the various committees set up and maintained by successive congresses give permanence to efforts to deal with such horticultural problems as the nomenclature of horticultural varieties and of the colours employed in their description, fruit culture, botanical gardens, the international exchange of young gardeners, etc.

At the dinner to the official delegates given by the Royal Horticultural Society in its Greycoat Street Hall on Monday, Aug. 11, very general expression was given to the opinion that this Ninth International Congress had been very successful and fully justified the hopes of the original promoters of this international horticultural effort. On its scientific side, horticulture is obviously very closely bound up with botany, and particularly with the study of the physiology and structure of the growing plant. The fact that the Fifth International Botanical Congress followed immediately at Cambridge (Aug. 16–23) naturally ensured a very representative attendance of foreign botanists, so that the three days devoted to communications upon horticultural topics showed a quite exceptional list of papers of great scientific interest. As a result, three sessions, devoted to papers, were conducted simultaneously in the Caxton Hall, the papers being grouped so far as possible around three main topics—propagation, pomology, and tropical and sub-tropical horticulture.

Some of the regular attendants at the International Horticultural Congress may have felt that their scientific colleagues' zeal had rather outrun their discretion. They certainly have a right to expect that, on these horticultural occasions, the botanist should make an effort to make himself intelligible. As always, at such conferences, the audience had occasionally to suffer from the inaudible lecturer; and also, sometimes, in view of the difficulty in darkening some of the large windows in one of the lecture halls, the lantern illustrations provided only intensified the obscurity of the lecturer's utterances. Communications might be made in one of three languages—English, French, or German—and this also added to the difficulty, as either speaker or audience might be struggling with an unfamiliar medium. International congresses, like our own British Association meetings, also suffer from the speaker who reads a paper which will be more suitably studied in print. In these days, when science has multiplied the facilities for intercommunication of ideas, there seems little excuse for this procedure. A halting speaker, or a speaker using an unfamiliar language, may well read from a manuscript, but at least that manuscript should be the condensed and vivid précis of the full account, intended for print, which an audience assembled at such pains has the right to expect. If the speaker on these occasions will not learn this lesson, then time will see all the business of these international meetings carried on in informal conversations in the corridors and anterooms around large empty lecture theatres.

Such a result would be unfortunate, because the papers presented are always, as in the present case, of very great interest. In the space available it is not possible to comment upon all communications. The main topic indicated in advance for discussion at the Ninth Congress, was propagation, vegetative and seminal. Many of the papers presented dealt with vegetative propagation, and in the following paragraphs an effort is made to indicate the general nature of some of the very interesting communications made under this head.

VEGETATIVE PROPAGATION.

The practice of vegetative propagation has always been of great interest, because by this means alone can most of the remarkable horticultural achievements obtained by hybridisation be perpetuated in the garden. It also appeals to the genuine gardener, because every new plant presents a new problem in practical propagation and new peculiarities of plant behaviour are always coming under notice in the propagating frames. Modern commercial methods now demand standardised horticultural produce, and this again sends the horticulturist to renewed study of vegetative propagation. A Cox's Orange apple can represent a definite standard of quality and flavour, because all Cox's Orange apples really come from one plant; the next generation is obviously going to see standardised types of cacao, rubber, coffee, tea, etc., driving others off the market, because they similarly will be the result of the successful development of vegetative propagation. Thus, in the present congress, Mr. W. G. Freeman discussed the vegetative propagation of cacao, Dr. P. J. S. Cramer and Lieut.-Col. F. Summers the propagation of rubber, whilst Prof. H. S. Reed communicated a paper by Prof. H. J. Webber, the Director of the Citrus Experiment Station at Riverside, California, upon propagation problems with citrus.

Some of the general considerations as to the development of vegetative propagation were raised

by Prof. J. H. Priestley and Dr. A. B. Stout. Vegetative propagation is a possible method of propagating the higher plant, because of its method of growth. The new parts of the plant are laid down at the apices of shoot and root respectively; therefore, when a plant is cut into pieces, provided it still contains such growing points or regenerates new ones, it will continue to grow. Many stems when cut from a bush thus grow on freely: a black-currant stem roots freely at its base, whilst the stem continues to grow and branch, so from one stem a new bush develops; from it again a stem can be taken and grown into a bush, and so many bushes can be obtained from one single bush—and thus in time one black-currant plant may occupy square miles of space and yield tons of crop, all the currants being as like to one another as the currants gathered from the original bush. There is still much discussion, which Dr. Stout ably summarised, as to whether such a bush can thus be multiplied not only indefinitely in space but also in time. The original bush would grow old and die, but there is no clear answer yet to the question whether the young bush, still being propagated from branches separated from bushes within this 'clone'—as the colony of vegetatively propagated plants from the same parent is termed—should necessarily fail in vigour with the increased age of the clone.

At one time 'degeneration' of such vegetatively propagated clones of potatoes was much under discussion; now it has been shown that such variation is often the result of the accumulation of disease within the stock, especially virus disease. When a true seed is grown from such a stock, the fertilised egg is separated from the parent plant by a barrier wall which usually prevents transmission of the virus disease. Thus the new seedling starts unhampered by the virus, which is now found in new members of the clone from the beginning; the result is that the new seedling seems more vigorous than the 'degenerate' descendant of the clone. It is sometimes possible, however, to select bits of the clone to which the virus has not yet spread, and then, by multiplying the new pieces of the clone from the virus-free stock, it seems possible to get it back in all its pristine vigour. At least, such work, as also the cases of vegetatively propagated seedless bananas and breadfruit trees, etc., show how dangerous it would be to attempt to set a limit, at present, to the potentialities in vegetative methods of propagation.

At the same time it has its very striking limitations; Dr. Auchter, of the Department of Plant Industry, Washington, U.S.A., illustrated this very vividly in his account of recent American work on rooting cuttings of fruit trees, especially apple. Very few varieties of valuable scion apples can be propagated upon their own roots, because it is so difficult to get branches from these trees to root when removed and put in the soil. Dr. Auchter described some very interesting experiments of Dr. Gardner at Maryland, in which 100 per cent success had been obtained instead of the usual 1 per cent or 0 per cent, the branches having been previously bound with black tape near the base since growth commenced, and whilst still on the tree—curiously enough, in this experiment, the buds on these rooting shoots failed to grow out! Dr. Auchter also brought to light the very interesting fact that propagation of seedling apple trees by either stem or root cuttings can often be successfully accomplished, although the same methods are quite unsuccessful when tried with the same tree when it is several years old. Dr. Niels Esbjerg also described attempts to root scion apples in which some success had been met with; whilst Dr. H. A. A. van der Lek directed attention to the significance of the presence or pre-existence of root initials in favouring rooting. External conditions in rooting cuttings were especially considered in communications (by Miss Mary E. Reid and Dr. P. W. Zimmerman, from the Boyce Thompson Institute for Plant Research, Yonkers, U.S.A.); whilst the very considerable practical success obtained in cutting propagation at the Edinburgh Botanic Gardens was described and illustrated by Mr. L. B. Stewart.

In spite of the advance that is slowly being made in this difficult field, the difficulty in propagating many desirable woody plants as cuttings results in their appearance as 'scions', raised into the air upon the root systems of another plant with which they are in union through the process of budding or grafting.

Around the Mediterranean, these practices are still utilised in various forms with the olive and the vine, and were discussed very fully by Dr. Mameli Calvino (Italy), Prof. Dr. H. Faes (Switzerland), whilst Prof. Ravaz (Montpelier) argued again the much-discussed problem as to the relative influence of stock and scion upon one another. Prof. Ravaz concludes that there is no reciprocal influence of stock and scion upon one another in vines, the colour, shape, size, and flavour, etc., of the grapes varying as much in a clone upon its own roots as when carried on various stocks. The general question at issue here is of great complexity and magnitude, and it is well worth while multiplying efforts to obtain scion varieties upon their own roots, as urged by Dr. Esbjerg, so that the performance of such plants may be compared with the performance of the varieties upon different stocks in the critical atmosphere of the experiment station. Where this is not possible, then the experiment station, following the lead of East Malling, will certainly try to study the performance of a clone of scion upon a uniform clone of vegetatively propagated stock, rather than upon different seedlings with, of course, varying growth vigour.

It is another question, however, and one keenly debated in horticultural circles now, whether the commercial propagation of seedling stocks should be replaced entirely by the vegetative propagation of stocks. In the United States, as in the British Dominions, orchards of root acreage have sprung into being within the last few decades, in which the scions have been budded or grafted upon seedling stocks because of the relative simplicity of this

method. On one hand, it is argued that it is not sufficient for horticultural standardisation, which has to meet stringent modern commercial requirements, that the scion should be a clone, so that the produce of one variety, whilst plucked from the branches of one and the same plant, may be nourished on those branches through the roots of countless different varieties. On the other hand, it is argued by the practical man, in the light of horticultural experience, that a Cox's Orange scion gives a Cox's Orange apple whatever the root system may be, and Prof. Ravaz's experience with vines seems to endorse this conclusion.

Whilst it is agreed that certain stocks, 'dwarfing' stock, modify the habit of the tree in that they cause dwarfed growth and early bearing, there is no evidence that the quality of the scion fruit is modified; and provided that ordinary care to select vigorous seedlings is shown, there seems little doubt that uniform orchards of the scions are obtained—uniform because the stock is not limiting appreciably the natural vigorous full growth of the scion.

Much work still remains to be done upon this interesting problem; the interchange of comment and criticism at the congress is a good augury for the report of progress at a later congress, whilst some of the contributions show the interesting range of the problems. Thus, Prof. N. F. Hansen (Dakota, U.S.A.), Dr. L. Filewicz (Poland), and Dr. J. Smolak (Czechoslovakia) joined in a symposium upon fruit culture problems in regions where frost damage is frequent and severe. In the course of this discussion, Dr. Filewicz pointed out that certain apple trees which are susceptible to frost in central Poland resist the winter after top-grafting with a more hardy variety. Dr. Filewicz described some very remarkable experiments in keeping frost-injured trees alive and bearing by making new unions between shoots thrown up from the roots and buds on higher branches still capable of growth.

An Elizabethan Colony of Craftsmen.

By Dr. E. F. ARMSTRONG, F.R.S.

THOSE who walk the fells of the Lake District will not have failed to notice the abandoned copper workings which scar the hillsides in many places, notably at Manesty and elsewhere in Borrowdale, near Stair and at Goldscope in the adjacent Newlands Valley, at Grasmere, in the Vale of St. John, and in other localities. Whilst it is common knowledge that these represent ancient mines dating from the time of Elizabeth, only the few are aware how unique and interesting a historical story is attached to these visible relics of bygone days. It has relation to the formidable enterprise of bringing from Germany to the Keswick dales a little colony of workmen and experts in the mining and smelting of copper. It needs very little imagination and knowledge of the existing conditions in England at that time to picture the dales as then, surely very remote from medieval civilisation, particularly when it is remembered that the Lord Warden was watching the fords to hold back the Armstrongs and the Grahams but a few miles north of where the craftsmen in Borrowdale were to be engaged in their peaceful activities.

Though the enterprise was in the end a business failure, it left its impress on the district in numerous ways, as witnessed by many mixed marriages with the dalesfolk, by German words absorbed into the local dialect, by place names: the details of all these afford a fascinating study in local history. Far more important, however, in its ultimate effect on the prosperity and future of the district, must have been the spending there during the life of the venture of upwards of £100,000, and that at a time when money was worth several times what it is to-day. Although many of the fortunes made locally were lost for King Charles, this undoubtedly led to a development of the Lake country, both then and afterwards, quite out of proportion to its inaccessible and wild character, as well as to the provision and maintenance of routes and roads to Newcastle via Barnard Castle and to the south in advance of the times. Leland, whose "Itinerary" was written about the year 1545, calls Keswick a poor little market town. Elsewhere we read of the Lake country being almost *terra incognita* until the publication of the letters of Gray, the poet. It is a satisfaction to those who are fighting for the preservation of the natural beauty of the district to-day to remember that Gray's later letters, especially those from the Lakes in 1769, show before those of most others the rising sense of the picturesque in literature.

The known facts relating to the settlement compiled from local sources have been supplemented in an altogether unexpected manner by the discovery at Augsburg of the original account books of the German firm, Haug, Langnauer and Co., including twelve volumes of manuscript which are the actual journals written at Keswick and sent first to Hans Loner, the agent in London, and by him, after some added pages of balancing, to Germany. These have been rendered available by W. G. Collingwood in 1912 in a publication of the Cumberland and Westmorland Antiquarian and Archæological Society.

The value and interest of this find is very great when it is remembered that the earliest known English diaries come from the late sixteenth century and that some of them grew out of a punctilious habit of keeping accounts. More than the usual bald facts of the financial operations began to be added, and the entries became amplified, so that one finds in them as here the ancient day spread out before us in considerable detail.

The Company or Society of Mines Royal was founded in 1564, when an indenture was made between the Queen on one part and Thomas Thurland and Daniel Hechstetter on the other, to search, dig, try, roast, and melt all manner of mines and 'ures' of gold, silver, copper, and quicksilver in a number

of counties. The Queen was to have one-tenth of the precious metals and one-twentieth or 2*s.* per cwt. on the copper.

Hechstetter proceeded to form a company with a number of prominent shareholders, including Lords Burghley, Pembroke, Leicester, and Mountjoy. In 1566–67 parties of German workmen were brought from Schwatz to Keswick. A rich mine was very soon found at Newlands, on the manor of the Earl of Northumberland, in 1566—the Germans called this "Gottesgab", a name which locally became Goldscope. The Earl stopped the working after a time, claiming the sole right to the minerals. His suit against the Queen went before all the judges and barons of the Exchequer in 1568, when it was decided by a majority that as there was more gold and silver than copper and lead in these mines, the Queen was within her rights in claiming them. A strange miscarriage of justice this, and an early example of faulty analysis (!), particularly as it remained the leading case regarding Royal rights in mines until the time of William III.

Hechstetter's accounts were made up seven times a year; they enable us to picture almost every happening in the life of the colony. For example, in 1569 we find complete accounts, amounting in all to £21 9*s.*, for building the men's bathroom. Whereas the company bore the expenses and outlay, the men agreed to repay this afterwards out of club money and fines. At that time, apparently, the use of baths was frequent in Germany, both in private houses and in public baths: it is stated that the hot bath was used as an antidote to immoderate drinking. Wine for the colony was bought by the tun or cask and resold to the men at a price which made no profit; there are entries of its purchase at Newcastle, at Kendal, and at Cockermouth, in the last instance from Henry Fletcher, the well-known merchant who had entertained Mary Queen of Scots on her landing at Workington a few months earlier (May 15, 1568), when she fled to England after the defeat of her army at Glasgow.

The smelt houses were begun in the summer of 1566 at Brigham, on the Grete, half a mile from Keswick. Within a year, Thurland confessed that they were "more chargable than he had imagined", an experience which has been repeated by most inventors of new processes down to this day. Hechstetter persevered, however, and did well to create, in a country so barren of facilities, a cluster of workshops and machinery so famous as to make Camden at the end of the century write "not without admiration to those that behold it". Alas! The progress of actual smelting was accompanied by the devastation of the woods far and wide, local labour being used for this purpose, though skilled charcoal burners were imported from the Midlands. An attempt was made to form charcoal-burning stations in Ireland at a time when the opposition of the Earl of Northumberland made local supplies difficult.

There are items in the accounts of 1569 for the carriage of sea or stone coal from Cockermouth and from Workington, and a payment of 1*s.* 4*d.* for a man to watch for several nights over the coal at the smelting house for fear of it burning; this seems to have been their first practical introduction to mineral coal. One Anthony Dediman was promised £20 if he found coal mines near Keswick; there is an entry of £4 in hand and 3*s.* 4*d.* earnest money. No coal was found, but he spent a good deal in this fruitless search.

Although the first royal charter to dig coal in the Castle Fields was granted in 1239 by Henry III. to the freemen of Newcastle, and the coal trade became an important branch of commerce within fifty years, apparently it was not in general use in provincial towns until the reign of Charles I. These journals must be the first records of coal being worked in Cumberland, for it was not until a hundred years later that Whitehaven became a busy export centre, chiefly to Ireland and Scotland.

The mines, workshops, and houses were lit with tallow candles, but in November 1570 there is mention of a sample of train oil which soon afterwards was used in the mines. Although, according to Hakluyt, whale fishing began somewhat later than this date, it is known that a number of English ships were fishing off Iceland about this time. This is probably one of the first uses of the oil in England.

The original business of Haug and Co. was drapery, and at first they tried to sell silk and satin and other costly stuffs at Keswick, disposing of more than £400 worth.

The mines were worked to some extent by what is called 'tributing'; the miner chose his own place, hewed at his own pleasure, and was paid a percentage on the value of the ore he got. He paid for his own candles and tools. Apparently the earnings by this method were very uneven. The system survived to the end of the period of copper-mining at Coniston.

The details of one of Hechstetter's journeys with three others from Augsburg to London show how he travelled by cart from Speir to Mainz, hired a boat to Cologne, then a covered carriage to Antwerp, thence to Calais, how is not stated: across the water to Dover, which cost £2 6*s.*, horses to Gravesend, and from thence to London by boat. The customs at Dover extracted 16*s.* duty! The same paragraph contains the item "a poor German in charity 3*s.*".

In spite of the energy of Hechstetter and his associates, the enterprise did not prosper financially; we are told that, notwithstanding very considerable quantities of copper had been won, the difficulty of finding a market was accentuated in 1571 owing to the depression of trade in England during that year. There is a long and somewhat despairing letter from Langnauer in Augsburg to Loner in London, who in consequence approached the Queen, probably through Leicester, begging her very materially to increase the amount of copper ordered from the company.

A little later fresh impulse was given to the business by the addition of coppersmith's work, that is, the making of kettles, pots, and pans, for which skilled men were again imported from Germany. An artistic craft was thus very early introduced

into the dales, which to-day the school of industrial art is perpetuating.

In 1576, Loner left the business, but Hechstetter struggled on for a few years: the company was reconstructed by Thomas Smyth in 1580. His enterprise prospered for some years, mines being opened also in Cornwall and South Wales, but by 1597 the Keswick works were in difficulties again. A little later, in 1600, an inquiry into the condition of the northern mines showed that in thirty-six years, after paying £4500 to the Queen, £68,103 had been made by the sale of metal, and the expenses had been £104,700 plus a capital outlay of £27,000. Nearly all the money, found and lost by Augsburg and London merchants, had been lavished in the dales.

The smelt houses were destroyed at the Civil Wars, probably in 1648, and many of the miners slain.

Certain points in this very slight sketch of the colony in the dales are outstanding; one, the effect of the intermarriage of the Germans with the dalesfolk in promoting some of the energy and intelligence for which the 'old stocks' were remarkable, which together with the then large sums of money spent locally by the enterprise have had a far-reaching effect on its subsequent prosperity and development; the other, the close parallelism between the trials and tribulations, both technical and financial, in starting a new industry three hundred and fifty years ago and to-day. Very little profit in this respect seems to have been gained by experience; indeed, it appears axiomatic that the first venturers will not reap material rewards. Then, as now, we cannot withhold admiration from the German craftsmen for their willingness to try new ideas, new methods, with scientific thoroughness and exactitude.

Obituary.

Prof. H. H. Turner, F.R.S.

THE death of Prof. H. H. Turner occurred at Stockholm, where he was attending the meetings of the International Union of Geodesy and Geophysics. Just before the afternoon meeting on Saturday, Aug. 16, he fell forward on the table. His colleagues at first thought he had merely fainted, but the doctor who was called found that he had a severe attack of cerebral hæmorrhage and had him removed to the hospital. His wife was informed and she and her daughter went at once to Stockholm by aeroplane. He died on Wednesday, Aug. 20, without recovering consciousness.

Herbert Hall Turner was born at Leeds in 1861, and went to the Leeds Modern School and then to Clifton College. He obtained a Major Scholarship at Trinity College, Cambridge, was Second Wrangler in 1882 and second Smith's Prizeman in the following year. He became Chief Assistant at the Royal Observatory, Greenwich, in 1884, shortly before his election to a fellowship at Trinity. He soon became interested in the problems of fundamental astronomy and made researches on the $R-D$ discordance of the Greenwich transit circle. He elucidated but did not find a complete explanation of this still unsolved problem of the persistent difference between the zenith distances of stars from observations taken by reflection from mercury or directly. It is still in doubt to what extent this is due to flexure of the instrument, the differences of temperature in the observing room from that outside, and other instrumental causes. Turner made series of observations of the temperature in different parts of the room, and varied the conditions in which the observations were taken, taking the direct observation before that made by reflection.

A leading part was taken by Turner in a determination of the longitude of Montreal. This was determined in three links: Greenwich-Waterville, Waterville-Canso, Canso-Montreal. The difference of longitude Montreal-Washington being already known, the longitude of Washington was thus determined. The result obtained by this complicated series of connexions agreed closely with the direct determination found in recent years with the assistance of wireless signals. The difference of longitude Paris-Greenwich was twice determined conjointly with French astronomers. Here the results were not accordant, as in both series the French obtained a larger value than the English observers. Accordant results were not obtained until 1902.

Turner took part in a number of eclipse observations, and, like other astronomers, suffered from the vicissitudes of weather. At one of these expeditions, a brother-astronomer was seriously ill with fever. With characteristic kindness, Turner deliberately read the thermometer wrongly to the patient, and so cheered him that his temperature fell before the end of the visit. For the eclipse of 1896, in Japan, Turner introduced the use of the cœlostat. M. Lippmann had pointed out that a mirror turning on an axis in its own plane at half the speed of the earth's rotation and pointing to the pole gave a stationary image of the entire field. Turner realised the great convenience of this for photography of the sun at eclipses, and, with his friend Dr. Common, designed instruments which have served English observers in many subsequent eclipses. The weather was unfavourable in Japan in 1896, but Christie and Turner had good fortune in India in 1898, Newall and Turner in Algiers in 1900, and Turner and Bellamy in Egypt in 1905. He went to Paris for the eclipse of 1912 as a spectator, as the duration of totality was too short for serious observation; and at the eclipse which passed over England in 1927 he and Dr. Knox Shaw had only partially favourable weather at Southport.

Turner entered heartily into the scheme for the International Photographic Map of the sky inaugurated at Paris in the late 'eighties. Christie obtained one of the standard astrographic telescopes made by Sir Howard Grubb for Greenwich, Gill one for the Cape, Pritchard for the University

of Oxford, and others were obtained by the Australian observatories at Perth, Melbourne, and Sydney. In November 1893, Turner contributed to the Royal Astronomical Society a short and important paper on the method to be employed in the determination of the positions of the stars from the micrometric measures of the photographs, a method which has been generally adopted by astronomers. After the death of Pritchard in 1893, Turner was appointed to succeed him as Savilian professor of astronomy at Oxford, and carried out the part of the work allotted to Oxford with great energy. He took the line that the short exposure photographs, which would give the positions of some two million stars, should be measured and the rectangular co-ordinates of the star-images published promptly with such additional data as were necessary for the determination of the accurate positions of the stars. He urged this very strongly, and on the formation of the International Astronomical Union was, on the nomination of the first president, M. Baillaud, appointed chairman of the Committee dealing with the International Photographic Map of the Heavens. His efforts have brought the scheme much nearer completion than it would otherwise have been. After finishing the Oxford section, he measured photographs belonging to other observatories, and was largely instrumental in getting the observatory of the Nizam of Hyderabad to take up the photography and measurement of a zone allotted to an observatory which had later been unable to carry out the work. Among other interesting by-products of the work, Turner found that owing to curvature of the field, the photographs which were in critical focus at a distance of 30′ or 40′ showed far fewer stars at the centre of the field than at this distance.

Turner was a delightful popular exponent of astronomy, with a natural facility for speaking. He also wrote several popular works on astronomical subjects. His short and lively contributions to the *Observatory* magazine, "From an Oxford Notebook," were widely read and appreciated. Some of these consisted of amusing incidents or historical reminiscences interesting to astronomers. Others contained references to the current work and publications of other atronomers, with friendly criticism and appreciation.

On the death of his friend Prof. Milne, Turner took charge and largely extended the organisation which Milne had formed for the collection of seismographic records from all parts of the world. Milne-Shaw seismographs, comparatively inexpensive instruments devised by Milne, but improved greatly by Mr. Shaw of West Bromwich and manufactured by him, have been installed all over the world and the times of different phases of the shocks were reported to Turner at Oxford. As in the Astrographic Catalogue, he attached great importance to the prompt collection and publication of these data, which have thrown great light on the internal constitution of the earth. Turner made frequent harmonic analyses of earthquake records with the view of finding correlation between them and other astronomical and meteorological phenomena.

His disposition made Turner like work in co-operation with other people. He always enjoyed the international meetings of astronomers and other men of science. He invited the International Solar Union to Oxford in 1907, and attended the meetings at Meudon in 1904, at Mt. Wilson in 1910, and at Bonn in 1913. He was also a Royal Society representative at the meetings of the International Association of Academies. At the meetings of the International Astronomical Union he has been president of the Committee for the Photographic Map of the Heavens, and at the International Union of Geodesy and Geophysics, president of the Section of Seismology. He was secretary of the British Association from 1913 to 1922.

Turner will be greatly missed at the meetings of the Royal Astronomical Society, which he attended with the greatest regularity. He has served on the council for forty-three years, and has been secretary, president, and foreign secretary of the Society. At the council meetings he invariably took a charitable view of a doubtful paper, and at the meetings never failed to compliment a young author on his research. At the dining club after the meetings he was secretary and Glaisher president, to the great satisfaction of the members, for many years. On Glaisher's resignation owing to failing health, Turner became president, and continued to delight and enliven the gathering by speech and occasionally by song. He took a great interest in other people's work, including modern developments, and was a very kindly and genial colleague, whose death will be mourned by astronomers all over the world.

Prof. Turner was elected a fellow of the Royal Society in 1896. He was a corresponding member of the Paris Academy of Sciences, and he received the Bruce medal of the Astronomical Society of the Pacific in 1927. He was given honorary doctorates by the Universities of Leeds, Sydney, Wales, Strasbourg, Durham, and California. F. W. D.

PROF. J. F. POMPECKJ.

DR. JOSEF FELIX POMPECKJ, professor of geology and palæontology in the University of Berlin, and Geheimer Bergrat, died on July 8, while still in the midst of his activities. He was born in East Prussia on May 10, 1867, and graduated as Ph.D. at Königsberg in 1890, with a thesis on Trilobites. He had a varied official career, beginning in 1891 as assistant in the geological institute at Tübingen, and removing two years later to Munich, where he was both a curator in the Palæontological Museum and *privat-docent* in the University. In 1904 he became professor in the Agricultural Academy at Hohenheim, and in 1907 he was promoted to the professorship of geology first in the University of Königsberg and then in the University of Göttingen, where he followed A. von Koenen. He remained at Göttingen for six years, and in 1913 returned to Tübingen as professor in succession to E. Koken. In 1917, on the retirement of his old teacher, W. Branca, he was appointed professor in the University of Berlin, and in 1925–26 he served his term as rector of the University.

Prof. Pompeckj was especially insistent on the necessity of studying sedimentary rocks and fossils together, and all his researches were guided by this idea. In continuation of his doctoral thesis, he began by studying the Trilobites and other early Palæozoic fossils and their distribution in the various rocks in which they were found. He published papers on Trilobites and on the Cambrian formations of Bohemia, Sardinia, and other regions. In his latest years he returned to the same subject when examining the boulders on the north German plain. His most important work, however, was on the stratigraphy of the Jurassic formation, especially of Württemberg, but also of the Arctic regions, from which he examined several collections of rocks and fossils. In this connexion he became an authority on certain groups of Ammonites and other Mollusca. He was ever in search of general principles, and his addresses on the former extension of seas (1909), on race-persistence among Ammonites (1910), on the origin of the copper-slate (1920), and on environment, adaptation, and struggle in the light of geological research (1925), are full of interesting and valuable suggestions.

Outside the University, Prof. Pompeckj also took his full share in promoting geological and palæontological science. For many years he was one of the editors of the *Palaeontographica*, *Geologische und Paläontologische Abhandlungen*, and *Neues Jahrbuch für Mineralogie, etc.*, and he was an active member of the German Geological Society, of which he was several times president. The Geological Society of London expressed its appreciation of Prof. Pompeckj's contributions to science by electing him a foreign correspondent in 1925.

WE regret to announce the following deaths:

Dr. Henry Fraser, formerly director of the Institute for Medical Research, Federated Malay States, when he made valuable contributions to our knowledge of beri-beri, bacillary dysentery, and leprosy, on July 17, aged fifty-seven years.

Mrs. Albert Howard, Second Imperial Economic Botanist to the Government of India, who was associated with her husband in the work of the Institute of Plant Industry, Indore, on Aug. 18, aged fifty-three years.

His Grace the Duke of Northumberland, K.G., president of the Royal Institution and Chancellor of the University of Durham, on Aug. 23, aged fifty years.

Dr. George W. Patterson, associate dean of the College of Engineering of the University of Michigan, known for work on standards of electrical current, on May 22, aged sixty-six years.

Prof. Conrad von Seelhorst, professor of agriculture in the University of Göttingen, author of "Handbuch der Moorkultur", on July 6, aged seventy-seven years.

News and Views.

THE anniversary address of Mr. C. R. Peers, president of the Society of Antiquaries, which is printed in full in *The Antiquaries Journal* for July, ranged over a wide variety of topics in archæological research, not the least interesting section being his review of current activities in the field. A matter of special interest to the readers of NATURE, in view of recent correspondence in our columns, was the reference to the researches of Mr. Reid Moir and Mr. Burchell on the boulder clay of Norfolk and Yorkshire. Touching upon the archæological aspect of their work, he pointed out that in common with other recent research, it tended to contract still further the distinction which has been drawn between the culture of palæolithic and neolithic man. For these glacial deposits have been found to contain an appreciable number of flints which were surface deposits before the clay was laid down, and are, therefore, indubitably of palæolithic date, yet of a type which would generally be regarded without question as being neolithic. Such a classification, he said, can no longer be accepted, and palæolithic man would appear to have "made a most impressive invasion of what, till late, was neolithic territory".

IN dealing with research in the field, Mr. Peers referred in some detail to the conditions in which excavations are being carried out under the auspices of the Society of Antiquaries at Colchester and St. Albans. A preliminary account dealing with the first fortnight's work at St. Albans appeared in the *Manchester Guardian* of Aug. 14. The prospects are indeed promising. There are already indications that it may be possible to fix with some certainty the date of the great defensive Roman wall, assigned by some to the first, by others to the third century A.D. If further investigations confirm that it is of first century date, as the evidence at present suggests, it will also fix the date of the London wall, which is identical in construction with that at St. Albans, and in both cases will demonstrate the correctness of the view which holds that these cities were walled after the suppression of Boudicca's rebellion. The entrance gates of the town have been unearthed and the foundations of one of the two flanking towers usually found with such gates have been laid bare. Verulamium has a history stretching from prehistoric times to the fifth century A.D. This is unique in Britain, and with the view of throwing light on its Celtic culture and on the later phases in its history, Mrs. Wheeler is excavating houses fronting on Watling Street within the town. Three have now been unearthed. They show that after the Roman occupation the Roman art of building was lost, but a remarkable pot, unearthed from the beaten clay floor which had been laid down over the tesselated pavement, suggests that the Roman-taught art of pottery was still practised in degenerate form.

WE have received an interesting communication, unfortunately too long to print in full, from a correspondent, W. W. L., commenting upon the views expressed in our article "Education, Environment, and the Criminal" (NATURE, July 12, p. 45). The writer directs attention to the arguments and assumptions typified in that article, and urges that the attitude of science to-day countenances a self-expression demanded for unregulated and uncontrolled impulses

and selfish desires, while neglecting the means whereby the true individuality of man can evolve and find self-expression. Finally, our correspondent asks whether if human beings have no conscience, no psycho-spiritual nature, no evolutionary objective, does it matter what they do? W. W. L.'s letter raises a question which is becoming increasingly important in modern life, namely, the relation of science and ethics; but the form in which the criticism is made suggests an application of a moral standard as a test of the validity of scientific reasoning which would stultify research. The research worker as such, whatever his duty towards humanity and his fellow-citizens as an individual, in dealing with scientific data is concerned only with the truth—the facts, and the inferences from those facts. It is in the application of scientific conclusions to the problems of life that the ethical standard comes into operation. It is not for the psychologist or the sociologist to speak of the 'higher' and 'lower' impulses in the sense used by our correspondent. These are distinctions for the social reformer who applies the conclusions of the psychologist and the sociologist relating to these phenomena in dealing with his own special problems of social reform.

AN article by Prof. Raymond Dart, in the *Times* of Aug. 22, gives an account of some results obtained in excavating the Mumbwa Caves during the last three months by the Italian scientific expedition operating in Portuguese East Africa, South Africa, and Southern Rhodesia under Capt. Attilia Gatti and Prof. Lidio Cipriani. Mumbwa is approximately 130 miles south-west of Broken Hill, where Rhodesian man was discovered. The excavations revealed strata with implements ranging from the most recent types of stone age implements to Mousterian; but the most interesting find was that of a peculiar type of iron smelting furnace at a depth of six feet below the surface above it and eight feet below the surface at the middle of the cave. This is the first occasion on which a smelting furnace has been discovered in South Africa in conditions which permitted of an archæological dating. On one side of the furnace was a great accumulation, 2 ft.–3 ft. thick, of ashes, burnt rock, incinerated bones, clay, slag, and of quartz and metal showing the action of fire. On the other side, between the furnace and the cavern wall, were human burials. Two of these which were carefully excavated showed that the bodies were buried in sepulchres of stones piled beehive fashion and supported by earth. The skeletons were all of Bushmen. The furnace stratum and overlying earth were filled with quartz flakes and implements of middle and late stone age type, and one foot below the furnace was the Mousterian level with implements of ironstone similar to that which attracted the iron smelters. In the superficial deposits were found occasional iron arrow-heads and pottery, these probably of Bantu origin.

IT is obvious, in view of the peculiar archæological conditions in South Africa, that the material discovered by Capt. Gatti and Prof. Cipriani is susceptible of very diverse interpretation. Prof. Dart himself regards the furnace culture as coeval with the later phase of the palæolithic and as the introduction of a superior race into an Africa "still in the throes of the stone age". The continuation of the stone age culture relatively unaltered, he holds, shows that the local inhabitants were not initiated into the mysteries of the smelters. It is further suggested that this evidence points to an antiquity for a knowledge of iron smelting in Rhodesia of 3000–4000 years, the superficial supposedly Bantu finds being perhaps 2000 years later. Prof. Dart goes on to point out that whereas the Zimbabwe culture, usually associated with mining and metal working, has been attributed recently to a Bantu people of about 400 to 500 years ago, we now have in the Mumbwa cave evidence that metallurgy was being actively prosecuted in the Zambezi watershed thousands of years ago. Prof. Dart's conclusions may be soundly based, but in default of a more precise nomenclature for the implements in accordance with the generally accepted classification of South African stone age cultures, they are difficult to appraise. Implements of "late stone age type" in South Africa might be of any date. Nor is it possible to say that the smelters' culture is of Bushman origin on the evidence of burials which might be intrusive or explicable in other ways, unless the proof of their contemporaneity is more convincing than has been shown at present. More precise information as to the type of the furnace, which differs from that of the Bantu, may furnish some clue. If further examination of the data supports Prof. Dart's dating, this is a discovery of first-rate importance; in any event it is extremely interesting.

AUGUST ANDRÉE started from Danes Island, Spitsbergen, on July 11, 1897, with two companions, Drs. Strindberg and Fraenkel, to drift across the north pole by balloon. Ample supplies of food and ammunition were taken, the capacity of the balloon was increased by 300 cubic metres to 4800 cubic metres and the fabric strengthened by additional coats of varnish, but the risks were clearly great. Andrée sent messages by pigeons up to July 13, when their position was lat. 82°, long. 15° E. After that, nothing was heard of the party. Now, after an interval of thirty-three years, comes the report that the bodies of Andrée and one of his companions have been found on White Island, Franz Josef Land. It seems that a party from the Norwegian expedition carrying out investigations in Spitsbergen and the Arctic Ocean under Dr. Horn landed on the south-west of White Island on Aug. 6 and found traces of a camp near the coast. Further search led to the discovery of a boat and sledge, with notebooks, instruments, and other equipment marked "Andrée's Polar Expedition, 1897", and near by was Andrée's body. Another body was found some distance away and between some great stones in a cleft in the rocks. Both bodies have been well preserved by the intense cold, and their discovery is thought to be due to the unusual warmth of the present season. The remains of the expedition have been put on board the *Bratvaag*, the ship carrying the Norwegian expedition, which is due to return to Tromsö early in September.

THE preservation of memorials to famous men of science should be regarded as a duty. We are glad, therefore, to record that the tomb of Sir Humphry Davy in the old cemetery of Plainpalais in Geneva, which had fallen into disrepair, has not only been renovated but also that arrangements have been made for it to be suitably cared for in the future. Davy died in Geneva on May 29, 1829, while on his way home from Rome, and the funeral, arranged by de Candolle, the eminent botanist, was attended by a large number of the citizens of Geneva. Last year on the centenary of Davy's death the Faculty of Science of the University of Geneva visited his tomb and laid a wreath upon it. Through Dr. R. Fleming, of the Physiological Laboratory, Geneva, the attention of the Royal Institution was then directed to the state of the monument, and, thanks to the action of that body and the collaboration of Sir Humphry Davy Rolleston, it has been possible for a complete restoration of it to be carried out.

ACCORDING to a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., a curious phenomenon was recently observed by the General Electric Company engineers who operate the broadcasting station WGY (Schenectady, U.S.A.). Having solved the problem of broadcasting waves in the broadcast band with 200 kilowatts, they attempted to broadcast waves of short wave-length using similar large power. With a power of 35 kilowatts brilliant brush discharges flashed and wavered round the antenna when the carrier wave was modulated with the current from the microphone in the studio. The carrier wave alone had no effect on the air near the antenna. It was only when it was modulated that violent corona effects were observed. These discharges caused the air to vibrate and produced noises like thunder which roughly reproduced the music. The antenna apparently acted like a gigantic loud speaker. If allowed to continue it would doubtless have arced across the insulators, fused the copper wires, and broken the antenna. To prevent this effect the wires were replaced by much thicker ones. Large hemispheres were also placed at each end of the antenna. This diminished the electric stress on the air near the conducting surfaces and 35 kilowatts of power are now successfully modulated by WGY on short waves without the formation of corona flashes.

THE overhead line from Luton to Bedford which was put into operation on May 29 last gives a good idea of the British 'grid' scheme which is rapidly being erected in many parts of the country. It consists of six steel cored aluminium line conductors and one overrunning steel cored aluminium earth conductor for lightning protection. Each line conductor consists of thirty aluminium strands surrounding seven steel strands. The insulators have nine discs, each ten inches in diameter, in series, which are suspended from the cross arm ends on straight line galvanised steel lattice towers. The towers vary in height from 72 ft. to 98 ft., and their bases vary between 14 ft. and 25 ft. square. The normal span is 900 ft. and the sag of the conductors is about 22 ft. From the æsthetic point of view little can be said for or against them, but as the transmission voltage is 132,000 they add to the risks of air navigation. In London itself it now seems quite certain that the cables will be put underground. The Italian Pirelli Co. has laid oil filled cables underground and found experimentally that they were satisfactory at pressures of 220 kilovolts. The Central Electricity Board began installing double circuit oil filled cable lines between Eltham and Deptford to work at the standard pressure of 132 kilovolts. It looks therefore as if all the main difficulties in the way of the grid transmission scheme are being overcome.

IT is highly probable that railway electrification would make much more rapid progress if it were not for the high capital outlay required. It is owing to this heavy outlay that many railway engineers are considering the possibility of using Diesel electric trains on British lines. In a brochure issued by Sir W. G. Armstrong Whitworth and Co., information is given of the advantages and growing popularity of this kind of traction. Armstrong-Sulzer Diesel electric motor coaches have been in service for more than five years without needing any overhaul. These motor coaches can be used for twenty hours out of the twenty-four and can run twice as many miles per annum as a steam locomotive. No time is required for lighting up and steam raising, and fuel for twenty-four hours' service can be pumped into the fuel tank in a few minutes. Economies can be effected when coasting down a long incline by stopping the engine. It is stated that a saving of several million pounds per annum on fuel alone could be effected by adopting this system on British railways. For the Russian State railways Diesel electric locomotives of this type have been made, having a working weight of 135 tons and of 1500 brake horse power. They are also used on one of the Tunisian railways, the Buenos Ayres Great Southern Railway, and the Swiss Federal Railways. We learn from *A.E.G.* (Allgemeine-Elektricitäts-Gesellschaft) *Progress* for August that this firm has had two petrol 150 horse power engine cars running on the Brazilian Central Railways since 1925, and that since then others of larger size have been supplied to the same railway. The Diesel electric locomotives have excellent running 'characteristics', there is practically no vibration, and the engines run noiselessly.

MR. G. STEVENSON TAYLOR gave the Gustave Canet Memorial Lecture before the Junior Institution of Engineers on the subject of industrial accidents, their cause and prevention. Mr. Taylor estimates that the total amount of compensation paid to workmen for accidents alone, apart from compensation for industrial disease, was nearly $6\frac{1}{2}$ million pounds in 1928: to this must be added the cost of administrative expenses as well as medical and legal costs. He thinks that this burden on industry could be materially reduced if the problem were attacked in the right spirit and on right lines. From information obtained by inspectors and others under the Factory Acts, he pointed out that more than 50 per cent of the accidents and more than 70 per cent of the fatalities were due to causes not

connected in any way with the use of machinery. A large number of accidents occur through persons falling over objects on the floors, and he urged the importance of clearly marked alleyways. It is also found that the percentage of accidents is greater during the winter months when the daylight hours are short. He considers that the personal factor in accidents is evidenced in carelessness, inattention, and want of thought. More recent studies than those reported by Mr. Taylor show that the personal factor involves much more than is suggested above. The work of Prof. M. Greenwood and his colleagues has shown statistically that the genesis of multiple accidents under uniform external conditions is an affair of personality and not determined by any obvious extrinsic factor. Later, Farmer and Chambers have produced evidence in favour of the view that there are people who have a definite measurable tendency to have accidents. This tendency may not necessarily be related to states of consciousness over which the person has control and cannot be adequately described by the moral judgment implied in such terms as carelessness or want of thought.

SOME years ago the idea was current that stone age man was a typical savage of a low grade of intelligence and the merest rudimentary forms of culture. We are now perhaps only just beginning to appreciate the significance of the stage of development of his brain, and to discern the skill and ingenuity that went to the fashioning of a stone implement and its adaptation to the needs of daily life. An interesting point bearing upon this aspect of relics of the stone age is discussed by Mr. Reid Moir in a communication entitled "Stone Implements from a New Angle", which appears in the *Journal of the Ipswich and District Natural History Society*, vol. 1, p. 2. With sound common sense, Mr. Reid Moir argues against the views of archæologists who hold that because the number of objects of material other than stone diminishes as the time series ascends until they disappear, therefore the earlier races of man employed no material except stone. He maintains that this takes too low a view of the intelligence of early man, and goes on to argue that both the nature of the material, that is, wood, bone, and ivory, and the conditions of deposit of the implements are such as to make it improbable that anything but the most durable material would survive except in such favourable conditions as are afforded by the French palæolithic caves. Yet even so, as he points out, we have the bone implement associated with Piltdown man, as well as other specimens for which a high antiquity is claimed. Mr. Reid Moir gives a useful hint to archæologists when he points out that the great majority of stone implements are implements with which other implements, now vanished, would be fashioned, As to the deeper significance of this dictum, we recommend consideration of Mr. Reid Moir's experiments in the practical use of stone implements, which the student might emulate if he can acquire the necessary dexterity and patient persistence.

FURTHER details of the International Zoological Congress have just been received, rather late in the day, as the Congress opens at Padua on Sept. 4. There will be an informal gathering at the Hotel Storione at 9.30 P.M. on Wednesday, Sept. 3. The opening ceremony will be at 10.30 A.M. on Thursday, at the University, when Dr. M. Caullery will give an address on genetics and evolution. The sections will meet in the afternoon and during such further afternoons or mornings as are not otherwise occupied. General meetings will be on the afternoon of Friday, Sept. 5, and the mornings of the following Saturday, Monday, Wednesday, and Thursday. Sunday, Sept. 7, will be filled with an excursion to the Lagoon of Venice. Shorter excursions during the meeting will be to the Royal Villa at Strà, to Rovigo, including a visit either to Count Arrigoni's ornithological collection or to Petrarch's house at Arquà, and to Abano. From Friday to Sunday, Sept. 12–14, there will be an excursion to the Lagoon of Comacchio, Badia di Pomposa, Bonifica di Codigoro, Ferrara, Bologna, and Ravenna. Favourable terms have been arranged at the hotels of Padua, and the Italian State Railway will issue return tickets from any frontier station or port to Padua at a reduction of 30 per cent. An exhibition of optical and other scientific instruments by Italian and foreign firms has been arranged. The address of the Congress is Via Loredan 6, Padova.

IN a pamphlet entitled "How Unemployment Might be Prevented", Capt. J. W. Petavel, formerly lecturer on "The Poverty Problem" at the University of Calcutta, advocates the formation of labour colonies or guilds as a solution of the unemployment problem. The basis of the proposal is that members of the guilds would undertake the direct production of most of their requirements, and the scheme is worked out to suit both Indian and European conditions. The author holds that the scheme would greatly increase the well-being of the Indian peasants, whose agricultural output is low, but whose needs are simple. In Europe it is suggested that the labour colonies might if necessary be modified so as to allow the workers to put in part of their time in ordinary factories and part in work at the colonies. In support of the scheme the success of a Swiss colony is cited. This has been organised on a self-supporting basis for 'unemployables', who can earn their keep at the colony together with a small surplus which is paid them on leaving. Educational colonies are also advocated for young persons up to eighteen years of age, who would spend half their time at school and the other half in productive employment at the colony, bringing back produce to their homes in lieu of wages.

AN important Congress of representatives of Czechoslovakia and Rumania was held at Krakow last December, for the purpose of discussing common interests in the protection of Nature. The *compte rendu* of the Congress, which has just been published, illustrates the necessity and the value of co-operation in such matters. The chief objective of the meetings was the attainment of agreement especially in regard to the national parks lying on the borders of the countries concerned, for the creation of a great boundary reserve in the mountain range of Czywczyn, and for the protection of the valley of the Dniester.

No less than fifty-three resolutions were agreed upon, perhaps the most important being those concerned with the setting-up of a permanent Commission representing Rumania, Czechoslovakia, and Poland, to deal with common problems and to endeavour to obtain general laws applicable to the three States, but allowing possibilities of modifications in detail to meet special needs in any particular territory. Other resolutions signified areas suitable for reserves, and pleaded for the protection of the forests, which are gradually disappearing, of rare animals and plants, for the reasonable regulation of fisheries in the boundary reserves, and of sport.

WE have received the annual report for 1928–29 of the National Institute for Research in Dairying, University of Reading. The Institute's home is four miles from Reading at the Shinfield Manor House; this was acquired in 1923 and adapted at a cost of £30,000, and a considerable balance of this sum still remains to be raised by public appeal. The report reviews the work of the Institute during the year, giving summaries of papers published by the staff during the period, and forecasts some of the investigations to be carried out in the future.

THE Ministry of Health has issued to councils of counties and county boroughs in Great Britain a "Memorandum on Cancer as a subject for the attention of Local Authorities" (Cancer · vii., *Circular* 1136). Its object is to suggest the desirability of local authorities acquiring more complete knowledge of the reactions between cancer and the local community, with the view of devising such local ameliorative measures as may be necessary and practicable. A scheme of methods of investigation, appropriate action, and co-operation with other authorities is suggested.

THE summer issue of *Sunlight*, the journal of the Sunlight League (Vol. 2, No. 2), contains articles urging that greater use should be made of the healing virtues of the sun's rays, particularly in England. Sir Bruce Bruce-Porter and Dr. Eidinow write on ultra-violet and other rays in health and disease, the Marchioness of Aberdeen and Temair on open-air village settlements, and Dr. Saleeby on the children's home at Chailey Heath, Sussex, which locality he maintains need not fear comparison with Leysin, and is far superior to Berck, the most celebrated sun-cure place in France.

THE *Journal of the Cancer Research Committee of the University of Sydney* for May (Vol. 2, No. 1) contains articles of considerable interest. Prof. Welsh writes on the classification and characters of the endothelial new growths, Mr. Mankin discusses micro-methods of chemical analysis, describing methods for the estimation of molybdenum, potassium, sodium, calcium, and chlorides, and Mr. Gower Stephens deals with the radiation treatment of brain tumours. From a small number of cases of brain tumour treated with X-radiation, experience shows improvement which is usually prompt and definite.

The Carnegie Institution of Washington has published a new edition (April 1930) of its "Classified List of Publications." This useful volume of 207 pages contains a chronological list of the Institution's publications, a subject index, with brief summaries of the most important works, and an authors' index. It is impossible to indicate here the variety or importance of the contributions to knowledge so listed, but an indication of the extent of the catalogue is given by the fact that the subject index is arranged under twenty-seven branches of science. Such books as are not out of print are available to correspondents at prices approximating to the cost of publication, and price-lists or classified lists as issued will be sent to scientific workers on the receipt of the requisite address.

THE Liverpool Electric Cable Company, Ltd., of Bootle, Liverpool, has sent us a catalogue of low tension paper insulated cables. All the cables described in this catalogue are manufactured in accordance with the regulations of the British Engineering Standards Association and the components of the cables are in accordance with the B.E.S.A. specifications.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in chemistry at the Brighton Technical College—F. W. Toyne, Secretary, 54 Old Steine, Brighton (Sept. 2). A lecturer in mechanical engineering at the Norwich Technical College—The Principal, Norwich Technical College (Sept. 3). An assistant organiser of agricultural education under the Wilts County Council—The Clerk of the Wilts County Council, County Offices, Trowbridge (Sept. 6). An instructor in the department of navigation of the Sir John Cass Nautical School—The Principal, Sir John Cass Nautical School, Jewry Street, E.C.3 (Sept. 9). An assistant in the Barnato Joel Laboratories, Middlesex Hospital, for radiological research bearing upon the treatment of malignant disease—The Dean, Middlesex Hospital Medical School, London, W.1 (Sept. 13). An inspector under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1. (Sept. 15). A demonstrator of biology at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S.E.1 (Sept. 20). An expert hydrobiologist for fisheries investigations in Turkey—Mr. E. C. Weberman, Beyoğlu, Sira Servi 4, Istanbul, Turkey (Oct. 15). A Pilkington fellow in cancer research in the University of Manchester—The Registrar, The University, Manchester (Nov. 15). A lecturer in physics at University College, London—The Secretary, University College, Gower Street, W.C.1. A lecturer on surveying and geodesy at the Regent Street Polytechnic—The Director of Education, The Polytechnic, Regent Street, W.1. Teachers of engineering drawing, heat, electricity and magnetism, mechanics and hydrostatics at the Croydon Polytechnic—The Principal, Central Polytechnic, Croydon. A laboratory steward and lecture assistant in the chemistry department of Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14.

Research Items.

Cancer of Lip and Skin.—Cancer of the lip, tongue, and skin is the subject of a report by Dr. Janet Lane-Claypon for the Ministry of Health (*Reps. on Pub. Health and Med. Subjects*, No. 59. London: H.M. Stationery Office, 2*s.* net). Cancer of the skin and of the lip is a readily curable disease if promptly diagnosed and treated. The results secured by radio-therapy appear equal if not superior to those obtained by operation, reaching 80 per cent or more of cures in the case of skin cancer. Cancer of the tongue, on the other hand, is far less amenable to treatment, either by operation or by radium. As regards causation, evidence is accumulating that the actual cancer is preceded by some apparently simple and harmless condition, such as a pimple, wart, mole, etc. A proportion of skin cancers is known to be associated with certain occupations involving contact with soot, tar, mineral oils, arsenic, and similar substances. As regards cancer of the tongue and lip, this is known to be frequently causably connected with syphilis and with smoking, but there is no evidence that the simple inhalation and exhalation of tobacco smoke are causative.

Comparison of Left and Right Ovaries.—In the whole animal economy, no organs lend themselves more readily than the ovaries to the study of quantitative and qualitative functional comparison, that is, to a comparison between the activity of one organ situated on one side, with another situated on the other side, of the body. In a preliminary note published in the *Rendiconti della Reale Accademia delle Scienze dell' Istituto di Bologna* (1929), Prof. Pasquale Sfameni shows that, as regards the ovigenic function, with cows, rabbits and women, the right-hand ovary predominates over the left. In the case of women, this predominance weakens as age increases up to thirty-five years, after which it becomes reversed. As regards the fœtus, this has the greater weight if generated by the right-hand ovules. Multiple corpi lutei are more frequent as the period of genital life advances, the superiority in this direction being shown by the left-hand ovary.

Effect of Cold on Sea Life. The second and third parts of the recent Report of the Danish Biological Station to the Ministry of Shipping and Fisheries (35; 1929), by H. Blevgad and A. C. Johansen, give accounts of the effect of cold on certain animals, the first dealing with the littoral invertebrates, the second with porpoises, fish, and crustacea. The winter of 1928–29 was specially severe and its effects were felt by many animals. It is shown that this prolonged frost had a pronounced effect on the littoral fauna, but some forms were much more resistant than others. The bottom animals are particularly exposed to the dangers of being killed in ice winters in the coastal belt between 0 m. to c. 1 metre's depth, especially in places which are liable to be left dry at low tide. The mussel *Mytilus edulis* suffered badly, also the cockle *Cardium edule* and the oyster (*Ostrea edulis*). Dr. Johansen notes the large numbers of porpoises dead in the Bornholm Deep, having probably fled from the ice in the Belt Sea. Only in areas of slight extent was there any wholesale destruction of fish such as cod, haddock, plaice, and flounder, and this probably chiefly owing to lack of oxygen near the bottom. The eel was the fish which suffered most, although in no locality was the stock wholly eliminated. Many smaller fishes besides crabs, lobsters, and shrimps also died.

Californian Commercial Fish Catches.—*Fish Bulletin* No. 20, "The Commercial Fish Catch of California for the Year 1928" by the staff of the Bureau of Commercial Fisheries of California (Division of Fish and Game of California, 1930) contains a large amount of information concerning a variety of commercial fishes and crustaceans. This is the second of the special bulletins dealing principally with monthly tables, and it is hoped to continue this annually, including in addition summaries of other classes of fisheries statistics collected by the Bureau. The chief features of 1928 were a continued increase in the amount of fish used for canning as opposed to utilisation in fish markets, the sudden development of a mackerel canning industry on a large scale, continued indications of the failure of the local fishing banks on the narrow continental shelf to supply the increasing demands for fish, and in consequence an increasing dependence on distant and foreign areas, extension of the tuna fishing area to far below Cape San Lucas, importation of albacore from Japan and Hawaii and, finally, the commercial utilisation of sword-fish. The bulletin begins with a useful list of the common and scientific names of the fishes, crustaceans, and mollusks, after which come short chapters on the most important species. The sardine is easily the first, the total catch being 2½ times that of the rest of the fish combined. Mackerel comes next, having risen from the tenth place in 1927 to second in 1928, due to canning. The rest are much the same as in former years.

Japanese Fresh-Water Rhabdocœlids.—Dr. K. Okugawa gives an interesting list of these flatworms in his paper "A List of the Fresh-Water Rhabdocœlids found in Middle Japan, with Preliminary Descriptions of New Species" (*Memoirs of the College of Science*, Kyôto Imperial University, Series B, vol. 5, No. 1, Article 4, 1930). No details were hitherto on record relating to the fresh-water species of this group, although certain cosmopolitan forms were known to be abundant in the rivers, ponds, and lakes of Japan. The author finds that the rice-fields of Middle Japan are specially favourable situations for these worms, the area containing warm and fertile water from May to October. Thirty-one species belonging to nine families are recorded, with notes on their structure and distribution. Six new species and two new varieties are described. Many of these Rhabdocœlids are very abundant in ditches and ponds as well as in the rice-fields. The research, extending over two years, was carried out chiefly at the Otsu Hydrobiological Station on Lake Biwa under the supervision of the Director, T. Kawamura.

The Mid-Atlantic Ridge.—The origin of the Mid-Atlantic Ridge, one of the most remarkable features of the globe, is a much-disputed problem. Haug regards the Ridge as a median anticline formed by the beginning of crumpling in the great 'geosyncline' of the Atlantic. For Taylor, Wegener, and others, it is a strip of the original crust from which the continents on opposite sides have drifted away. Thus, as in the case of the African Rift Valleys, there are two diametrically opposed hypotheses in the field: one involving compression, the other tension. Dr. H. S. Washington now enters the field via the petrology of St. Paul's Rocks, a group of four rocky islets lying on that part of the Ridge which runs nearly east and west just north of the equator (*Jour. Maryland Acad. Sci.*, vol. 1, No. 1, Jan. 1930). Unlike most of the Atlantic islands, St. Paul's Rocks are not volcanic, but are composed of a plutonic ultrabasic rock—a wehrlitic dunite—that has been metamorphosed by pressure. Washington therefore regards

"lateral pressure as the sole competent cause of the uplift of this part of the Ridge, which is quite in accord with the known condition of instability and present-day seismic and submarine volcanic activity of the region". To account for the peculiar shape of the Ridge, Washington is tempted to apply the torsional hypothesis of Prinz, suggesting an eastward movement on the south and a westward movement on the north.

Remarkable Series of Earthquakes at Ito (Japan).—Ito is a watering-place on the west coast of Sagami Bay. For two months since the middle of last February the town has been shaken by almost incessant earthquakes, none of them of destructive intensity, though a few were strong enough to overturn grave-stones and crack plaster-walls. The earthquakes have been studied by Prof. Imamura and three of his colleagues in the Seismological Institute (*Proc. Imp. Acad., Tokyo*., vol. 6, pp. 190-193; 1930). A network of five seismograph stations was formed round the epicentral area. The total number of shocks recorded from Feb. 13 to April 11 was 3684, the maximum daily frequency (of 209) being reached on Mar. 9. Comparing the hourly frequency of the shocks with the tidal phases at Misaki (on the north coast of the bay), it was seen that the shocks occurred in groups coinciding with periods of low water. The most interesting result is one due to Mr. Nasu that, with a few exceptions, the foci of the earthquakes were confined to a conical region of the crust, the apex of the cone being at a depth of 6 km., while the base is a circle of about 2 km. radius on the sea-bed in the inlet of Ito. The nearer the earth's surface, the denser is the clustering of the foci. This distribution seems to suggest the presence of a hidden extinct volcano with the above-mentioned cone as its crater.

Distribution of Earthquakes in the East Indies.—Dr. S. W. Visser has recently published a useful discussion of the distribution of earthquakes in the Dutch East Indies during the years 1920–26 (*Verhand. Konin. Magn. en Meteor. Obs. te Batavia*, No. 22; 1930). In this interval 3310 earthquakes were recorded, the great majority very slight, though 35 were registered all over the world. Of the total number, only 244 had an inland origin. A large district, including Sumatra east of the Barisan Mountains and the whole of Borneo, with the exception of the east coast, is practically aseismic. On the other hand, earthquakes are frequent all along the coasts of the Indian Ocean from Atjeh to Timor, in the north of Celebes, in a small central area of the Moluccas, including Boeroe, Ceram, and Banda, and the northern portion of New Guinea. As a general rule, the epicentres of submarine earthquakes lie on the steep slopes of the oceans and deep seas, while those of land earthquakes are closely connected with existing fractures.

Magnetic Tables for the United States.—In the *United States Magnetic Tables and Magnetic Charts for 1925*, issued by the U.S. Department of Commerce, Coast and Geodetic Survey (Serial No. 453, 1929, price 60 cents, pp. 136, 4 maps), complete revised data are given concerning the distribution of magnetic force over the United States, for the epoch 1925; the publication supersedes the Tables and Charts for 1915 given in *Special Publication*, No. 44, now out of print. It contains the observed values of declination, dip, and horizontal intensity for all places in the United States at which reliable observations have been made, together with the reduced values for Jan. 1, 1925; tables giving repeat observations at stations occupied between January 1917 and December 1928; tables giving the secular variation; and isomagnetic charts for declination, dip, and the horizontal and vertical intensities. The charts measure 20½ in. by 26½ in.; the lines of equal declination and dip are given for each degree, and of equal annual change for each minute of arc; the lines of equal intensity are given for each 1000γ, and of equal annual change for each 10γ. The maps extend northwards to about latitude 50°; Alaska is not included. The tables occupy 124 pages, 98 of which are reproduced from typewritten sheets by photo-lithography.

Stark Effect.—An investigation of the electric fields needed before lines of a spectrum appear which are normally forbidden by the selection rule for azimuthal quantum numbers, is described by Y. Ishida and T. Tamura in a *Scientific Paper* (No. 241) of the Tokyo Institute of Physical and Chemical Research. This effect, which is distinct from the splitting of lines already present in the absence of a field, has been studied for helium in a tube of the Lo Surdo type. The field strength below which these 'forbidden' lines are still absent is greatest when they involve no change in azimuthal quantum number (k), falls to zero for the normal change of unity, and increases again, although not to the same extent as for $\Delta k = 0$, for the lines for which Δk is 2, 3, and 4. For a transition to a definite final state from an initial state in which only the initial total quantum number (n) is variable, the field required falls off rapidly with increase in n; for example, 87 kilovolts per cm. are needed to bring out the line $2S$-$3S$, but only 3·2 kv./cm. for the line $2S$-$6S$. A disappearance of lines in very strong fields, of the order of a million volts per cm., has also been recorded recently by Traubenberg, Gebauer, and Lewin, with the Stark effect of the Balmer lines of hydrogen (*Die Naturwissenschaften*, vol. 18, p. 417; 1930).

Electrical Heating in Laboratories.—In the April number of *Helios*, an export electrical trade journal published in Leipzig, there is an illustrated article showing many heating devices for use in laboratories. Laboratories for general analytical work are sometimes built at a distance from public gas mains. If there is no great demand for gas for smelting and muffle furnaces, the cost of laying down gas mains over long distances may be unduly heavy. To obviate this expense all kinds of makeshifts have been tried, such as acetylene Bunsen burners and spirit or petroleum Bunsen burners. The cost of service for the acetylene burners is low although their initial cost is high. On the other hand, spirit or petroleum burners cost little but the charge for the fuel is high. The latter system therefore is only used in very small laboratories. The question of using electric heating in laboratory equipments has been little considered in Great Britain, although it possesses many advantages. The heat can be applied exactly where it is wanted and there is much less risk of explosions. The high radiation and convection losses from flames are avoided and despite the high cost of electricity the running cost in service may be actually less than when gas is used. Up-to-date water baths and drying cabinets heated electrically are shown, in which the consumption of energy is a minimum. In the drying cabinets the heating member is built inside the heat protection jacket, so it is easy to maintain a constant temperature. For laboratories in which much high class work has to be done, small test tube furnaces are specially suitable. Only the lower parts of the test tubes are heated and there is no useless waste of electric energy. There is no risk in heating explosive or highly inflammable material. A small crucible

furnace is shown suitable for the incineration of analytical precipitations. Permanent temperatures up to 1200° C. can be obtained without any trouble. The furnaces are furnished with an external nickel protective jacket.

Chemistry of Immunology.—*Science Progress* for July contains an article by Dr. W. O. Kermack on some recent advances in the chemistry of immunology in which the part played by non-protein compounds is more especially dealt with. These carbohydrates, called haptenes, resemble proteins in reacting with homologous antisera even in very great dilution, but they are not antigens since they cannot produce antibodies. It appears that Ehrlich's general idea of haptophores may have a real significance, and that the molecular groupings to which he gave that name may, in certain instances at least, be given a definite chemical configuration.

Iron Carbonyl.—With reference to the note on the formation of iron pentacarbonyl in a cylinder of compressed coal gas, which appeared in NATURE of June 7, p. 873, Mr. J. E. Mason informs us that the possibility of the formation of iron carbonyl in these circumstances was recognised by Dr. Bedford in 1912. On the experimental plant at Sleaford (Lincoln) for the hydrogenation of oils by the Bedford-Williams process, it was made a rule not to store hydrogen in the large laboratory cylinders for more than a day or two if the carbon monoxide content of the gas exceeded a few per cent. It is not stated that the actual production of iron carbonyl was experimentally demonstrated, as in Friend and Vallance's communication.

Atomic Weight of Tantalum.—The accepted value for the atomic weight of tantalum, 181·3 or 181·5 (the values adopted in different countries vary since the machinery of the International Committee on Atomic Weights broke down), is based on results which are not in satisfactory agreement. In the June number of the *Journal of the Chemical Society*, Kolar Ramakrishnaiyer Krishnaswami describes experiments on the determination of the ratios $TaBr_5$: 5Ag : 5AgBr and $TaCl_5$: 5Ag : 5AgCl, in which twenty-four closely agreeing results pointed to the value 181·36 for the atomic weight of tantalum. Modern methods were used and great care was taken in the purification of the materials.

Vitamin-D.—It is now known that vitamin-D is produced by the irradiation of ergosterol and that the latter is the only sterol which gives rise to it. Previously it was thought that cholesterol was the provitamin, but experiments seem to have proved that its activity is due to a content of about 0·05 per cent of ergosterol in the cholesterol. Several investigations have been made on the effect of monochromatic light on cholesterol. In the June number of the *Journal of the American Chemical Society*, Marshall and Knudson describe some experiments made with ergosterol. They conclude that the rate of production of vitamin-D is proportional to the first power of the light intensity, that it is directly proportional to the number of light quanta absorbed by ergosterol and independent of the wave-length, and that the quantum efficiency is 0·3 molecules of vitamin-D per quantum absorbed. Vitamin-D absorbs in the same wave-length region as ergosterol and is destroyed by light of the same wave-length as that which forms it. The highest concentration of vitamin-D which can be produced by direct irradiation of ergosterol is 35 per cent. This is an absolute maximum and the probable value is lower.

Yeast Research.—To summarise in a critical fashion the salient features of existing knowledge in a particular sphere of activity is no easy matter, but, once successfully accomplished, cannot be other than useful. A recent paper by Dr. L. H. Lampitt (*Jour. Inst. of Brewing*, **36**, p. 250; 1930) may be said to fall in this category, and should provide food for thought for scientific workers whether they are interested in yeast from the practical or academic point of view. After a brief sketch of the classical work of Pasteur, Büchner, Harden, and others, the problem of the acceleration of fermentation by substances which can act as acceptors for hydrogen is discussed. The anomalous behaviour in this respect of sodium arsenate is noteworthy in view of recent work on the possibility of replacing phosphates by arsenates in the cycle of changes accompanying fermentation. Reference is also made to the effects on yeast activity of antiseptics, and in this connexion attention is directed to the fact that the study of maltase, which is readily crippled by phenol, has been comparatively neglected in recent years. Fernbach's selective fermentation of dextrose and lævulose and the theoretical deductions arising therefrom are also discussed. Other starting-points for investigations include the effects of radiations on the growth of yeast, the nitrogen question (NATURE, **125**, p. 105; 1930), yeast-enzymes and the existence of bios, and the nature of the yeast-substance. It is pointed out that the confusion arising from many of the existing results is due chiefly to lack of standardisation of the experiments, and it is suggested that such results should always be confirmed by direct experiment before an investigation is started. It is interesting to note that Dr. Lampitt regards the production of carbon dioxide as the only true criterion of fermentation.

Researches on Globin.—The *Comptes Rendus du Laboratoire Carlsberg*, vol. 18, No. 4 (1930), contains a communication by Roche on the above subject. The author has confirmed the experiments of Hill and Holden, published in 1926, on the decomposition of hæmoglobin by dilute acids; the product is called paraglobin, and is regarded as different from denaturated globin. The *p*H value of natural globin is 7·5-7·6, as determined by cataphoresis. Natural globin and hæmatin form alkaline methæmoglobin, which was prepared in several other ways. The combination of a natural globin from various animals takes place with any hæmatin. The isoelectric point of paraglobin is 7·6-7·8, by cataphoresis. It shows a minimum solubility in a pure solution over the range of *p*H 6·6 to 8·4. The variations found by other authors are due to degradation of the protein in their experiments. Paraglobin forms with hæmatin cathæmoglobin, but this reaction is specific for the globin, since it does not occur with other proteins. Boiling with acid (*p*H 2-4) for a short time does not alter the isoelectric point or solubility of paraglobin, but with *p*H 7·0 it is coagulated, and is then insoluble in strong acid or alkaline media. This form is called denaturated globin. Pepsin has an optimum action on paraglobin at *p*H 2·2, trypsin at *p*H 8·2, in opposition to the results of Northrop. Trypsin does not act unless kinase is present. Pepsin liberates COOH and NH_2 in the ratio of unity. The first action of pepsin or trypsin causes modifications indicated by a movement of the isoelectric point towards more acid values of *p*H. Since this is also found in the action of the hydroxide ion, it is suggested that both changes, at the commencement, have the same mechanism.

Denaturation of Proteins by Urea and Related Substances.

By Sir F. GOWLAND HOPKINS, F.R.S.

'DENATURATION', though a phenomenon familiar objectively to all who handle proteins, involves a change of state of which the precise nature is yet obscure. The term itself is scarcely capable of adequate definition. It is only certain that native proteins dispersed in water as lyophil colloids suffer, as the result of diverse alterations in their environment, a change which is accompanied by complete loss of solubility in pure water or dilute salt solutions. If under any influence (such as that of dilute acids or alkalis) a protein denatured in this sense is retained in solution, or redispersed after separation, it is then found no longer in the lyophil but in the lyophobe condition. Denaturation thus understood is always antecedent to coagulation or flocculation, these being secondary processes dependent upon conditions which make for instability in suspensoid systems. We are quite ignorant of the nature of any molecular change which may be responsible for, or accompany, this change in the type of dispersion. Evidence suggesting that some intramolecular readjustment does, as a matter of fact, occur will be mentioned immediately.

A special interest is attached to the change of state involved in denaturation because its occurrence appears to be characteristic of the protein molecule when it is intact. It is apparently not undergone by even the most complex of its degradation products; this circumstance tends to justify the view, based also on other evidence, that the molecular structure of an intact protein has features differing from, or added to, those of a complex polypeptide.

It is well known that in albumins, globulins, and a number of other native proteins in solution, denaturation is induced by heat, by certain forms of radiation, by the action of relatively strong acids and alkalis, by adsorption at surfaces or in films and mechanically by shaking. Such proteins are also denatured when under defined conditions they are precipitated from solution by such agents as alcohol or acetone.

It has recently become known that these diverse methods of denaturation all produce, in addition to the colloidal change, a shift in the relations of sulphur within the protein molecule, such that the denatured product yields, in some cases directly, and in others after treatment with a reducing agent, a reaction characteristic of the thiol group. This is not given by the native proteins. This characteristic happening was first observed by Heffter in 1909, though he did not specially relate it with the events of denaturation. The relation has since been more fully established.[1]

An influence, seemingly quite different from those already mentioned but resulting in typical denaturation, is exerted by urea (and, as will be immediately indicated, by other related substances) when added in high concentration to native protein solutions.

This phenomenon has received but little attention until recently. So far back, indeed, as 1900, K. Spiro[2] directed attention to it. His experiments, however, were in the main concerned only with the effect of urea and certain other amides and organic bases in preventing the heat coagulation of proteins or in raising their coagulation temperatures.

Anson and Mirsky[3] have recently pointed out that urea in concentrated solution can denaturate hæmoglobin, egg albumin, and serum albumin, and that it also dissolves the denatured protein. Hsien Wu has devoted several recent papers to a study of denaturation and has observed that some denatured proteins are soluble in urea solutions, while with Huang he has taken advantage of this circumstance to determine their molecular weight, finding that "denaturation *per se* does not necessarily involve a change in molecular weight". Dill and Allsburg employed urea solutions as solvents for a protein insoluble in water. Burk and Greenberg[4] have used them in order to determine the molecular weights of proteins at their isoelectric point, and to decide whether they are capable of undergoing changes in their state of aggregation with changes of solvent. They found that hæmoglobin and egg albumin are denatured by urea, and that the former has, in urea solutions, only half the molecular weight indicated in aqueous solution. These authors refer incidentally to the circumstance that formamide, urethane, and thiourea act in solution similarly to urea though not so effectively. Owing to their particular aims, the work of the authors quoted has involved the use of urea solutions as denaturants and solvents rather than a study of the conditions and rate of the changes induced by such agencies.

The following preliminary and descriptive account of certain observations of my own (some were made so far back as 1899, though now extended) will suggest, I think, that the mechanism of this form of denaturation is worthy of close study.

The experiments have dealt with ovalbumin and with serum proteins. It will be convenient to deal first with the former, which has been more fully studied.

EGG ALBUMIN.

Pure egg albumin, twice recrystallised by the method of Hopkins and Pinkus and its solution afterwards dialysed until wholly free from ammonium sulphate, was the material usually employed. At the end of dialysis, the *p*H of such a solution is invariably within the range of 4·8-4·9.

If in a few cubic centimetres of such a solution urea be dissolved (say 0·1 gm. per c.c.; though the amount is unimportant) and the solution evaporated to dryness in a vacuum desiccator at room temperature, the urea may then be extracted from the residue with water, while the protein will be found to be wholly insoluble, forming a cast of the urea crystals which separate on evaporation. The *p*H of the mixture may be adjusted from, say, 4·0 to 7·0 without any difference in the result. If the washed protein residue be now ground up with a few small crystals of sodium nitroprusside and a drop or two of weak ammonia added, a deep red-purple colour characteristic of a sulphydryl reaction immediately develops. If ordinary egg-white be diluted, filtered, and similarly treated, it behaves as described whether at its original *p*H (7·5 to 8·0) or when brought to *p*H 4·8.

The above simple method is a convenient means for deciding whether or not a given substance exerts a denaturing influence upon proteins. Using the pure albumin a number of substances were thus tested. Positive results were given by methyl-, ethyl-, and butyl-urea; by unsymmetrical dimethyl- and diethyl-urea; by thiourea; by acetamide, formamide, and by urethane. Wholly negative were the effects of symmetrical diethyl-urea, of acetyl-, and methyl-acetyl-urea; of biuret, allantoin, and semicarbazide; of alanine, phenyl alanine, valine, leucine, and cystein; of benzamide; of creatine, caffeine, and asparagine. Also negative was found to be the effect of a number of other nitrogenous compounds more remote from the active amides.

Results so obtained are with ovalbumin quite unequivocal. The residue obtained on evaporation is either completely resoluble or the protein is manifestly denatured. When washed free from the denaturant the denatured protein yields a nitroprusside reaction in all cases, while none is given by the solution when the protein residue remains soluble.

Most of the above denaturants are but slightly dissociated in solution, and in other cases adjustment of the pH to near neutrality has no effect on their behaviour. It is clear that denaturation on these lines does not depend primarily upon the influence of hydrogen or hydroxyl ions.

To some degree at least, relations between constitution and denaturating power would seem to hold. An amide structure is apparently necessary, but in certain relations its activity is lost. Among the ureas, mono-alkyl substitution, or unsymmetrical di-alkyl substitution, leaves the activity qualitatively intact. Symmetrical di-alkyl ureas, on the other hand, are inactive ; one amino group must apparently remain unsubstituted. To judge from the case of acetyl urea, however, mono-acyl substitution removes the activity. In biuret, allantoin, and semicarbazide activity is also lost. Acid amides (acetamide and formamide) are active, but all amino acids tried were without effect, and likewise asparagin. Noteworthy is the activity of urethane. Bases of the type of creatin or caffeine are inactive.

More detailed aspects of the events involved in denaturation on these lines are to be observed in solution. If a solution of the pure protein is fully saturated with urea (1 gm. per c.c.) at room temperature, it will be found to give a well-marked nitroprusside reaction immediately. Even before the solution has recovered from the depression of temperature due to the solution of the urea the colour reaction is marked. By the time that room temperature is reached it becomes, in the case of moderately high concentrations of protein (4-5 per cent) intense. It can be observed to increase during the following half-hour or so.* The establishment of a reactive thiol group in the protein molecule is thus a rapid process, and quantitative evidence of the simultaneous occurrence of a colloidal change will be given later.

If the urea-protein solution is exposed to the air, the thiol group is slowly oxidised. It is restored, however, by reducing agents and the colour reaction immediately reappears if the solution be first treated with cyanides (see later). Its behaviour in the denatured protein is the same, therefore, as in cysteine, glutathione, etc.

Since urea exerts not only a denaturating action, but also a dispersive action upon the denaturated protein, the behaviour of an albumin solution, when urea is added to it, will vary in detail not only with the absolute but also with the relative concentrations of the two constituents. The data in the following table will be sufficient to illustrate the observed effects as modified by concentration variations. The strongest protein solution had a pH of 4·9, which shifted to 5·8 on saturation with urea. The small variations at other concentrations were insufficient to affect the results.†

It will be seen that though denaturation itself is more rapid with the higher concentrations of urea (see below), the dispersive action may prevent or delay the separation of a precipitate or gel which occurs at lower concentrations. Whether gel or precipitate shall result seems to depend essentially on the rate of separation. It may be said that an identical experiment was simultaneously carried out at 37° C. with little difference in the results save that the gel formation was somewhat faster. Needless to say, any considerable modifications in the concentrations will affect the time relations as given in the above table.

Concentration of Original Protein Solutions (per cent).	Amount of Urea added. (per cent Saturation).	Condition after standing for the intervals given. Temp. 22° C.					
		Immediately.	½ Hour.	1 Hour.	2 Hours.	5 Hours	20 Hours.
7	100	No visible change	→	Increasing	Viscosity	→	Fragile gel.*
	60	Ditto	Viscous	Gel	Firm gel	..	..
	30	Heavy cloud	Precipitate	..	Heavy ppt.	..	Protein 50 per cent pptd.
	15	No visible change	..	..	..	Cloud	Heavy ppt.
5	100	No visible change	..	..	..	Viscous	Marked viscosity
	60	Ditto	..	..	..	..	Slightly viscous.*
	30	Precipitate	→	Increasing	precipitation	→	70 per cent of protein pptd.
2	100	No visible change	..	..	..	..	Viscous.
	60	Ditto	..	..	..	..	..
	30	Ditto	..	..	Cloud	..	Definite precipitate.

* On longer standing firm gels.

Rapid gel formation can be observed in the case of still stronger albumin solutions and an easy demonstration of the potency of urea as a denaturant is so obtained. If 5 c.c. of undiluted egg-white, which has been first whipped to destroy the membranes and squeezed through muslin, be placed in a test tube and 5 gm. or a little less of urea, finely powdered to facilitate solution in the viscous material, be added, the mixture will begin to gelatinise almost as soon as the urea has dissolved. In fifteen minutes or less at room temperature a firm gel is obtained of which a

* To observe the full colour, relatively high concentrations of the nitroprusside should be used. Twenty to thirty milligrams of the solid, for example, dissolved in 5 c.c. of the solution. It is then made alkaline with ammonia.

† Throughout this notice the concentrations of urea, because they are generally so high, are for convenience reported not in terms of molarity but as percentages of complete saturation at 17° C. (1 gm. per c.c.). The results can thus be reproduced without reference to volume changes consequent upon adding varying amounts of urea to the protein solutions. The concentrations of albumin referred to are those of the original solution ; those actually present in the urea-protein mixtures vary therefore with the amount of urea added. It will be found that all essential conclusions are unaffected by this circumstance ; the observations upon which they are based being comparative. The actual concentration of protein in a solution saturated with urea is given approximately by multiplying that of the original solution by 0·55, and in a solution 60 per cent saturated by 0·70.

portion, if soaked in a solution of sodium nitroprusside, will develop on its surface a strong purple colour.

The gels, which result from the denaturation of the pure albumin, display many characters of interest. Though containing so high a concentration of urea, they are optically completely homogeneous and transparent, resembling in appearance pure silica gels. When treated with successive quantities of water until the urea has wholly diffused out of their structure they become slightly opaque, but they display great resistance to sol formation. When they are heated with excess of water the amount of protein found in the sol phase is, no matter what the temperature, negligibly small. Remarkable is the behaviour of an original gel, still containing the urea, when alternately cooled and warmed. If the flask or test-tube containing such a gel be placed on ice, its mass becomes pervaded with silky crystals of urea. If it now be allowed to return to room temperature or even if it be rapidly warmed to higher temperatures, it completely regains its homogeneous transparent appearance, and in the case of a well-formed gel without displaying at any moment the least sign of increased fluidity. The vessel containing it can be placed in a boiling water bath without producing any effect upon its visible characters. Gels formed originally within certain ranges of protein or urea concentration may require to be cooled to a degree or two below 0° C. before the urea separates as described and should be placed for a few moments in an ice-salt freezing mixture.

With regard to the effect of such internal crystal formation upon the ultimate structure of gels, Moran and Hardy have studied what is clearly a somewhat different case, namely, the formation and disappearance of ice crystals in aqueous gelatin gels when respectively frozen and thawed. These authors discuss the effect of the crystal formation upon the ultimate gel structure. Hardy found, though only in the case of gels much more concentrated than those dealt with here (20 per cent gelatin and upwards), that the capacity of the gel for re-adsorbing water is so great that after thawing, the spaces occupied by the ice crystals vanish "almost entirely" though the collapsed walls of such spaces do not join together. With lower concentrations of gelatin the final result is an open sponge. Hardy also found that the gel, while originally singly refractive, became doubly refractive after freezing and thawing. Evidence for such effects upon the gel structure has proved difficult to obtain in the case of the urea-protein gels by ordinary microscopic study, with or without polarised light. Doubtless a more highly developed technique may be necessary for the purpose. No ice crystals are associated with the urea crystals: separation of the latter within the gel will commonly occur at temperatures somewhat above 0° C. A study of these urea-protein systems may, I think, prove important with respect to gel structure.

When in any circumstances the denatured protein separates not as a gel but as a precipitate, it is found to be insoluble in hydrochloric acid of any strength, and is only very slowly dispersed in alkalis. On the other hand, in a saturated solution of urea it is dispersed to a clear sol.

If an albumin solution, after admixture with urea in effective quantities, be diluted or dialysed at any stage before a precipitate or gel has formed spontaneously, the denatured product is precipitated. A precipitate is obtained almost immediately after the urea has been added, but the amount becomes, of course, greater with the progress of denaturation. Precipitation does not occur, however, if the pH of the mixed solution is appreciably greater than 6·0. When thoroughly dialysed solutions of the crystallised albumin are employed as in most of the experiments under discussion, one effect of adding pure urea in the amounts employed is to shift the pH from 4·8 to ± 5·8.‡ In these circumstances the precipitation of the denaturated albumin on ten-fold dilution of the solution or on dialysis is nearly complete. If, however, before or after the addition of urea the pH is brought to 6·5 or higher by the addition of minute quantities of alkali, no precipitation occurs. If, on the other hand, such a solution be dialysed until all urea is removed (the pH being thereby somewhat reduced) the denatured protein present is found to be in typical suspensoid or lyophobe solution. The urea-free solution is precipitated by salts in minute concentration and the negatively charged particles obey the rule of Hardy. Needless to say, the charge may be reversed by shifting the pH to the acid side of the isoelectric point. It may be mentioned that when weak solutions of albumin containing high concentrations of urea are allowed to stand for three or four days some form of stabilisation may be observed. Clear suspensoid solutions may then be obtained on dialysis when the pH of the original mixture was less than 6·0. The particles then carry a positive charge.

‡ Such a change in pH seems in the circumstances to be unduly great. All estimations were made with the quinhydrone electrode. My colleague, Dr. M. Dixon, has since suggested to me that a chemical action of urea upon the quinhydrone might lead to error. With the hydrogen electrode, however, a shift of the same order is observed. The values obtained with the quinhydrone are perhaps 0·2 of a pH unit too high.

[1] L. J. Harris, *Proc. Roy. Soc.*, B **94**, 425, 1923; F. G. Hopkins, *Bioch. Jour.*, **19**, 807, 1925.

[2] *Zeit. f. Physiol. Chem.*, **30**, 182.

[3] *Jour. Gen. Physiol.*, **13**, 123; 1929.

[4] *Jour. Biol. Chem.*, **87**, 197; 1930.

(*To be continued.*)

Norwegian Contributions to the Geology of Spitsbergen.*

DURING every year between 1906 and 1926, Norwegian State-aided expeditions have been at work in western and central Spitsbergen. Of nineteen out of the twenty-one expeditions the geologist, Adolf Hoel, was the leader or joint-leader, and he has prepared, as the first of the long series of *Skrifter* on Spitsbergen or Svalbard, an account of the whole series with summaries of the routes and the work undertaken, maps showing the journeys and the areas surveyed, and appendices on the topographic and hydrographic work.

This memoir will be a great aid to those using the special reports, of which six new contributions are issued along with it. They make an important addition to the geology of Spitsbergen. Hans Trebold has written two memoirs on the Mesozoic rocks, and shows that the Jurassic is represented by the Upper Lias and all the stages from the Lower Callovian to the Upper Volga Beds, which are equivalent to the Purbeck and Lower Wealden of England and the Tithonian of Central Europe. The sequence is then continued through the Lower Cretaceous up to the Aptian. This long succession is nearly all marine, though there are two local developments of estuarine or fluviatile beds with land plants. The author carefully discusses the geographical relations of these beds and the nature of their faunas. He discusses the

* Det Kongelige Departement for Handel, Sjøfart Industri, Handverk og Fiskeri. Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard, og Ishavet. Nr. 1, 19-24. (Oslo: Jacob Dybwad.) 10, 3, 2.50, 4, 15, 3, and 3.50 Kr.

two explanations that have been advanced, that of Neumayr, who considered the special features due to climatic influences, and that of Pompeckj and Salfeld, who explained them as the result of life in an isolated sea with unusual physical peculiarities. The author considers that the fauna was mainly controlled by growth in a special sea in which there was great continuity of evolution. He says that the isolation which he accepts is quite different from that contemplated by Pompeckj and Salfeld.

That complete separation from the other seas would affect its inhabitants is undoubted; but in view of the parallel development of the faunas in the Spitsbergen sea with those that lived farther south, some frequent connexions appear to have taken place. The peculiar features of the Spitsbergen fauna, when compared with those of England, the Mediterranean and the Himalaya, appear to indicate the influence of a colder climate than that enjoyed by the Jurassic areas farther south.

Hans Trebold has also written *Memoir*, No. 21, a description of the Valanginian Ammonites of Spitsbergen, a fauna which is similar to that of the Petchora basin in north-eastern Russia and has some of the species found in the Specton Clay of Yorkshire.

The most remarkable addition to palæontology in this series of memoirs is the rich fauna of fossil Acanthaspid fish described by Anatol Heintz from the Downtonian. He includes that formation in the Lower Devonian, but it has been usually regarded as uppermost Silurian. The fauna described in the first *Memoir*, No. 22, is from Ice Fiord, and it includes three new families and seven new genera. The type of the new genus, *Jækelaspis*, is a species described by Ray Lankester as a *Cephalaspis* and by Sir Arthur Smith Woodward as an *Acanthaspis*. The affinities of these fish have been uncertain. Lankester and Sir Arthur Smith Woodward regarded them as belonging to the primitive class of Agnatha; but Traquair referred them to the fish as Dipnoi and members of the Arthrodira. That view is adopted by Herr Heintz. The second *Memoir*, No. 23, describes some additional new species of Acanthaspids, including a remarkable new form, *Huginaspis broggeri*, from the Downtonian of Wijde Fiord in north-western Spitsbergen. These two memoirs form a material addition to knowledge of this group.

The other Palæozoic fossil described in this new series is a simple coral, *Caninia* (*C. callophylloides*, Holtedahl sp.), from the Carboniferous of Ice Fiord. The coral is described in detail by F. Heritsch, and he clearly states the relations of the genus to *Zaphrentis*. The largest radius in the biggest specimen is 27 mm. There is nothing in this coral to call for any special climatic conditions in the Arctic Sea at the time of its existence.

Experiments in the Sea on Antifouling Paints.

PROF. J. H. ORTON (*Jour. Mar. Biol. Assoc.*, N.S., vol. 16, No. 2, 1930) describes the results of a series of experiments, extending over a period of three and a half years, to test the power of a number of paints and other substances (fifteen in all) to inhibit the growth of marine organisms, their preservation value, and their durability in sea water. The experimental material included proprietary antifouling and anticorrosive paints and was tested in seven different habitats in three different localities on wood and on shells. Observations were also made on the growths on ships' bottoms, piers, buoys, and rafts.

It was found that the fundamental factors determining the capacity of a paint to prevent growths include (*a*) capacity to adhere to a surface, which in practice may be slightly damp; (*b*) capacity to resist erosion; and (*c*) the possession of a toxicity depending upon slow but efficient ionisation of toxic substances. It is proved by critical chemical analyses that gradual loss of toxicity of the more efficient poisonous paints was accompanied by gradual diminution of the toxic elements, arsenic, copper, and zinc, in the paints. Antifouling paints exposed to strong light permit the growths much sooner than in subdued light, but, in the former case, the growth is marine algæ. It is not clear whether this phenomenon is due to the loss of toxicity in the paint due to the direct action of light, or to a greater resistance of the spores of marine algæ to toxic agents.

The preserving value of antifouling substances was also investigated, and it is shown that, for wood at least, coal-tar and black varnish have superior preservative properties to red oxide of iron, the commonest and most widely used anticorrosive paint for the bottoms of iron ships. Coal-tar and black varnish will preserve wood against *Chelura* and *Limnoria*, but not against *Teredo*, to an extent at least equal to that ensured by red oxide, but, on the other hand, they give innocuous surfaces on which marine growths establish themselves more readily than on untreated wood.

The composition of an ideal antifouling paint is discussed and the conclusion reached that if the bottoms of ships are to be maintained free from growths for a period stated in years, some other method must necessarily be used than the application of paints, owing to the comparatively rapid disintegration of the matrix of the paint due to the action of bacteria.

Ceylon Pearl Fisheries.

A MOST interesting memoir entitled "The Pearl Fishery of 1925" by Dr. Joseph Pearson, assisted by Mr. A. H. Malpas and Mr. J. C. Korkham, is given in the *Ceylon Journal of Science* (Section C, Fisheries, Bulletin of the Ceylon Fisheries, vol. 3, December 1929). It includes a review of the scientific investigations since 1902 and is directly concerned with the industrial problems and those of economic importance.

The outstanding features of the Ceylon pearl fisheries are their irregularity and uncertainty. After the fishery of 1891, there was a barren interval of eleven years followed by five splendid fisheries in 1903–7, and after 1907 there was an interval of seventeen bad years before the fishery of 1925; making only six fisheries since 1891—a period of thirty-four years.

The establishment of a Department of Fisheries, with the appointment of a marine biologist, provision of a modern steam trawler, and the regular inspection of the pearl banks, have made possible a survey of the littoral waters of Ceylon, and much is now known of the biology of the coastal waters in general and of the pearl-banks in particular. The investigations carried on since the War have been restricted to the inspections, supplemented by trawling and dredging operations and to periodic hydrographical cruises in the Gulf of Mannar.

The situation of the pearl-banks area, with its hundreds of square miles of deep water, its lack of protection from the violence of the south-west monsoon, and a complete lack of a suitable situation in which to establish a 'nursery', makes cultural work

a matter of extreme difficulty if not impossibility. Mortality of the oysters is enormous, both young and old. At no stage in its life history is the oyster immune from attacks of predaceous fishes, especially rays, and from the effects of silting sand or other vicissitudes, including accumulating growths of *Sargassum* weed. Any system of cultivation and protection must deal with half-grown and full-grown oysters. Such a programme of oyster culture is apparently not practicable in Ceylon because local conditions are unfavourable and because the cost of such a scheme, even if feasible, would be prohibitive.

The question as to how the banks became repopulated after a term of blank years is still a matter of uncertainty. At one time it was thought that the spat from the Tuticorin banks was wafted, under favourable conditions, to the Ceylon side and vice versa, there being two breeding seasons in the year, one at the height of each monsoon, July–August and December–January, and this is probably one cause of repopulation. Other causes, however, may be important, such as repopulation from a few scattered oysters or from adjacent beds in the same local area. As to the complete disappearance of oysters after they have established themselves in large numbers, the main reason seems to lie in the geographical peculiarities of the Ceylon pearl banks. Both the Ceylon and Tuticorin banks lie on a submerged shelf limited in extent and varying from 5 fathoms to 12 fathoms in depth, which drops suddenly into one hundred fathoms. The pearl banks never lie more than five miles from the 'overfalls' to the west and the same distance from the shallows to the east. The floating larvæ are at the mercy of the elements. They might easily be carried out into deep water or shoreward into too shallow water. Then the irregular currents would cause the irregularity of the oysters, and although there are two spawning seasons and oysters are sexually mature at twelve months, there is no guarantee that a bed of oysters, once established, will produce a spat-fall on the banks.

The memoir includes chapters on the methods of pearl fishing, the history of the oysters fished in 1925, the age and growth of the oysters, and nautical notes.

University and Educational Intelligence.

ABERDEEN.—The King has been pleased, on the recommendation of the Secretary of State for Scotland, to approve the following appointments: Dr. James Ritchie, presently Keeper of the Natural History Department of the Royal Scottish Museum, Edinburgh, to be Regius professor of natural history in succession to Prof. J. Arthur Thomson, on whom a knighthood was conferred in the King's birthday honours list; Dr. David Campbell, Pollok lecturer in pharmacology and therapeutics in the University of Glasgow, to be Regius professor of materia medica in succession to Prof. C. R. Marshall.

CARDIFF. Dr. R. T. Dunbar, lecturer in physics, has been appointed to the chair of physics at the University College of South Wales and Monmouthshire, in succession to Prof. H. R. Robinson, who has been appointed professor of physics at East London College (University of London).

GLASGOW.—The King, on the recommendation of the Secretary of State for Scotland, has approved the appointment of Dr. John Walton, lecturer in botany in the University of Manchester, to be Regius professor of botany in the University of Glasgow in succession to Prof. J. M. F. Drummond, whose resignation takes effect on Sept. 30.

THE issue of the *British Medical Journal* for Aug. 23 contains an account of medical teaching in Burma and of the new medical college opened at Rangoon last October. Until the beginning of the present century, Rangoon was very backward as regards public buildings and particularly hospitals and schools, which were out-of-date. Since then, however, as the result of a government grant and the generosity of numerous private donors, a remarkably rapid improvement has taken place. Rangoon, which has a population of nearly 400,000 inhabitants, now possesses a general hospital of 650 beds, a hospital for women, and a mental hospital, all of the most modern type and equipped with up-to-date clinical and postmortem theatres. The new college of medicine building, for the equipment and design of which Lieut.-Col. T. F. Owens, the dean of medical studies, and Mr. S. P. Bush, the consulting architect, are responsible, is described as being unsurpassed by any teaching institute in Asia. It contains departments for physiology (including histology and biochemistry), anatomy, forensic medicine, operation surgery, pharmacology and materia medica, and pathology and bacteriology, with amply stocked and well arranged museums attached to the departments of pathology and forensic medicine, a library, and a large lecture theatre. Instruction in hygiene is given at the recently opened Institute of Hygiene, of which the director is the University lecturer in hygiene. Seven University medical chairs have been established—for anatomy, physiology, pathology, forensic medicine, surgery, medicine, and obstetrics respectively. All the heads of these departments are Europeans, as is also the case in the departments of arts, science, engineering, and law.

A CO-OPERATIVE large-scale study of the relations of secondary and higher education in the State of Pennsylvania is now in progress under the direction of the Carnegie Foundation for the Advancement of Teaching and the Educational Commission of the State. It represents an attack on the problem how to transform mass education into particular education, aiming at the maximum development and integration of each individual pupil's capacities for achievement and self-direction. Begun a year ago and planned to be completed in six years, the inquiry is being conducted, not by an outside staff but by the institutions (some fifty in number) themselves. An interim account of it appears in this year's annual report of the Foundation. At present attention is focused on the 'wastage' involved in the entry upon a four-years' college course in the institutions under observation of more than a thousand students annually who drop out during or at the conclusion of the first semester, and the still larger number who drop out during the remainder of their first year. To what extent is this wastage attributable to the high school's misjudgment of the fitness of its pupils for a university course, and to the college's failure to guide, inspire, and confirm its freshmen? To answer this question, procedures have been devised for placing at the disposal of the high school sufficient data covering a considerable period of school life for truly estimating the pupil's equipment of genuinely assimilated knowledge and state of mind before recommending entry into college, and for enabling the college to discharge its "first duty with the new student": "to assure itself of an intelligent, sincere, and feasible purpose within him and to make certain that he is so situated that this purpose can be fulfilled".

Historic Natural Events.

Aug. 31, 1886. Charleston Earthquake.—This visited a district in which earthquakes were previously almost unknown. Though not destructive in the ordinary sense, its disturbed area (of 2¾ million square miles) has seldom been exceeded. The earthquake originated in two foci about 13 miles apart and situated at depths of about 12 and 8 miles. The velocity of the earth-waves was 5·2 km. per sec.

Sept. 1, 1667. Hurricane at St. Kitts.—M. Laurent, the Governor of St. Kitts (then French), wrote in a letter: "There has blown here the most violent hurricane ever known, and I hold myself obliged to inform you that this island is in the most deplorable state that can be imagined and that the inhabitants could not have suffered a greater loss, or been more unfortunate, except they had been taken by the English."

Sept. 1, 1859. Solar Disturbance and Magnetic Storms.—During the period Aug. 28–Sept. 7, magnetic disturbances, accompanied by remarkable auroral displays, took place throughout the world. There were two major storms, the first commencing on Aug. 28 and the second on Sept. 2; it was found that each began suddenly, at (or nearly so) the same absolute time throughout the globe, and each corresponded in time with a great auroral display. Superimposed upon the disturbed conditions between these major storms, there was a moderate but marked disturbance with a sudden commencement at $11^h\ 20^m$ G.M.T. on Sept. 1. At the same time, two solar observers, Carrington and Hodgson, observed independently a brilliant patch of light that lasted about 5 min. ($11^h\ 18^m$–$11^h\ 23^m$) and moved some 35,000 miles across an unusually large and complex sunspot then nearly in line with the earth. The coincidence between the occurrence of this solar outburst (unique in observations made with direct telescopic means without the discerning power of the spectroscope applied more recently) and the minor magnetic storm was thought, at that time, to be significant. (A time interval of about 24 hours between some form of solar disturbance and the commencement of an associated terrestrial magnetic storm is now recognised.)

Sept. 1-3, 1883. Great Storm.—This storm was traced from the tropical Atlantic, where it appeared as a violent hurricane on Aug. 25, along the coast of North America and across the Atlantic to the British Isles. In mid-Atlantic the barometer fell below 957 mb. (28·25 in.). The storm reached England on the afternoon of Sept. 1, and the centre crossed England in a north-easterly direction from Pembroke to Berwick. There was a violent gale over western and southern England, as well as France and Germany, accompanied by very heavy rain. In the Thames one of the lowest tides on record occurred on Sept. 2.

Sept. 1, 1923. Disastrous Earthquake in Japan.—The Kwanto earthquake of 1923, though not the strongest, was the most destructive of all Japanese earthquakes, owing to the great fires that followed the shock. The burned-out districts in Tokyo and Yokohama covered about 6·9 and 3·1 square miles, or nearly half the area of each city; 99,331 persons were killed, 103,733 wounded, and 43,476 missing, while the number of houses completely ruined exceeded half a million, and the value of property destroyed was about 550 million pounds. The epicentre lay in Sagami Bay, to the north of the island of Oshima. The earthquake was accompanied or followed by remarkable distortions of the crust. Though the greatest known elevation on land was 7 ft. 8 in. and the greatest subsidence 5 ft. 4 in., the changes in the bed of Sagami Bay were on a scale hitherto unknown. The total areas elevated and depressed were 90 and 270 square miles, and the total volumes 5 and 12 cubic miles, the greatest uplift being 755 ft. and the greatest subsidence 1312 ft. The earthquake seems to have been caused by block movements of the crust, especially along the continuation of the rift-valley of the Sakawa River.

Sept. 1-3, 1923. Cumulus Clouds over Tokyo.—Following the destructive earthquake in Tokyo on Sept. 1, great fires broke out and continued for about 40 hours. Yokohama and other towns were also burnt. The heat of the fires caused rapid ascent of air and a strong indraught, the wind velocity reaching gale force. Gigantic cumulus clouds developed above the fires in consequence of this uprush of air, the tops of the clouds being five miles above the ground. Whirlwinds were formed over the fiercest fires, and it was observed that when these fires decayed the whirls moved on to other fires.

Sept. 2-3, 1588. Armada Gales.—It has frequently been stated that the defeat of the Spanish Armada in 1588 was largely due to storms. Careful historical investigation has shown, however, that the weather was not especially bad until the remnant of the fleet was in the open Atlantic west of Scotland and Ireland, when a severe gale occurred on Sept. 2-3, which drove some of the ships on to the coast of Ireland. Bad weather was also reported by the English fleet in the Downs.

Sept. 2, 1666. Drought before Great Fire of London.—On this date Pepys recorded: "The wind mighty high and driving it [the fire] into the City; and everything, after so long a drought, proving combustible . . . the wind carries it into the city. [The fire] still increasing, and the wind great, it being brave dry, and moonshine, and warm weather." The general wind direction during the fire was easterly, for an entry on Feb. 3, 1667, records that pieces of burnt paper were carried by the wind so far as Cranborne, near Windsor. The drought continued until Sept. 9.

Sept. 3, 1919. Detonating Meteor.—At 10.25 P.M. a meteor appeared over north-west Germany at a height which was afterwards calculated as 76 miles. It traversed a path of 194 miles from south-south-east to north-north-west in less than six seconds, and disappeared at a height of about 17 miles over Schleswig-Holstein. Its brightness was such that it was visible at a distance of more than 300 miles. Nearer the path its apparent diameter was given as up to twice that of the full moon and it made the night as light as day. From the reports received, the diameter of the glowing sphere was calculated by A. Köppen as about 270 metres (890 feet).

Sept. 3, 1925. *Shenandoah* Squall.—The United States airship *Shenandoah*, while flying over south-eastern Ohio, was struck by a violent squall with powerful vertical air-currents. The airship broke in two, and out of 43 officers and men 14, including the commander, were killed.

Sept. 6, 1926. Detonating Meteor.—About 9.50 P.M. a brilliant meteor travelled from the North Sea near Bridlington over Sheffield at a speed of 19 miles a second. It gave a brilliant greenish light, and was followed by a reddish trail, and the illumination was seen over almost the whole of the British Isles, as well as in Belgium and France. Just beyond Sheffield it burst with a rumbling like thunder or heavy explosions, which at Sheffield lasted for 43 seconds. An interesting feature was that while the explosion was distinctly heard at distances of 70-140 miles, and at one place 100 miles distant houses were shaken, at intervening places no noise was heard, thus providing a good example of an outer zone of audibility.

Societies and Academies.

PARIS.

Academy of Sciences. July 7.—The president announced the death of Georges Neumann, *correspondant* for the Section of Rural Economy.—**H. Deslandres**: The properties of the lines and abnormal series in atomic spectra.—**Charles Richet**: A paradox on (visual) accommodation. Looking down an avenue, after fixing the eyes on the nearest trees, there is an obvious effort of accommodation when bringing a more distant tree into focus. In a picture showing the same view in perspective, there is still a distinct effort of accommodation in changing from the nearer to the more distant trees. This is a paradox, since all the objects are in the same plane.—**Louis Roy**: The dynamical adiabatic law relating to elastic surfaces.—**N. St. Georgesco**: A problem of the calculus of probabilities with application to the search for unknown periods of a cyclic phenomenon.—**Henri Poncin**: The flow in a canal.—**J. Baurand**: The formation of waves at the surfaces of liquids.—**G. W. Ritchey**: First results in celestial photography obtained with the Ritchey-Chrétien telescope.—**Alex. Véronnet**: The trans-Neptunian planet. The determination of an orbit by three observations.—**Al. Proca**: Dirac's equation. The sixteen ψ_k components.—**E. Sevin**: The origins of a synthesis of the laws of the physical world.—**E. Kogbetliantz**: The velocity of propagation of gravitation.—**André Marcelin** and **Mlle. Simone Boudin**: Coloured stratifications by sublimation. **Mlle. Suzanne Husson**: The mechanical action exerted in a conductor by electromagnetic waves. An expression for the force due to the electromagnetic radiation on a single element oscillating in resonance has been calculated, and an apparatus has been designed and constructed capable of detecting this force.—**S. Holgersson** and **Mlle. A. Serres**: The properties and crystalline network of the ferrites. The magnetic properties of zinc ferrite differ entirely from those of the ferrites of magnesium, lead, copper and nickel. Since X-ray study proves that all these compounds have the same crystalline structure, one possible explanation of this anomaly fails. It is concluded that the magnetic properties of Fe‴ depend on the nature of the other atoms placed at the nodes of the network near those which are occupied by Fe‴.—**G. Bruhat** and **J. Terrien**: The ultra-violet absorption of solutions of tartaric acid: the influence of concentration. The absorption of tartaric acid solutions for concentrations between 0·16 and 3·3 gm.-mols per litre obeys Beer's law exactly. This confirms the conclusion drawn from the study of the rotatory dispersion, that there is nothing pointing to the existence of two forms of the tartaric acid molecule possessing different absorptions.—**Marcel Dufour**: The orthogonal trajectories of the generators of a ruled surface.—**Ch. Guilbert** and **Livet**: An improved method for taking stereoradiographs.—**Chapas**: The form of the solubility curve of benzoic acid in toluene. Taking as co-ordinates the reciprocal of the absolute temperature and the logarithm of the concentration, the curve found by experiment is a straight line which passes through the melting point of benzoic acid, (t = 121·9, c = 100 per cent).—**O. Liévin** and **J. Declerck**: The kinetics of alkaline solutions of iodine. The case of alkaline borates.—**Léon Thiéry**: The influence of nickel and chromium on the properties of malleable cast iron. Nickel can replace silicon from the point of view of the graphitisation effect: it allows the temperature of graphite formation to be lowered and gives a finer grained and better disseminated graphite. Chromium has the opposite effect; it hinders graphitisation, increases the hardness, and reduces elongation and resilience.—**Claude Fromageot**: The action of ultra-violet light on dimethylpyruvic acid. Dimethylpyruvic acid, in neutral or alkaline aqueous solution, under the influence of ultra-violet light, forms a compound capable of setting free iodine from potassium iodide. This property is connected with an ethylene linkage.—**Mlle. J. Foret**: Calcium nitroaluminate. A description and the preparation and properties of the double salt $3CaO . Al_2O_3 . Ca(NO_3)_2 . 16 H_2O$.—**Pierre Poulenc**: Complex compounds of rhodium bromide and pyridine.—**Charles Boulanger**: The reduction of metallic salts in solution by aluminium.—**P. Delauney**: The biochemical synthesis of β . 5-iodosalicylglucoside.—**Pereira de Sousa**: The eruptive rocks of the western part of Algarve, Portugal.—**Jean Lugeon**: The radioelectric determination of the position of sand storms in the Sahara from a great distance.—**R. Bureau**: The study of the propagation of electric waves with the aid of atmospherics.—**A. Gruvel**: Some submarine springs observed on the Libano-Syrian coasts.—**René Girard** and **Robert Lemesle**: Polystely in *Ramondia pyrenaica*.—**Antonin Némec, Joseph Lanik**, and **Mme. Anna Koppovà**: A colorimetric method for rapidly determining the citric acid soluble phosphoric acid of the soil.—**D. Bennati, J. Gautrelet**, and **E. Herzfeld**: Adrenaline, the alkaline reserve and apnœa.—**Georges Bourguignon** and **Mlle. Marie Louise Verrier**: The mechanism of (visual) accommodation in the Teleosteans.—**Paul Mathias**: The evolutive cycle of a trematod of the family of the Notocotylidæ (*Notocotylus attenuatus*).—**Marcel Avel**: The rôle of the nervous system in the regeneration of the head in *Lumbricus*.—**M. Lemoigne** and **P. Monguillon**: The presence of acetylmethylcarbinol and of 2·3 butylene glycol in the blood of the higher animals.—**G. Guittonneau, H. Delaval**, and **Mlle. M. Bejambes**: A lactic fermentation of certain sugars at a temperature of 70° C.

Diary of Societies.

CONGRESSES.

SEPTEMBER 1 TO 6.

INTERNATIONAL AIR CONGRESS (at the Hague).—Sections: Aerial Traffic, Science and Technics, Legal Questions, Medical Questions, and Aerial Tourism.

SEPTEMBER 3 TO 10.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Bristol).

Wednesday, Sept. 3, at 8.30 P.M. (in Colston Hall).—Prof. F. O. Bower: Size and Form in Plants (Presidential Address).

Thursday, Sept. 4, at 10 A.M.—(A) Discussion on The Meteorological Relations of Atmospherics.
(A) E. H. Linfoot: A Problem in the Analytic Theory of Numbers.
(B) Prof. G. T. Morgan: A State Experiment in Chemical Research (Presidential Address).
(C) Prof. S. H. Reynolds, J. W. Tutcher, and Prof. L. S. Palmer: The Geology of the Bristol Area.
(D) Dr. W. T. Calman: The Taxonomic Outlook in Zoology (Presidential Address).
(E) W. W. Jervis: General Introductory Survey of the Bristol Region
(F) G. Ponsonby: The Incidence of the Cost of Road Maintenance and Construction.
(G) T. F. Hurley and R. Cook: The Influence of Turbulence upon Highest Useful Compression Ratio in Petrol Engines.
(H) Dr. H. S. Harrison: Evolution in Material Culture (Presidential Address).
(I) Prof. H. S. Raper: The Synthetic Activities of the Cell (Presidential Address).
(J) Discussion on The Psychology of Adolescence.
(K) Dr. A. W. Hill: Recent Developments and Present-day Problems in Taxonomic and Economic Botany (Presidential Address).
(L) Miss Margaret Drummond, Dr. J. A. Hadfield, and Dr. W. E. Blatz: The Pre-School Child.
(M) Discussion on The Influence of Fertilisers on the Yield and Composition of Plants.
At 10.15 A.M.—(K) D. W. Young: Cultivation of Hardwoods.
At 10.20 A.M.—(A) Dr. L. S. Bosanquet: The Summability of Fourier Series.

At 10.40 A.M.—(G) C. F. Abell: Some Recent Progress in Air-cooled Aero-Engine Development.
(A) Prof. E. C. Titchmarsh: Functions which are their own Fourier Transforms.
At 10.45 A.M.—(E) Mrs. D. Portway Dobson: The Bristol District in the Prehistoric Period.
At 11 A.M.—(D) Miss S. M. Manton: *Anaspides* and *Paranaspides*.
(F) Discussion on The Value and Limitation of Costing in Industry and Agriculture.
(K) A. Howard: Our British-Grown Hardwood Trees and Timbers.
At 11.10 A.M.—(K) Dr. W. B. Turrill and E. M. Marsden-Jones: Species Studies in Plants.
At 11.15 A.M.—(C) E. H. Davison: The Granite of Western Cornwall, its Alteration and Contact Metamorphism.
(H) Discussion on A Proposed National Folk Museum.
At 11.20 A.M.—(G) Dr. S. J. Davies and E. Giffen: The Present Position of the High-Speed Heavy-Oil Engine.
At 11.30 A.M.—(A) Prof. M. Siegbahn: The Highly Ionised Spectra in the Extreme Ultra-Violet.
(A) T. W. Chaundy: A Note on the Hypergeometric Equation.
(D) Prof. H. G. Cannon: (*a*) On the Internal Anatomy of a Marine Ostracod, *Cypridina* (*Doloria*) *levis Skogsberg*. (*b*) An Undamaged Specimen of *Nebaliopsis typica* G.O. Sars.
(E) S. J. Jones: The Historical Geography of Bristol.
(I) Prof. A. F. S. Kent: Some Unpublished Work on the Heart.
At 11.40 A.M.—(C) Dr. G. Slater: The Glaciated Rock-surfaces of Nooitgedacht, and the Upper Dwyka Boulder-shales of Griqualand West.
At 11.45 A.M.—(K) W. H. Guillebaud: Experimental Studies on the Artificial Regeneration of Oak.
At 11.50 A.M.—(A) Dr. D. M. Wrinch: Recurrence Relations and some Definite Integrals involving Legendre Polynomials.
(B) Prof. F. E. Francis, Dr. T. Malkin, and S. H. Piper: Natural Fatty Acids.
(K) Prof. F. A. F. C. Went: Wegener's Theory and the Distribution of the Podostemaceæ.
At 12 noon.—(A) W. Sucksmith: The Gyromagnetic Effect in Paramagnetic Substances.
(K) Prof. R. S. Adamson: Annual Rings in a Monocotyledon.
(L) Rt. Hon. Lord Eustace Percy: A Policy of Higher Education (Presidential Address).
At 12.10.—(A) Miss R. C. Young: The Algebra of Infinities.
(B) Dr. M. Nierenstein: Pyryllium Series.
(C) Prof. J. W. Gregory: The Recent Cable Fractures in the Western Atlantic.
At 12.15.—(D) Prof. F. A. E. Crew: The Effects of Density on a Mouse Population.
(I) Dr. F. W. Edridge-Green: Pseudo-Isochromatism and the Detection of Colour-Blindness.
At 12.30.—(A) Prof. W. E. H. Berwick: The Complex Multiplication of Elliptic Functions.
(B) Dr. H. T. S. Britton, Dr. R. A. Robinson, and W. L. German: Complex Acids of the Rarer Elements.
(C) S. H. Straw: On the Fauna of the Palæozoic Rocks of the Little Missenden Boring.
At 2.—Conference of Delegates of Corresponding Societies.
Prof. P. Abercrombie: National Parks (Presidential Address).
(I) R. J. Bartlett: Some Effects of Low Frequency Vibration on Body and Mind.
At 2.15.—(D) The Work of the Great Barrier Reef Expedition:—A. P. Orr: Conditions in the Sea-water bathing Coral Reefs.
At 2.30.—(H) Mrs. D. P. Dobson: General Survey of pre-Roman Sites in the Bristol District.
Prof. D. H. Campbell: The Preservation of the Red Wood Forests in the Western States.
(K) J. Macdonald: The Measurement of Standing Trees.
(M) T. Wallace: Soil Surveys.
At 2.40.—(J) E. Farmer: A Consideration of the Frequency Distribution of Certain Tests.
At 2.45.—(D) F. S. Russell and Miss S. M. Marshall: The Plankton of the Seas round the Great Barrier Reef.
At 2.50.—(M) T. Swarbrick: Stock and Scion Relationship.
At 3.—Miss G. V. Barnard, Dr. Cyril Fox, and Dr. M. Wheeler: Folk Museums and Local Societies.
At 3.10.—(M) F. Tutin: Investigations on Tar Distillate Washes.
At 3.15.—(D) Dr. C. M. Yonge: The Food, Feeding, and Digestive Processes of Corals.
At 3.20.—(J) H. E. O. James: Interference.
At 3.30.—(H) Dr. R. E. M. Wheeler: A Prehistoric, Roman, and Post-Roman Site in Gloucestershire; the Excavations at Lydney.
(K) Dr. R. N. Chrystal and E. R. Skinner: (*a*) Notes on the Biology of *Xylonomus brachylabris*. (*b*) Notes on the Biology of *Xyphidria prolongata* . . .
(M) A. W. Ling: Sugar Beet Investigations.
At 3.45.—Sir Leonard Hill: The Registration of Ultra-Violet Light in Towns and Country.
(D) Dr. T. A. Stephenson: The Growth, Breeding, and Life Conditions of Corals.
At 3.50.—(M) C. V. Dawe: The Work in Agricultural Economics at Bristol University.
At 4.—(H) R. W. M. Wright: Celtic and Saxon Bath.
(J) Mr. Sahai: Outstanding Features of the Circular Type of Character.
At 4.10.—(M) F. Hirst: Problems in connexion with the Establishment of the Canning Industry.
At 4.30.—(H) Mrs. E. Clifford: Report on the Barnwood Discoveries.
At 5.15 (at Merchant Venturers' Technical College).—Sir Daniel Hall: Apples: the Bearing of Research on Improved Production (Public Lecture).

Friday, Sept. 5, at 10 A.M.—(A) Papers dealing with Aspects of the Solid State by Prof. J. E. Lennard-Jones, Prof. W. L. Bragg, and Dr. E. Bloch.
(B) Discussion on The Present Position of the British Dyestuff Industry.
(C) Discussion on The Validity of the Permian as a System.
(D) Dr. D. de Lange: The Phylogeny of the Placenta.
(E) Prof. P. M. Roxby: The Scope and Aims of Human Geography (Presidential Address).
(F) Sir John Mann: Some Neglected Aspects of the Housing Problem. Sir Josiah Stamp: The Inheritance Enquiry.
(G) Sir Ernest W. Moir, Bart.: The Interdependence of Science and Engineering, with some Examples (Presidential Address).
(H) Miss D. A. E. Garrod: Excavations in the Caves of the Wady el-Mughara.
(J) Mrs. S. Isaacs: The Relation between Thought and Fantasy in Young Children.
(K and M) Discussion on Mineral Elements in Plant Nutrition.
(L) The Curricula of Central Modern and Senior Schools.
At 10.30 A.M.—(D) Dr. C. Tate Regan: The Evolution of the Primates.
(I) Prof. R. R. Gates: The Blood Groups and their Inheritance.
At 10.35 A.M.—(A) Dr. R. A. Fisher: Inverse Probability.
(A) Dr. J. Henderson: The Methods of Construction of the Earliest Tables of Logarithms.
At 10.45 A.M.—(H) G. Horsfield: First Excavations at Petra.
At 11 A.M.—(E) Town Planning.
(G, I) Discussion on Air Pressure Variations encountered in Engineering Works and their Physiological Effects.
(I) Miss M. Grace Eggleton and Prof. C. Lovatt Evans: The Removal of Lactic Acid after Exercise in the Mammal.
(J) Prof. C. W. Valentine: The Foundations of Child Psychology (Presidential Address).
At 11.15 A.M.—(H) Sir Flinders Petrie and E. Macdonald: Neolithic and Palæolithic in the Beersheba Basin.
At 11.30 A.M.—(A) Dr. J. Wishart: Combinatorial Methods in Problem of Sampling.
(D) Prof. F. H. Edgeworth: On the Musculature for opening and closing the Mouth in Vertebrates.
At 12 noon.—(A) J. O. Irwin: The Approximate Evaluation of Single and Double Integrals.
(D) Miss D. M. Sladden: (*a*) The Adaptation of *Alytes* to Warmth. (*b*) The Production of Defects in the Frog.
(H) R. F. Parry: Cheddar Excavations.
(K) A. Malins Smith: The Composition of Upland Bog Water and its Relation to Algal Vegetation.
(M) Dr. J. F. Tocher: The Adulteration of Milk with Water.
At 12.30.—(A) Dr. L. J. Comrie: Modern Babbage Machines.
(D) Prof. J. Graham Kerr: John Samuel Budgett, a Bristol Naturalist.
(H) Dr. H. Taylor: Recent Work of the Spelæological Society.
At 2.15.—(D) H. W. Miles: On the Diversity of Habit of three Saw-flies (*Tenthredinæ*) infesting Gooseberry.
At 2.30.—(E) Col. E. W. Lennard: Some Intimate Bristol Connexions with the Overseas Empire.
(H) Sir Flinders Petrie: Excavations at Bethpelet, Palestine.
(M) Sir Frederick Keeble: Agricultural Problems in South Africa.
At 2.40.—(J) Miss C. A. Simmins: The Mental Processes involved in learning a Foreign Language.
At 2.45.—(D) Miss M. J. Norris: The Factors affecting Fertility in certain Moths.
At 3.—(M) Commissioner D. C. Lamb: The "Human Aspect" in relation to Agriculture.
At 3.15.—(D) Prof. J. W. Munro: The Feeding Habits of Bark Beetles.
(E) Major R. W. G. Hingston: British Guiana.
(H) H. St. George Gray: Explorations of Somerset Earthworks.
At 3.20.—(J) H. Binns: Some Experiments with Wool-textile Trade Advertisements.
At 3.30.—(M) H. W. Miles: Recent Research in the Potato Root Eelworm and its Relation to Potato Sickness.
At 3.45.—(D) J. V. Pearman: The Natural History of the *Psocoptera*.
At 4.—(H) C. W. Phillips: The Circle, Avenue, and other Earthworks on Walton Down, near Clevedon.
(J) Dr. C. S. Myers: The Place of Industrial Psychology in a University City.
At 5.15—Sir Arthur Keith: What Dr. John Beddoe did for Modern Anthropology (Public Memorial Lecture).
At 8 (in Victoria Rooms).—Prof. E. V. Appleton: Wireless Echoes (Evening Discourse).

Monday, Sept. 8, at 10 A.M.—(A) Dr. F. E. Smith: The Theories of Terrestrial Magnetism (Presidential Address).
(B) Discussion on Chemotherapy.
(C) Prof. O. T. Jones: Some Episodes in the Geological History of the Bristol Channel Region (Presidential Address).
(D) C. B. Williams: Migration among the Lepidoptera.
(F) Prof. P. S. Florence: The Theory of Women's Wages.
(G) The Trend of Airship Construction:—Lt.-Col. V. C. Richmond: The Development of Rigid Airship Construction.—B. N. Wallis: The Design and Construction of H.M.A. *R100*.—W. E. Doerr: The Airship *Graf Zeppelin*.
(H) L. S. B. Leakey: The Kikuyu.
(I, J) Discussion on In what Sense can we speak of Primary Colours?
(K) Prof. W. Goodspeed: Cytogenetic Evidence as to Species Origins and Relationships in the Genus *Nicotiana*.
(K) Capt. C. R. Robbins: Air Surveys in Relation to Forestry.
(M) Dr. P. J. du Toit: Veterinary Science and Agriculture (Presidential Address).
At 10.15 A.M.—(E) S. K. J. Baker: The Population Map of Uganda: A Geographical Interpretation.
At 10.30 A.M.—(L) Disciplinary Values in Education.
At 10.40 A.M.—(K) M. Thomas: Fermentations in the Cells of Higher Plants in the Presence of Oxygen.
At 10.45 A.M.—(D) N. N. Murti: The Physiology of the Heart of Larval Starfish and Sea-Urchins.
(H) A. L. Armstrong: The Antiquity of Man in South Africa, as demonstrated at the Victoria Falls, Rhodesia.

At 11 A.M.—(A) Dr. P. A. M. Dirac: The Proton.
(C) Prof. A. H. Cox and D. A. B. Davies: On a 100-feet Base-level in the Cardiff Area.
(E) M. Amer: The Social Geography of the Egyptian Oases.
(K) W. L. Taylor: The Afforestable Lands of Great Britain.
At 11.10 A.M.—(K) Prof. D. Thoday and N. Woodhead: The Growth and Metabolism of *Kleinia articulata*.
At 11.15 A.M.—(C) Prof. G. Delépine: The Dinantian Zones of Goniatites in the North of France and Belgium.
(D) W. E. Swinton: The Plesiosaurs of the Bristol Museum.
At 11.30 A.M.—(A) Prof. A. C. Dixon: Integral Equations.
(F) Prof. T. E. Gregory: Rationalisation and Technological Unemployment (Presidential Address).
(H) Miss M. A. Murray: Excavations in Minorca.
(I) A. D. Macdonald and J. Schlapp: Quantitative Aspects of the Action of Drugs.
(J) Dr. R. H. Thouless: (*a*) The Influence of the Physical Object on Perception, and its Bearing on the Laws of Perspective. (*b*) Dr. Houston's Substitute for Weber's Law.
At 11.40 A.M.—(K) H. Evans: Buffering and Acidity in *Kleinia articulata*.
At 11.45 A.M.—(G) Dr. A. E. Trueman: The Classification of the Upper Carboniferous.
(D) M. A. C. Hinton: Extinct Cave Fauna of the Bristol District.
(E) W. Fogg: Morocco: Some Aspects of the Sebou Basin.
At 12 noon.—(C) Dr. D. A. Wray and Dr. A. E. Trueman: The Sequence of Non-Marine Lamellibranchs in the Upper Carboniferous of Yorkshire.
(C) Dr. D. A. Wray: The Succession of Marine Bands in the Coal-Measures of Yorkshire.
(L) Miss L. E. Hawker: A Quantitative Study of the Geotropism of certain Seedlings, with Special Reference to the Nature and Development of their Statolith Apparatus.
(K) Dr. J. Burtt Davy: A Preliminary Report on a Recent Investigation of the Forest Floras of Northern Rhodesia, Nyasaland, Pemba, and Zanzibar.
At 12.10.—(A) R. Stoneley: The Identification of the Phases of Earthquake Shocks.
At 12.15.—(E) V. S. Swaminathan: The Villages and Village Life in the Tamil Country.
(H) Sir Richard A. S. Paget, Bart.: Influence of Mouth Gesture on the Development of the Alphabet.
(I) Prof. J. A. Nixon: The Factor concerned in Diabetic Coma.
At 12.30.—(C) W. S. Bisat: The Major Subdivisions of the Carboniferous of Western Europe.
(K) Dr. E. H. Moss: The Parkland of Alberta.
At 2.—(H) E. E. Evans: An Industry of the Late Bronze Age in Western Europe.
(J) G. C. Grindley: Psychological Factors in Peripheral Vision.
At 2.15.—(K) Prof. R. R. Gates: Haploid Plants.
At 2.30.—(D) Major R. W. G. Hingston: An Expedition to British Guiana.
(E) Dr. C. E. P. Brooks: Climatic Changes in Historic Times.
(H) E. G. Bowen: The Racial Geography of Europe at the Dawn of the Age of Metal.
At 2.40.—(J) C. A. Mace: The Psycho-physics of Desire.
At 2.45.—(K) Dr. J. Walton: A Hollow Fossil Tree of Lower Carboniferous Age and its Contents.
At 3.—(H) W. A. Heurtley: A Neolithic and Early Bronze Age Site in Western Macedonia.
At 3.10.—(K) Prof. B. Sahni: (*a*) A Petrified Williamsonia from the Rajmahal Hills, India. (*b*) Petrified Plant Remains from certain Cherts of Upper Cretaceous Age in the Deccan.
At 3.20.—(J) J. M. Blackburn: Analytic Tests in Relation to Rifle Shooting Efficiency.
At 3.30.—(E) Prof. A. E. Douglass: Past Changes in Climate in Relation to Settlements in the New World.
(H) L. A. Cammiade: Pluvial Periods in Palæolithic India.
At 3.40.—(K) J. Stirling: Studies of the Morphology of Heterostyly.
At 4.—(H) S. J. Jones: The Domestication of the Horse.
At 5.—(K) Dr. Macgregor Skene: Dormancy and Germination (Semi-popular Lecture).
At 5.15.—(H) Miss G. Caton-Thompson: Excavations at Zimbabwe and other Ruins in Southern Rhodesia.

Tuesday, Sept. 9, at 10 A.M.—(A) Discussion on Flow in Gases.
(A) H. S. M. Coxeter: Regular Polytopes.
(B) Prof. M. W. Travers: New Experimental Methods for the Study of Gas Reactions.
(C, E, H) Discussion on The Relation between Past Pluvial and Glacial Periods.
(D) Dr. B. P. Uvarov: Cyclic Polymorphism in Locusts and the Periodicity of Locust Invasions.
(F) D. Caradog Jones and H. A. Mess: Social Surveys of Merseyside and Tyneside.
(G) The Economical Production of Power.
(I) Miss E. M. Killick: The Adaptation of Small Animals to Carbon Monoxide.
(J) Dr. W. J. Pinard: Perseveration and the Introvert.
(K) Prof. O. V. Darbishire: Observations on the Protothallus of the Lichen *Pertusaria communis* (L.) D.C.
(K) W. R. Day: The Relation of Frost Damage to Larch Canker.
(L) English and Foreign Ideas on Method of Education in Relation to Industry and Commerce.
(M) Discussion on Grass Land Improvement.
At 10.20 A.M.—(A) P. Du Val: Some Relations between the Theory of Polytopes and Algebraic Geometry.
At 10.25 A.M.—(K) Mrs. N. L. Alcock: A Phytophthora on Strawberries causing a Root-rot.
At 10.30 A.M.—(I) Prof. R. J. C. McDowall: The Function of Carbon Dioxide.
At 10.40 A.M.—(A) W. V. D. Hodge: Topological Methods in Algebraic Geometry.
(J) Dr. H. Banister: The Psychology of the Tuberculous Patient.
At 10.45 A.M.—(D) Dr. F. B. Turck: The Cell and its Fluid in the Process of Growth and Animal Metabolism.
At 10.55 A.M.—(K) Dr. W. R. I. Cook: *Cystochytrium radicale*, a new Species of Protista occurring in the Roots of *Veronica Beccabunga*.
At 11 A.M.—(A) L. C. Young: Continuous Groups and the Foundations of Geometry.
(B) Prof. N. Semenoff: The Initiation of Combustion.
(K) Dr. M. C. Rayner: Observations on the Behaviour of *Armillaria mellea* in Pure Culture with certain Conifers.
At 11.15 A.M.—(K) Dame Helen Gwynne-Vaughan and Mrs. H. S. Williamson: A Re-investigation of the Life-history of *Pyronema confluens*.
At 11.20 A.M.—(J) Dr. P. C. P. Cloake: Conditioned Reflexes: their Interest to the Psychologist.
At 11.30 A.M.—(A) Dr. W. S. Tucker: The Screening of Southend from Gun-Fire.
(D) Dr. Nellie B. Eales: The Mandible of Fœtal Elephants.
At 11.45 A.M.—(K) Dr. B. Barnes: On Variations in Fungi induced by heating the Spores.
At 11.50 A.M.—(A) Dr. H. W. Richmond: The Canonical Curve of Genus Five.
At 12 noon.—(A) Mr. Rothwell: Meteorological Acoustics.
(B) Dr. R. C. Menzies: The Organic Chemistry of Thallium.
(D) G. L. Purser: A Reconsideration of certain Embryonic Stages.
(F) Prof. F. W. Ogilvie: Margins.
(J) Dr. A. Wohlgemuth: Psychological Analogues of the Conditioned Reflex.
(K) K. St. G. Cartwright and W. P. K. Findlay: Diagnosis of Decay in Timber.
At 12.10.—(A) Prof. P. J. Daniell: The Mathematical Theory of Flame Motion.
At 12.15.—(K) Miss H. Heslop Harrison: The Cytology of the Genus *Euphorbia*.
At 12.30.—(B) Dr. F. G. Soper: The Effect of the Solvent on Reaction Velocity.
At 2 (in Victoria Rooms).—Conference of Delegates of Corresponding Societies.
Discussion on Co-operation between Scientific Societies.
At 2.15.—(D) Miss P. M. Jenkin and E. B. Worthington: A Symposium on The Ecology of African Lakes.
At 8 (in Victoria Rooms).—Dr. R. E. Slade: The Nitrogen Industry and our Food Supply (Evening Discourse).

Wednesday, Sept. 10, at 10 A.M.—(C) Dr. G. W. Tyrrell and Dr. K. S. Sandford: Tectonic Relations and Petrography of Spitsbergen Dolerites.
(E) Prof. Ll. Rodwell Jones: Physical Factors concerned in the Characteristic Functioning of the Port of London during the Period 1880 to the Present Day.
(F) W. H. Whyte: The Standard of Living and the Post-War Trade Depression.
(G) J. S. Wilson: Structional Steel Design and Regulations.
(G) J. S. Lewis: Standardisation of Design for Structural Steelwork.
(G) Prof. C. Batho: Experiment and Theory in Structural Design.
(H) L. S. B. Leakey: Human Types associated with various Stone-Age Cultures in Kenya.
(K) R. A. G. Knight: The Moisture Content of Wood in Relation to Hygrometric Conditions.
At 10.30 A.M.—(C) Dr. H. C. Versey: The Speeton (pre-Glacial) Shell Bed.
At 10.35 A.M.—(E) Dr. S. W. Wooldridge and D. J. Smetham: The Geographical Features of the Boulder Clay Margin in Essex and Hertfordshire.
At 10.45 A.M.—(C) Dr. A. Heard and J. F. Jones: *Eohepatica Dyfriensis*, a Liverwort-like Plant from the Lower Downtonian of the Llandovery District.
(H) Prof. E. Fischer: Inheritance of Variations in the Human Vertebral Column.
(K) S. H. Clarke: The Tertiary Wall of Wood Fibres.
At 11.15 A.M.—(E) H. J. Wood: Agricultural Distributions in Scotland.
(H) E. W. P. Chinnery: Natives and Government Mandated Territory in New Guinea.
At 11.30 A.M.—(K) J. Bryan: Antiseptic Treatment of some Home-grown Conifers.
At 11.45 A.M.—(C) Dr. A. Raistrick: The Moraines of Western Durham.
(E) Miss C. P. Snodgrass: Some Aspects of the Agricultural Geography of the Lothians and Berwickshire.
(H) Dr. M. Vassitz: Excavations on the Neolithic Site at Vinča.
At 12 noon.—(C) Miss E. M. Lind Hendriks: The Stratigraphy of South Cornwall.

SEPTEMBER 4 TO 7.

GERMAN PHARMACOLOGICAL SOCIETY (at Königsberg).—Discussion on Problems of the General Reaction of the Organism from the Pharmacological Standpoint, with papers on Problems of Inflammation, Problems of Febrile Diseases, Allergy, and Problems of Reticulo-endothelium and its Functions.

SEPTEMBER 4 TO 14.

INTERNATIONAL ZOOLOGICAL CONGRESS (at Padua).

SEPTEMBER 7 TO 13.

INTERNATIONAL CONGRESS OF AMERICANISTS (at Hamburg).—Papers on The Aboriginal Peoples of America and their Ethnic Relations, The Prehistory of America, Manners and Customs of the Various Groups of Indians and their Distribution in the Old and New World, The Aboriginal Languages, The Discovery and Colonisation of America, The Geography and Geology of America, with Special Reference to Human Activities, and a Discussion on The Civilisation of the Indians at the time of their first contact with Europeans and to-day.

SATURDAY, SEPTEMBER 6, 1930.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Science and Leadership.

AMONG the changes which the British Association for the Advancement of Science has witnessed since its formation in 1831 is the gradual disappearance of the demarcation between science and industry. As Lord Melchett pointed out in a recent address, the endeavour to distinguish between pure and applied science has now lost any kind of meaning. No clear distinction is possible between science and industry. The results of research work of the most speculative character often lead to outstanding practical results. Such progressive firms as Imperial Chemical Industries, Ltd., now follow in Great Britain the practice long current in Germany by fostering close contact with the scientific research work of the universities.

The relation of science to industry was a main theme at the discussions of the British Association at Cape Town and Johannesburg last year, and this year's programme affords further evidence of the interpenetration of science and industry. The discussions on the influence of fertilisers on the yield and composition of plants, on chemotherapy, and on the present position of the British dyestuffs industry, and the addresses to be given on recent progress in air-cooled aeroplane development, on investigations on tar distillate washes, on sugar beet investigations, the bearing of research on improved production of apples, Dr. P. I. du Toit's presidential address on veterinary science and agriculture, and Sir Ernest W. Moir's presidential address on the interdependence of science and engineering, are sufficient evidence that the outlook of modern science is essentially practical and related to the requirements of industry. On the other hand, scientific leadership is now a characteristic of all progressive and prosperous branches of industry. The industries in which the neglect of science has been most marked are those which are most stagnant or most acutely confronted by problems of reconstruction.

If, however, it is true that in the last twenty-five years, science has rapidly assumed the responsibility of leadership in industry, a yet wider responsibility is now demanded of it. Under the conditions of modern civilisation the community in general, as well as industry, is dependent upon pure and applied science for its continued progress and prosperity. Under the influence of modern scientific discoveries and their applications, not only in industry but also in many other directions, the whole basis of society is rapidly becoming scientific, and to an increasing extent the problems which

confront the national administrator, whether judiciary or executive, involve factors which require scientific knowledge for their solution. The road traffic problem of to-day, for example, can be traced directly to the enormous expansion in output of motor-cars, and therefore reduction in costs of production, which resulted from chemical research in the field of lacquer solvents. The introduction of oil-fuel for steamers immediately created a problem of waste-fuel disposal, and the layman could not be expected to predict the serious consequences at many of our coastal resorts of the short-sighted policy of dumping waste-oil at sea.

Problems of atmospheric or riparian pollution are all largely problems which have arisen through society using the results of scientific discoveries and their applications, unguided by scientific and unprejudiced investigation of their reactions on the life of the community. Many such problems need not have become acute had an elementary amount of such foresight and scientific investigation been exercised in the early stages of the development of scientific inventions before vested interests had been created.

It is never easy to envisage the full consequences of a scientific discovery, but it is an imperative need of to-day that scientific workers should attempt to predict the consequences of their discoveries and to suggest means of dealing with the probable situation at the earliest and easiest moment. Much useless expenditure of public money, and many unsatisfactory and makeshift arrangements, might easily have been avoided in the past had scientific workers of sufficient foresight and character taken their share in local and national administration. Again, the control of public expenditure on, for example, the National Physical Laboratory or the Chemical Research Laboratory at Teddington in the final issue must be determined by scientific or technical knowledge, and cannot be regarded as satisfactorily exercised by administrators who are dependent on the advice of others for that knowledge.

In recent years the rapid growth in the rate of all kinds of international communication and transport has forced on industry an outlook and organisation that to an astonishing extent are international. These same forces have, however, enlarged the bounds within which mistaken policies can exert their ill-effects. Recent historical research has demonstrated that the difficult racial problems confronting the Union of South Africa to-day are the result of mistaken policies determined by political prejudices three generations ago. In the modern world the dangers arising from mistakes caused by prejudice and neglect of impartial or scientific inquiry are infinitely more serious. In an age when nearly all the problems of administration and development involve scientific factors, civilisation cannot afford to leave administrative control in the hands of those who have no first-hand knowledge of science.

It would be easy to adduce evidence that, in spite of all the increased interest in scientific research manifested by Parliament, science is far from exerting its fitting influence on government and administration. To the precarious position of the Royal Veterinary College and government indifference to scientific representations thereon we have recently alluded. Dr. A. C. D. Rivett, in an article in the *Times* of Aug. 7, has pointed out how neglect of soil science has been responsible for the economic ruin of many agriculturists and the failure of settlement schemes, and the indisposition to accord to scientific workers effective representation on a number of committees appointed in recent years to deal with a wide range of subjects upon which scientific workers could be expected to speak with authority tells the same tale.

Under modern conditions, therefore, more is required of scientific workers than the mere enlargement of the bounds of knowledge. They can no longer be content to allow others to take the results of their discoveries and use them unguided. Scientific workers must accept responsibility for the control of the forces which have been released by their work. Without their help, efficient administration and a high degree of statesmanship are virtually impossible.

The practical problem of establishing a right relationship between science and politics, between knowledge and power, or more precisely between the scientific worker and the control and administration of the life of the community, is one of the most difficult confronting democracy. The community is, however, entitled to expect from members of the British Association some consideration of such a problem and some guidance as to the means by which science can assume its place of leadership.

There are certain factors involved in the establishment of such a relation which are worthy of mention. In the first place, recent events, notably the tendency of the Civil Service to encroach upon the functions of the judiciary, have demonstrated to many what Mr. and Mrs. Sidney Webb (now Lord and Lady Passfield) observed in 1920: "The great mass of government to-day is the work of an able and honest but secretive bureaucracy, tempered by the ever present apprehension of

the revolt of powerful sectional interests and mitigated by the spasmodic interventions of imperfectly comprehending Ministers." * One essential condition of progress, therefore, is such a modification of the conditions of entry or recruitment and of promotion in the Civil Service that a reasonably adequate appreciation of the value of science is ensured in the whole personnel of the service, and, on the other hand, that avenues of promotion to positions of high administrative responsibility are open to its scientific officers.

The factor of education, however, is of importance not only in the production of a type of administrator more in keeping with the requirements of the modern world, but also in its influence in the production of a more enlightened type of public opinion and one more competent to sort out the issues. In such work of education scientific workers must take a much larger personal part. Much benefit may result from the mere presence of and contact with men of science in numerous committees, councils, and public bodies forming the machinery of local and national administration, and scientific workers must be prepared to offer themselves for election in much larger numbers than they have done hitherto.

The tendency for governments to overlook the need for adequate representation of science on important committees is at least in part due to the failure of scientific workers to indicate the contribution which they are able to make to the subject under discussion. In another sphere it is difficult to believe that the absence of scientific representation from the Melchett-Turner industrial conference has any other explanation than the failure of scientific workers to make a corporate approach.

A restatement of the claims of science to the attention of the civilised world, or the relation of science to social as well as to material progress, is required, and opportunities for scientific workers to participate in such a campaign of education are by no means wanting. Moreover, the recently formed Parliamentary Science Committee has made it considerably easier for scientific workers to demonstrate to Parliament the contribution science makes to the security and progress of the State and the directions in which that contribution can be expanded with advantage to the community.

The extent of the opportunities and the efficacy of such a campaign are largely determined by the representative character and the political strength of the professional organisations of scientific workers. For this reason the development of such organisations during the last decade is full of significance, not only in affording scientific workers wider opportunities of exerting their influence on public life, but also in raising their status to a point that is adequate to discharge the larger functions which the development of society as well as of industry increasingly thrusts upon them.

It is significant that, in contrast to the relative impotence of scientific workers in national affairs, in the international sphere advisory committees of experts have since the War exerted a remarkable and effective influence even when devoid of all legislative authority. To committees of experts organised by the League of Nations, and exercising advisory functions only, is due the credit of the schemes which were successful in rescuing a European State from bankruptcy and chaos and in handling an unemployment scheme which settled a million and a half refugees, following upon the greatest migration in history. These examples sufficiently demonstrate that, given the requisite stimulus and enthusiasm, the scientific expert can already exert an effective influence when normal administrative effort has failed, and when indeed, as in the case of Austria, the problem had been dismissed by statesmen as hopeless.

In truth, scientific workers occupy a privileged position in society as well as industry, and there are welcome signs that this is now recognised by scientific workers themselves. Thus, in his presidential address to the Chemical Society (at Leeds) last year, Prof. Jocelyn Thorpe suggested that the age is at hand in which the changing majorities of governments will no longer be able to determine major policies, except in directions approved by organised industry, and, in advocating the closer organisation of science and industry, stressed the political strength to be obtained thereby. The paper to be read before the British Association on "The Screening of Southend from Gunfire" is further evidence that scientific workers are accepting the responsibility of leadership in matters of social and industrial safety. Whatever inspiration or encouragement the meetings of the British Association may give to scientific workers in the prosecution of their researches, there is no way in which the Association can more fittingly serve humanity than by calling scientific workers to accept those wide responsibilities of leadership in society as well as in industry which their own efforts have made their inevitable lot.

* "A Constitution for the Socialist Commonwealth of Great Britain", 1920, p. 69.

The Roots of Hellenism.

Who were the Greeks? By Prof. John Linton Myres. (Sather Classical Lectures, Vol. 6.) Pp. xxxvii + 634. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1930.) 7 dollars.

HOW and through what ethnic migrations and changes were the essentially Mediterranean, almost Oriental, polity, culture, art, and religion of the Ægean Bronze Age transformed into the very different and distinctly European Hellenism in which western civilisation is so largely rooted? This question has confronted all historians since the discoveries of Schliemann and Evans. The answer elaborated by Prof. Myres in 600 closely reasoned pages is the first really serious attempt to co-ordinate into a single whole the bewilderingly diverse data upon which the solution must depend. He gives us for the first time a comprehensive synthesis of the deductions from geography and climatology, from physical anthropology and prehistoric archæology, from comparative philology and religion, from recently discovered Hittite documents and freshly interpreted Egyptian records, and above all, from the now rehabilitated traditional history of the Greeks themselves as embodied in epic, legend, and genealogy.

The combination of these heterogeneous elements to form the solution of our question may be compared to a jig-saw puzzle: the validity of the solution depends upon the coherence of the resultant pattern; and Myres's work passes the test brilliantly. The solver is indeed aided—but also handicapped—by a certain fluidity in some of the elements, due to ambiguities in the archæological record, obscurities in Egyptian and Hittite texts, or confusions in Greek genealogies: here you adjust the element to fit the pattern; and sometimes the element is missing altogether and the lacuna must be filled up with scientific imagination.

None the less, a coherent pattern does emerge, and very seldom is the fit of any element unsatisfactory. Still more rarely has an element been distorted—and that almost exclusively on the margins of the picture: confusions between mounds of many villages like Rustchuk and sepulchral tumuli, an over-high dating for the shaft graves of Mycenæ, inversion of the relations between Ukrainian and Transylvanian and painted wares and between 'Hallstatt' and 'antennæ' swords, or a perhaps too confident acceptation of Forrer's identifications of names in the Hittite texts, in no wise affect the coherence of the central picture.

To summarise in a short review the results of six hundred pages of detailed analysis would be as unjust to the reader as to the author; the discussions of geographical and climatic controls and the ethnographic and historical parallels worked out in digressions that are embarrassing on a first reading are really as essential to the final picture as the central figures which they help to define. It is not the least merit of the book that it takes full account of the complexity of the problem and does not attempt to simplify the picture by the omission of episodes on the pretext that their effects were transitory.

Passing over the more familiar points in the main narrative, we may direct attention to a few conspicuously original features in this genial work. Most striking is the vindication of Greek folk memory as preserved in the Epics and classical authors against the onslaughts of nineteenth century critics and mythographers. Not only does the author demonstrate the internal consistency of the traditions, especially the genealogies, but he also correlates in an entirely novel manner the crises thus disclosed with dated points in the archæological record. Thus in the Argolid the genealogical date for the first king whose name looks obviously personal, and not merely eponymous or toponymous, coincides fairly well with the beginning of colonisation by Minoan dynasts symbolised by the shaft graves of Mycenæ. (The discrepancy could be better overcome by shortening the generations than raising the date of the tombs.) The great reaction of the Mainland against Cretan domination which resulted in the sack of the Minoan palaces about 1400 B.C. coincides even better with the slaying of the sons of Ægyptus by the daughters of Danaus in the generation of 1400 (Minoan alliance with, if not dependence on, Egypt is clear enough from archæological and hieroglyphic evidence).

So, too, the accuracy of Homer's picture of Achæan society and life is demonstrated along the lines laid down by Allen and Chadwick, but with a fuller mastery and wider use both of the archæological material and of the data supplied by Egyptian and newly discovered Hittite documents. Politically, the Homeric age was a period when foreign dynasts from overseas, Phrygian rather than Hellenic, ruled over Minoanised Greeks as a loosely federated feudal aristocracy. Archæologically, it witnessed the gradual substi-

tution of cut-and-thrust swords for rapiers, of round shields with body armour for long shields, and of iron for bronze.

Very original, too, is the treatment of the fibulæ as illuminating the complex phenomena of this transitional period. Myres regroups several of Blinkenberg's types into larger units the distribution of which is shown to correspond respectively to the area affected by the sea raids mentioned in Hittite and Egyptian documents, to that of the similarly attested land raids into the heart of Asia Minor, and to the Achæan confederacy under foreign dynasts in mainland Greece. The uniformity of the early types in the last-named region is such as to imply quite intimate intercourse between the peoples from Thessaly to Laconia. Yet, apart from their foreign rulers, these peoples must already have been speaking distinct dialects, ancestral respectively to the Ionic, Æolic, and Arcadian of classical times. Myres ingeniously suggests that the 'mixed dialect' of Homer was such a *lingua franca* as was needed to facilitate intercourse in the conditions described. With the break-up of Achæan domination after the Trojan war, specialised local types of safety-pin grow up to symbolise the interruption of intercourse.

The Dorians, too, are recognisable by a special type of fibula, the spectacle brooch, but they did not bring it, as has been usually assumed, from the far north; for Myres would seek their cradle where Greek tradition located it in the peninsula itself, on the north-western fringe of the Achæan confederacy. Nor was the geometric style Dorian, as is generally believed. It was rather the creation of potters, trained in the old Mycenæan tradition, but working for a new public, the product of that dark age of migration the social conditions of which Myres reconstructs most brilliantly. In this style the concentric circle ornament is indeed a contribution from beyond the Balkans, brought by those Lausitz invaders whose presence in Macedonia has been demonstrated by Heurtley and myself. But the Lausitz invasion was just an episode of which Greek tradition preserves memories that lesser authors find it convenient to ignore. The invaders were not Greeks but Thracians, a view which agrees well with my independent conclusions as to the linguistic affinities of Lausitz folk in the Danube valley. Apart from the concentric circle enhancement, the geometric style is essentially Ægean and reaches its highest development in the region least affected by post-Mycenæan intruders, namely, Attica. But in its development the guiding spirit is no longer Minoan or Mediterranean but Hellenic, as Myres shows in a masterly analysis of its content and rhythm. Peculiarly suggestive is his comparison between the rhythm of vase painting and Greek versification. Here lies the clue to the initial question. But to use it the reader must turn to the actual book and read and re-read its arguments, even when they seem irrelevant or repetitive.

V. GORDON CHILDE.

The Importance of Morphology.

Studies on the Structure and Development of Vertebrates. By Prof. Edwin S. Goodrich. Pp. xxx + 837. (London: Macmillan and Co., Ltd., 1930.) 36*s*. net.

THERE is a peculiar irony in the fact that the method of investigation which in the nineteenth century was responsible for the greatest revolution ever effected in man's outlook and appreciation of his own place in Nature should at present be despised and rejected by so many biologists. The publication of a new treatise on morphology is a challenge to the widespread attitude of depreciation of the value of such studies. Perhaps the question at issue can be best defined by a concrete illustration.

During the present century, many hundreds of experimental and clinical investigators have been occupied in the attempt to discover the means whereby co-operation is effected between the pituitary body and the hypothalamus. Yet the unifying device is visible to the naked eye. Prof. Gregor Popa and Dr. Una Fielding have recently described (*The Lancet*, Aug. 2, 1930, p. 238) a hitherto unnoticed and unique series of vessels for conveying to the hypothalamus the colloidal material elaborated in the pituitary, which are virtually the ducts of the hypophysis, the channels in which blood serves the hydraulic function of moving the colloid upward into the brain. This is merely one example of the importance of morphology for the solution of problems of function, and a hint of the risks to which biology would be exposed if what Prof. H. S. Jennings (*Science*, July 30, 1926, p. 98) has called the 'phobia' of antagonism to morphology should be permitted to dominate our work.

It is the business of every department of science to lay a sure morphological foundation upon which to erect the edifice of knowledge. Whether the subject of investigation be the structure of the atom, the anatomy of a crystal, the plan of an

engine, or the architecture of a living organisation, the fundamental consideration is obviously a question of morphology, the neglect of which would stultify any attempt to solve the problems. The physicist, the chemist, the engineer, and the palæontologist do not waste their time in denying the importance of a department of their work which is so essential for the success of their efforts. Yet at the present time we are face to face with the paradoxical phenomenon that many biologists want to repudiate the particular instrument of their subject, which in the hands of Charles Darwin effected the most complete revolution that has ever been made, not merely in the interpretation of living plants and animals, but also in the whole attitude of man to the universe and to the character of his knowledge and sympathies. It is important not to ignore the fact that although Darwin's ideas were in large measure inspired by studies in field biology, in the geographical distribution of plants and animals, and in breeding experiments, his demonstration was based, as he himself so clearly emphasised, on morphology, which in "The Origin of Species" he called "the soul of natural history".

In emphasising the importance of morphology and the danger of neglecting the direct appeal to the observation of concrete facts, however tedious and laborious such a discipline may be, this attitude must not be supposed to involve any failure to recognise the vital importance of the experimental inquiry into the manifestations of life. Most people admit the major interest of the working of a machine and the results which accrue from its use in comparison with its mere structure. But the fascination of watching an aeronaut 'loop the loop' and perform other 'stunts' does not relieve the engineer of the necessity of investigating essential problems of aeroplane construction. Yet there is a widespread tendency to adopt such an attitude in biology—a tendency that is encouraged by the vast importance and brilliance of the results which can often be obtained quickly and easily by experiment. In biology, however, the laborious drudgery of morphological research is a necessary part of most investigations. Moreover, it is a profound mistake to pretend, as not a few zoologists are now doing, that the field of morphology, which has yielded such rich harvests in the past, has been exhausted and is now sterile. It should not be forgotten that a relatively small proportion of the problems of biology is susceptible to inquiry by experiment in comparison with the vast field for research in morphology. The methods which established the fact of evolution have even vaster opportunities for achievement in the future. Almost every discovery in physiology creates new problems for the morphologist—most advances into new territories need for their complete establishment the translation of the results into terms of structure and structural changes. The whole range of palæontological inquiry is primarily morphological.

The attitude of mind that is expressed in the morphology-phobia often assumes a more extreme form in minimising the value of things that can be seen with the naked eye. It is sometimes assumed that anatomical work that does not involve the use of an oil-immersion lens is necessarily futile. The prevalence of the practice of resorting to histological devices before the object of investigation has been thoroughly examined by the naked eye or with a hand lens is responsible for large gaps in our knowledge and a vast number of conventional errors. Not long ago a distinguished surgeon came from Europe to ask for permission to dissect muscles in the human body to compare the lengths of active flesh in the flexors and extensors. When asked why he undertook so long a journey to do what he might equally well have done in the laboratory of his own university (within ten minutes' walk of his house) he replied: "If our professor had an elephant to dissect he would begin by cutting it into sections 10μ thick." This absurd remark unfortunately expresses quite truly the irony of the attitude that is now so prevalent. Even if it be admitted that much of the distrust of morphology may be due to the narrowness and futility of some of the academic morphology of a past generation, this is no excuse for the widespread fashion of depreciation.

It would be possible, if it were desirable, to cite many instances of experimental research the results of which have been utterly stultified by the neglect to take into consideration questions of morphology. What vast accumulations of erroneous inference still encumber the literature of biology because considerations of phylogeny and homology have been ignored! Obvious as they are, these things needed saying to make plain the value and importance of such works as Prof. Goodrich's "Studies on the Structure and Development of Vertebrates". He set out to write a treatise to expound the present state of our knowledge of the comparative anatomy of vertebrates. More than half the volume is devoted to the skeleton, and 512 of the 754 figures with which it is generously illustrated. This is due, not to the assumption that the other parts of the

organism called for a less elaborate treatment, so much as the fact that the attempt to deal with them with the same thoroughness would have taken a lifetime to accomplish.

Prof. Goodrich has performed a very useful service in providing the advanced student of zoology and those engaged in teaching and research in comparative anatomy with trustworthy guidance to our knowledge of the vertebrate skeleton. As it includes an account of the fossil remains of extinct animals, the book is also a treatise on vertebrate palæontology, perhaps the most illuminating and comprehensive work that has been written on that subject. The discussion of the skeletal remains of a large series of extinct animals by a zoologist who is also giving the results of his own investigations on living representatives of the same groups provides a more vital and illuminating interpretation of the fossils than a work dealing with the latter alone. Such a mode of treatment minimises the risk of ignoring the fact that the bones were once clothed with muscles as parts of living creatures. The study of palæontology in association with the anatomy of existing animals represents the essential foundation of evolutionary inquiries. It emphasises the vast significance of morphology as the only key at present available to unlock the mysteries of phylogeny and evolution.

The rest of the book is devoted to the gills and gill-slits, the heart and vascular system, the air-bladder and lungs, the cœlom and diaphragm, the excretory organs and genital ducts, and a brief chapter on the peripheral nervous system and sense organs. No attempt is made to deal with the central nervous system.

In his preface Prof. Goodrich emphasises the fact that his book "is not a complete treatise, but deals with certain subjects and problems of special interest and importance, some of which receive but scant notice in current text-books". This qualification applies not only to the subjects chosen for discussion, but also to his method of dealing with them. Thus his excellent description of the comparative anatomy of the heart, based largely on his own researches, omits any account of the fascinating problem of the connecting systems (the atrio-ventricular bundle).

The difficult questions involved in the evolution of the diaphragm are discussed with great clearness, and, as the author explains with reference to the book as a whole, the lacunæ in our knowledge are defined, but no hasty attempt is made to hide them by premature conclusions.

The least satisfactory part of the book is the final chapter. Perhaps the author would have been better advised to have deferred it until he was ready to link his account of the peripheral nervous system with that of the central organs. The use of the term 'visceral motor' for nerves which supply voluntary muscles of striated type, wholly dissociated from any viscus, is very misleading, even if it is still fashionable among American neurologists. For more than thirty years it has been the practice among most anatomists to distinguish this group as 'lateral somatic', and repeated protests have been made against the application of the word 'visceral' to it.

Prof. Goodrich claims (p. 784) that, while the division of the autonomic nervous system into sympathetic and parasympathetic may be justified on physiological grounds, it is not satisfactory from the point of view of morphology. If, however, the morphologist should differentiate the autonomic fibres, as he suggests, on the basis of the paths—anterior or posterior nerve roots—by which they emerge from the central nervous system, the result will be, not only chaos, but also bad morphology. Clearly homologous fibres in different vertebrates would then have to be placed in different groups. Even in the same animal the cephalic fibres of the accessory nerve would belong to the dorsal root system, from which the caudal fibres of the same nerve would be excluded, although they do not fully acquire the right to inclusion in the ventral root. These considerations reveal the impracticability of Prof. Goodrich's suggestion.

The book in most respects is eminently conservative. In his classification of vertebrates, for example, Prof. Goodrich includes the Tarsiiformes in the sub-order Lemuroidea, although for more than thirty years the need for a special sub-order Tarsioidea to express the admitted facts of morphological distinction has been widely recognised.

These, however, are relatively trivial blemishes in a great achievement, upon which Prof. Goodrich is to be heartily congratulated. The conspicuous quality of the book is the fullness and impartiality of the statement of the present state of our knowledge of vertebrate morphology and the sources of information. Every student of zoology and palæontology should be grateful for this eminently useful book. The excellence of the illustrations, of which there are as many as 754, and the valuable bibliography and scheme of classification of vertebrates are features of the book worthy of special mention.

G. ELLIOT SMITH.

Science and the Layman.

(1) *The Mechanism of Nature: being a Simple Approach to Modern Views on the Structure of Matter and Radiation.* By Prof. E. N. da C. Andrade. Pp. xii + 170. (London: G. Bell and Sons, Ltd., 1930.) 6s. net.

(2) *Matter and Radiation: with Particular Reference to the Detection and Uses of the Infra-red Rays.* By John Buckingham. Pp. xii + 144 + 8 plates. (London: Oxford University Press, 1930.) 7s. 6d. net.

THE ignorance, in matters scientific, of the average intelligent and educated layman is one of the more curious and perturbing features of the age; curious, because science, mostly without intention and as a mere by-product of its activity, has done more to change the structure of society in the last fifty years than statesmen and reformers in all the preceding æons; perturbing, because the discoveries which the scientific worker drops so casually into the stream of knowledge have potentialities, for good or evil, so vast that it seems vitally important that those who are called upon to lead and direct society should have at least sufficient knowledge of the matter to enable them to appreciate these potentialities, and to direct them into wise channels.

Perusal of publishers' catalogues, or of the reviews which appear from time to time in this and other journals, might lead one to suppose that this need had been adequately foreseen and catered for. The fact remains, however, that this large amount of quite competent effort has on the whole failed in its object; the average layman remains still curious and still unenlightened. It is not interest that is lacking. Most of us can, no doubt, recall what should have been pleasant social functions, which have been turned for us into something approaching the horrors of the inquisition by the entirely sincere demands of our friends that we should explain to them some recent achievement in our particular branch of science. The difficulty which almost invariably arises on these occasions and turns what should be a pleasant and grateful task into something like a nightmare, is to find some common basis of knowledge to which we can refer. As Prof. Andrade puts it, in the preface to his admirable volume, "The task is rendered extremely difficult by the fact that the questioner is without the first beginnings of a knowledge of the matter and the method of the science, and is, as it were, like those chemical compounds which are apt and, so to speak, anxious to absorb the vapour of water, but cannot do so easily if they are already very dry; they require a preliminary infection with moisture if they are to drink in with facility a further store". Prof. Andrade's book has been written with the object of providing this necessary preliminary infection with physical science.

(1) "The Mechanism of Nature" is thus an attempt to give the uninitiated but not unintelligent reader an outline of classical and modern physics, to indicate its aims and methods, to expound its basic discoveries and principles, and to show the inter-relations of its various parts. After a preliminary chapter explaining the objects and methods of physical research, the author deals in four brief chapters with the essentials of the four main branches of physics—heat, sound, light, and electricity; and in two concluding chapters with the quantum theory and the atom. To pack so much material into so brief a space might appear to involve an almost impossible degree of compression, but there are no signs of compression or inadequacy in the text. The argument marches steadily step by step, the sentences flow easily, and there is a wealth of pithy but pointed illustrations and similes, which (with or without acknowledgment) we shall certainly see quoted again. So far as it is possible to deal intelligently and intelligibly with a technical subject in non-technical language, the language of the book is non-technical. There is not a single equation to frighten the most timid of readers, nor a single diagram to remind him, perhaps unpleasantly, of the text-books of his youth.

How much will the non-scientific reader carry away from his perusal of the book? It is a little difficult for the scientific reviewer to judge. He will at least realise that Prof. Andrade writes with distinction, and that the subject on which he writes is one which is worthy to occupy the attention of men of culture. If he does not further carry away with him some genuine appreciation of the purpose and content of physics, he may well be advised to give the matter up in despair; he is not likely to encounter an abler guide. "The Mechanism of Nature" is, in short, an exposition of physics which the physicist can recommend with confidence to his non-scientific friends, and by which he may be well content to have his subject judged.

(2) "Matter and Radiation" cannot be recommended with anything like equal confidence. Mr. Buckingham has not Prof. Andrade's art of exposition, and his rambling and pedestrian style makes tedious reading, even where the subject matter is interesting. This is regrettable, because in his two concluding chapters, on the detection and uses of

infra-red radiation, the author has a fascinating subject, and much that he has to tell will be new not only to the general reader but also possibly to some physicists. In this part of the book he writes, if not with distinction, at least with authority and knowledge, and he quite obviously knows so much more about the subject than he has chosen to tell us that he whets rather than satisfies our appetite for information. We could wish for more details than he allows us. It is these later chapters which contain the gist of what the author has to say. The earlier chapters, though they give the title to the book, are but by way of preface, a preface which struck us as being neither particularly well arranged nor particularly well expressed. Mr. Buckingham does not appear to have the proper touch for that kind of writing. We should, however, like to hear more about infra-red rays.

The Mendip Lead Mines.

The Mines of Mendip. By J. W. Gough. Pp. x+269. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 15*s*. net.

THE observant traveller who crosses the Mendip Hills cannot fail to notice the broken ground, so-called 'grubby or gruffy ground', which his map tells him represents the scene of ancient lead workings. Efforts to acquire fuller knowledge of these met with only partial success until the appearance of Mr. Gough's book, which obviously fills a definite want. The Mendip lead mines date from at least the second century B.C.; they have had a lengthy history, not without many vicissitudes. A good deal of the mining followed veins running near the surface, working either shallow trenches a few feet deep or small pits close to one another running in lines across the fields. The principal lead ore was galena.

In Elizabethan times calamine, a carbonate of zinc, was also worked in the Mendips, and this ore was of much importance in the middle of the eighteenth century when the lead industry was sinking.

The story of a mining field worked for two thousand years is full of interest in every direction. We know from Pliny that Britain became the chief source of lead in the Roman Empire: it was found at the surface of the ground so abundantly that a law was spontaneously passed to limit production. The mines were worked by slave labour or prisoners of war; they were imperial property and their produce was stamped with the Emperor's name; from time to time pigs so marked have been found. The Roman headquarters were at Charterhouse, but very little is known about the site.

Naturally, there has always been conflict between the miners and the farmers, particularly over such questions as common rights and the very serious risk of lead poisoning due to stream pollution or the escape of fumes during smelting. Mr. Gough tells us of some of the troubles during the sixteenth century and later; he further leads us on a side issue into the subject of dowsing for metals, which persisted from the date of its first mention about 1638 down to the last days of the mining industry.

Of the mines in the Middle Ages the knowledge is fragmentary, monotonous, and mainly financial. For a long time they were leased to the Bishop of Bath. Almost nothing is known about the methods of mining and smelting, though there is plentiful information available about the silver-lead mines in South Devon, no doubt because they were Royal mines. The Mendip industry had its own laws and customs, with special courts to enforce them.

Lead mining was at its pride between 1600 and 1670, when every foot of any rich patch of ground was exploited to the utmost, workmen digging pits within a few yards of each other; this is the explanation of the condition of the ground to-day with its profusion of mounds and hollows. Disputes were endless, as the records of the courts show, but the mines were never monopolised by any one big firm such as the Mines Royal which owned all the copper mines in the Lake District.

Our technical knowledge of the mines at this time is due to an elaborate list of questions published in the first number of the *Philosophical Transactions* of the Royal Society, by Boyle, entitled "Articles of Inquiries touching Mines". It was answered by Joseph Glanvil, the vicar of Frome, in two papers which appeared in the second and third volumes of the *Philosophical Transactions*.

By 1680 the readily accessible lodes were exhausted as the result of this intensive working and the deeper pits were much troubled with water flowing into them: various efforts were made to combat this, but none of them achieved commercial success. In later years the poor quality of the Mendip lead in comparison with that from Derby or Flintshire made it impossible to carry the heavy overhead charges of modern appliances. In the nineteenth century the Mendip lead, which contained arsenic, was practically all used for making shot in Bristol; it was too hard for the London plumbers to use for sheeting.

The ancient courts with their executive officers,

the records of which tell us so much of the financial and administrative work, disappeared together with the mines. Both lead and zinc had been kept going by a system of protection, and with the advent of free trade their days were numbered, though in any case the old-fashioned individual shallow mining could not have long persisted.

The long story of the Mendip mines is an attractive one, embracing many fields of science, well worth the telling in detail. Our epitome has indicated the breadth of Mr. Gough's treatment, and he is to be congratulated on the thoroughness of his achievement. E. F. ARMSTRONG.

Our Bookshelf.

(1) *Fortschritte der Geologie und Paläontologie.* Herausgegeben von Prof. Dr. W. Soergel. Band 8, Heft 24: *Die tektonische Entwicklung eines Schollengebirgslandes (Vogelsberg und Rhön).* Von K. Hummel. Pp. viii + 234 + 3 Tafeln. 18 gold marks. (2) Band 8, Heft 25. *Das varistische Bewegungsbild entwickelt aus der Inneren Tektonik eines Profils von der Böhmischen Masse bis zum Massiv von Brabant.* Von Hermann Scholtz. Pp. ix + 235-316 + 8 Tafeln. 15 gold marks. (Berlin: Gebrüder Borntraeger, 1929 and 1930.)

Two new parts of this serial form interesting contributions to the geology of south-western Germany and the Rhinelands. They both illustrate the increased recognition of the direct influence of earth movements on topography.

(1) Prof. Hummel of Giessen deals with the Vogelsberg in Upper Hesse and the Rhön Mountains along the western frontier of Bavaria and Thuringia, and shows how their topography is dominated by block movements. The area includes the extensive basaltic eruptions to the north-east of Frankfort, and he discusses the relation of the tectonic and volcanic processes. He considers the northern end of the rift-valley of the Rhine, of which the margins have been raised by uplift. Though the main direction of the fractures and rift-valley of the Rhine is to the north-north-east, the course of the valley is modified by the Variscan folds and in part takes their direction. The river system of the Upper Main, however, is less dependent on the tectonic structure than on the basalt eruptions, as the streams are mostly radial from the volcanic piles. The work is accompanied by three maps illustrating the relief of the Vogelsberg and the Rhön Mountains and the relations of the volcanic rocks of that area to the river system.

(2) The monograph by Scholtz is a study of the distribution of various pressure phenomena among the older rocks from Brabant to Bohemia. He classifies them into three types, cleavage, pressure-fractures (*Schubklüftung*), and cross-fractures (*Querklüftung*); he describes these structures in detail, and shows their relation to the Variscan and Alpine movements. The work is well illustrated by photographs, diagrams, and maps.

Annual Survey of American Chemistry. Vol. 4: July 1, 1928, to December 31, 1929. Prepared under the Auspices of the Division of Chemistry and Chemical Technology, National Research Council. Edited by Clarence J. West. Pp. 549. (New York: The Chemical Catalog Co., Inc., 1930.) 4 dollars.

THE object of this survey is " to present throughout a period of years a complete survey of American chemistry ", not, it will be noted, an American survey of chemistry, quite another and a much more acceptable thing to non-American chemists. The endowment of science with a national label would be open to criticism even were it admitted that chemical progress, like creative art or even mechanical invention, can be so characterised. In point of fact, one step depends too much on the success of another; moreover, the search for fundamental truth in scientific fact, whether it proves a source of strength or weakness, a curse or a blessing, according to the use made of it, is as little concerned with political frontiers as is the legislature with the laws of thermodynamics. Hence whatever value the series under review possesses—and its value in certain directions is not denied—the survey can scarcely be regarded as a significant contribution to the world's literature of chemistry. The limitation of its general value is admitted in the foreword: " The progress in any branch of chemistry is not confined by the boundaries of any one nation ", whilst the sentence which follows exhibits a proper sense of patriotism: " This fact means that in a short time fundamental progress abroad is reflected by the work carried on in America. Therefore a careful annual survey of American chemistry possesses only a certain lag. . . ." Incidentally, however, not all the authors mentioned are United States citizens, and not all of the journals cited are of American origin. The present volume covers a period of eighteen months in order that succeeding volumes may review a calendar year instead of a fiscal year. There are 43 chapters covering a great variety of subjects in pure and applied chemistry, and an author index is appended. A. A. E.

The Sea. By H. A. Marmer. Pp. x + 312. (New York and London: D. Appleton and Co., 1930.) 10*s*. 6*d*. net.

THERE are many popular books on the sea, but they commonly err in trying to combine its science in a single volume. The physics and chemistry are often so cut down that the biologist is not given the basal facts on which the understanding of his problems depends, while the general reader is left with almost nothing. The author of the volume under notice, who is assistant chief of the famous Coast and Geodetic Survey of the United States, omits biology altogether, and the result is a most readable volume that should appeal to every traveller.

The volume is written simply and sincerely, and has all the requisite illustrations. The Sargasso sea is mentioned for its extraordinary clearness, a white disc being visible when lowered to 200 ft., its high temperature and salinity, and its relative

motionlessness. Its weed is in small patches, and, while sometimes reinforced from the shallow reefs, ordinarily propagates vegetatively. The depths of the sea should shortly be better known by sonic sounding, which has already given us 35,400 ft. (6·7 miles) near the Philippines. It also suggests that the gentleness of relief of the sea bottom has been very greatly overestimated. The yearly, monthly, and daily variation in sea-level is brought out and clearly requires careful study. The tides are treated well, but we miss the familiar world chart, which serves to explain their origin and curious effects found in the North Atlantic.

We should have welcomed a discussion of the tidal currents in relation to depth and obstructions. A fuller account of 'the waters of the depths' and of their circulatory movements would excite the imagination of the reader. The genesis of the Gulf Stream, the earth's magnetism, and the characters of enclosed seas and their opening straits occur to us as 'larger features' than 'Legendary Isles' and accounts of polar explorations. A chapter on the U.S. Coast and Geodetic Survey would also be of interest as it would necessarily contain the history of the modern exploration of coastal waters.

Physiology and Biochemistry in Modern Medicine. By Prof. J. J. R. Macleod, assisted by Roy G. Pearce, A. C. Redfield, N. B. Taylor, and J. M. D. Olmsted, and by others. Sixth edition. Pp. xxxii + 1074 + 9 plates. (London: Henry Kimpton, 1930.) 42*s.* net.

PROF. MACLEOD'S text-book is now well established in the literature, in fact, it has reached its sixth edition in the course of twice as many years. It blends under one cover general and special physiology and biochemistry and applied or clinical physiology: it is larger than works devoted to clinical physiology, but makes no attempt to deal in any detailed manner with many of the problems of specialised physiology. In fact, this science has now so many branches, general, biochemical, and histological, that it has become impossible for one volume to deal adequately with all. Prof. Macleod has performed the useful service of selecting from the mass of literature material suitable for welding into a whole as human physiology, which is almost the same as clinical medicine, when healthy, and not diseased, individuals are the subject of study.

This edition has been thoroughly revised and in places rewritten: but in comparison with the total bulk of our knowledge, certain recent discoveries, which have loomed large in the public eye, assume their more correct proportions. The general plan of the work is well known: it is divided into ten parts devoted to the physicochemical basis of physiological processes, the blood and lymph, the neuromuscular system, the special senses, circulation, respiration, digestion, excretion, metabolism, and the endocrine organs. It should be in the hands of all medical students and teachers of physiology and can be read with profit by all interested in the scientific basis of modern medicine.

Engineering Electricity. By Prof. Ralph G. Hudson. Second edition. Pp. viii + 214. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 12*s.* 6*d.* net.

THIS book is intended primarily for the junior and senior engineering students of the Massachusetts Institute of Technology who are not specialising in electrical engineering. It contains an outline of lectures previously given by the author. These lectures are now discontinued, and in their place nine pages of the text are assigned each week for home study. The class-room exercises consist of three 'recitations' and one problem section per week. An independent laboratory course covers the same ground and follows the class exercises. The keynote of the work we are told in the preface is brevity, and since the students are nearing the end of their college studies the statements are made as rigorous as possible. Chap. xvii. is devoted exclusively to illustrations illustrating all kinds of electrical apparatus.

Apparently 'weatherproof' insulation and 'slow-burning' insulation are distinguished by the intensity of the shading. In Chap. xviii. a hundred practical problems are given. As a class-book we think this book will be useful. But considering its size we think that 12*s.* 6*d.* is far too much to charge for it.

Disease and the Man. By Prof. George Draper. (The Anglo-French Library of Medical and Biological Science.) Pp. xix + 270 + 19 plates. (London: Kegan Paul and Co., Ltd., 1929.) 12*s.* 6*d.* net.

DR. DRAPER provides us with a very interesting sidelight on the relation between disease and the type, physical and mental, of the patient. This book forms a useful extension to disease of the work of Kretschmer on the relation of bodily type to character. Anthropometric data are all too little used in connexion with disease. The author presents series of cases of gastric ulcer, gall-bladder disease, pernicious anæmia, tuberculosis and nephritis, and points out the varying physical characteristics which are common to these disease groups. The relation between psychological characters and physical disease is also considered.

The Planktonic Diatoms of Northern Seas. By Dr. Marie V. Lebour. (The Ray Society Volume 116 for the Year 1929.) Pp. x + 244 + 4 plates. (London: Dulau and Co., Ltd., 1920.) 12*s.* 6*d.*

THIS book is indispensable to all biologists interested in the life of the ocean. The families, genera, and species are clearly defined and well illustrated, their distribution properly recorded. There is a good bibliography. An introductory chapter gives a brief account of the general morphology, reproduction, and nutrition. We learn that all diatoms without chromatophores are saprophytic. Some have fungi and other algæ as parasites, while a dinoflagellate is found on *Chaetoceros*. There are several symbionts, especially flagellates, while some diatoms have special associations with infusorians.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Constitution of Molybdenum.

FOLLOWING the successful analysis of chromium announced in NATURE of Aug. 9, I have now been able to apply similar methods to molybdenum. The mass-spectrum of this element is a remarkable one, and the credit of its discovery rests with Dr. A. v. Grosse, who prepared the specimen of molybdenum carbonyl with which the work was done.

In contrast to the theoretical prediction of Russell (NATURE, Oct. 20, 1923) molybdenum has no less than seven isotopes, and the group indicates relative abundance relations far closer than those of any other multiple element so far investigated. Owing to incidental difficulties, which I need not enumerate here, measurements could not be made so accurately as usual. The following are the mass numbers and their approximate percentage abundance:

92	94	95	96	97	98	100
14·2	10·0	15·5	17·8	9·6	23·0	9·8

By comparison with the doubly charged mercury group the packing fractions of Mo^{98} and Mo^{100} were provisionally estimated. Both appear to be about $-5·5$, a considerably smaller negative value than that expected from the curve. From these values, correcting to the chemical scale we get:

$$\text{Atomic weight of Mo} = 95·97 \pm 0·05$$

in good agreement with the figure 96·0 obtained by chemical methods.

Two of the isotopes are isobaric with the well-established isotopes of zirconium 92 and 94, and a third with the doubtful one 96.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, Aug. 21.

The Period of 'Actino-uranium' and its Bearing on the Ages of Radioactive Minerals.

FROM the mass-spectrum of the mixture of lead isotopes isolated from Norwegian bröggerite Dr. F. W. Aston (NATURE, Mar. 2, 1929, p. 313) estimated the relative proportions of the individual isotopes to be approximately

Pb^{206}	Pb^{207}	Pb^{208}
86·8	9·3	3·9

The line 207 is referred to the end-product of the actinium series, and the latter is regarded as having its origin in an isotope of uranium (*actino-uranium*). In the course of a discussion of the significance of Aston's results, Sir Ernest Rutherford tentatively estimated the half-value period of the hypothetical isotope (NATURE, Mar. 2, p. 314; 1929). Taking the period of uranium I as $4·5 \times 10^9$ years, he found a probable value of $4·2 \times 10^8$ years for the period of actino-uranium. If this estimate (based on the unexpectedly high amount of Pb^{207} found by Aston in the bröggerite lead) be of the right order, then it follows that Pb^{207} has been generated in minerals more rapidly from the actinium series than Pb^{206} from the uranium series. In calculating the ages of radioactive minerals it would therefore be necessary to allow for this difference. The object of this letter is to direct attention to another line of evidence from which it can be inferred that the periods of uranium I and actino-uranium are probably more nearly equal, and that no correction to the calculated ages of minerals is required in the present state of our knowledge.

From the approximate constancy of the ratio of actinium or protoactinium to uranium in minerals, it has generally been accepted that the percentages of atoms disintegrating via actinium and radium respectively are about 3 and 97. This ratio has recently been investigated afresh by J. E. Wildish (*Jour. Am. Chem. Soc.*, **52**, Jan., 1930, p. 163), who finds that the number of atoms of protoactinium disintegrating per 100 atoms of uranium I ranges in five different minerals from 1·47 to 5·16. Incidentally, this departure from constancy strengthens the growing belief that the actinium series is not a branch of the uranium series; it also raises a doubt whether the actinium parent can be an isotope of uranium. The immediate point of importance, however, assuming that actinium produces Pb^{207}, is that the number of atoms of Pb^{207} produced in radioactive minerals at the present time is 3 ± 2 for every 100 atoms of Pb^{206} produced from uranium I. If both uranium I and actino-uranium disintegrate at about equal rates, then in Pre-Cambrian minerals the percentage of accumulated Pb^{207} to accumulated Pb^{206} should also fall within this range. If, on the other hand, Rutherford's suggestion is true, that actino-uranium disintegrates more rapidly than uranium I, then the proportion of accumulated Pb^{207} should be definitely higher. For a few minerals data are available which permit a test of these alternatives.

Let A = atomic weight of the mixture of lead isotopes isolated from a mineral;

$$\left.\begin{array}{l} a = \text{percentage of } Pb^{207} \\ b = \text{percentage of } Pb^{206} \\ c = \text{percentage of } Pb^{208} \end{array}\right\} \begin{array}{l}\text{in the mixture}\\ \text{of lead}\\ \text{isotopes.}\end{array}$$

Then we have

$$207a + 206b + 208c = 100A$$

$$a + b + c = 100$$

$$\frac{a+b}{c} = \frac{U}{0·38\,Th}$$

where U and Th represent the respective percentages of uranium and thorium in the mineral. The third equation is based on the fact that the lead-producing capacity of thorium is only 0·38 times that of uranium which, as chemically determined, includes actino-uranium as well as uranium I.

From the three equations we find

$$c = \frac{100}{\left(\frac{U}{0·38\,Th} + 1\right)}$$

and

$$a = 100(A - 206) - \frac{200}{\left(\frac{U}{0·38\,Th} + 1\right)}$$

The packing-effect is clearly important here, for if the atomic weight of Pb^{206} be 206·016 (as suggested by Aston), then the value of a will be diminished by 1·6, which is a considerable part of its total value. In the following table a is therefore calculated from the expression

$$a = 100(A - 206·016) - \frac{200}{\left(\frac{U}{0·38\,Th} + 1\right)}$$

	I.	II.	III.	IV.
A = At. Wt. of Pb	206·048	206·046	206·071	206·122
U per cent	c. 72	73·07	66·88	65·28
Th per cent	0·00	0·28	1·89	6·86
$\frac{U}{0·38\ Th}$	∞	686·75	93·12	25·04
a (Pb^{207})	3·20	2·71	2·38	2·92
b (Pb^{206})	96·80	97·14	96·56	93·24
c (Pb^{208})	0·00	0·15	1·06	3·84
$\frac{100\,a}{b}$	**3·3**	**2·8**	**2·5**	**3·1**

I.—Pitchblende, Katanga, Belgian Congo. Analyses, See G. Kirsch: "Geologie und Radioaktivität", p. 171, 1928; At. Wt., Hönigschmid and Birckenbach: *Ber. Deutsch. Chem. Gesell.*, Berlin, p. 1837, 1923.

II.—Uraninite, Morogoro, Tanganyika Territory. Analyses, See G. Kirsch: *op. cit.*, p. 170; At. Wt., Hönigschmid and Horovitz: *Monatsheft f. Chem.*, **36**, p. 355, 1915.

III.—Uraninite, Black Hills, South Dakota, U.S.A. Analyses, Davis: *Am. Jour. Sci.* (5), **11**, p. 201, 1926; At. Wt., Richards and Hall: *Jour. Am. Chem. Soc.*, **48**, p. 704, 1926.

IV.—Bröggerite, Raade, Moss district, S.E. Norway. Analyses, Gleditsch: *Norsk. Videns Akad.*, Oslo, I Mat. Nat. Kl., No. 3, 1925; At. Wt., Richards and Wadsworth: *Jour. Am. Chem. Soc.*, **38**, p. 2613, 1916.

In addition to the minerals listed there are some others of Pre-Cambrian age for which analytical and atomic weight data have been recorded. For the lead from the uraninite of Sinyaya Pala, East Karelia, Nenadkevitch gives two atomic weight determinations, 206·02 and 206·11 (*Min. Abstracts*, London, **3**, p. 263; 1927). On these results, $100a/b$ is between 0·2 and 10 with an average of 5. The cleveites of the Arendal district investigated by Mlle. Gleditsh (*op. cit.*) give very low or very high results for a, probably because the minerals are altered, in which case the method of calculation is invalid. Similarly, the thorium minerals of Ceylon are unsuitable as a test. They, too, are altered, and for each of them a turns out to be negative. So far as I am aware, only the four minerals given in the table can be appealed to safely for a solution of the problem under discussion.

The ratio $100a/b$, which is the ratio of accumulated Pb^{207} to accumulated Pb^{206}, is thus found to vary between 2·5 and 3·3. This clearly means that through the greater part of geological time the proportion of Pb^{207} generated in minerals has been of the same order as that generated at the present time. The adoption of a smaller value for the factor here taken as 0·38 (Kirsch favours a value near 0·25) leads to the same conclusion. There is certainly no indication that Pb^{207} was produced more rapidly 10^9 years ago than it is now, and we may therefore conclude:

1. That Aston's estimate of 9·3 per cent for the Pb^{207} in Norwegian bröggerite is too high to be considered representative;
2. That Rutherford's resulting estimate for the period of actino-uranium is too low;
3. That the periods of both uranium I and actino-uranium are probably of the same order; and
4. That in consequence there is at present no necessity to make any correction for the actinium series in age calculations when uranium has been determined chemically.

ARTHUR HOLMES.

The University, Durham,
July 28.

Catalysis.

IT is well known that only a few of the collisions between reacting molecules result in a reaction taking place, a certain 'energy of activation' being necessary to make the collision effective. The reducing factor for the case of three degrees of freedom is Exp. $(-E/RT)$ where E is the energy of activation. The value of E appears to be of the order of some tens of thousands, say, 50,000 calories per molecule. For a reaction at 1000° Abs., the index is of the order of -24.

Any cause which reduces the degrees of freedom by unity would reduce this index by one-third part; a reduction of two degrees of freedom would reduce it by two-thirds of its value and if all degrees of freedom were removed the index would disappear entirely. With the above value of E, the exponential factor in the several cases becomes (1) $3·77 \times 10^{-11}$ (2) $1·12 \times 10^{-7}$, (3) 3×10^{-4} and (4) unity, the first being the value met with in normal gas reactions.

Now an adsorbed layer of oriented polar molecules with their proper poles all pointing outwards toward a surrounding gas will tend to swing the colliding molecules round so that instead of it being a question of chance, it may become a certainty that the suitable poles for reaction to take place will be presented to one another; in this case, the rate of reaction passes from the first to the second of the above categories and it is therefore increased in a ratio of about 30,000 and we have a reasonable case of catalytic acceleration. If, further, the forces experienced by an oncoming molecule could swing it round the axis of approach so that it inevitably 'fits' its future partner, a second degree of freedom passes into the category of certainties and we have case (3) and the catalytic activity is multiplied by 10^9; and so on.

On the other hand, catalytic 'poisoning' occurs when the wrong poles are made inevitably to present themselves. A single layer might be quite effective in stopping a reaction; and a *very much smaller* quantity might reduce the rate a few hundred or thousand times, and this, in commercial practice, is equivalent to stopping it altogether.

It is quite commonly supposed that the facts of catalysis require a reduction in the value of E, whereas the above considerations show that E may remain of its normal value. To point this out is the main object of this letter. There is still considerable mystery enshrouding E. It is taken to be energy which a molecule must acquire before it can be in a reactive state; on the other hand, in the formula, it is calculated from the energy of molecular agitation. The need for a minimum velocity of agitation becomes clearer if we think of the corresponding case of expulsion of electrons by colliding α-particles: only particles of certain minimum velocities can penetrate the atoms to the requisite levels. Something of the same kind may be conceived as taking place in atomic interchange. If so, it is unlikely that the quantity E should change and considerations such as that taken into account in this communication become all-important.

ALFRED W. PORTER.

The Electrical Properties of Active Nitrogen.

WE have recently been investigating the electrical conditions obtaining in active nitrogen, and our findings seem of sufficient interest to justify a preliminary note thereupon. They are as follows:

(1) Removal of all charged bodies from a stream of active nitrogen is without effect upon its chemical properties, or the concentration of the chemically active species. Lord Rayleigh has already found that complete removal of ions from the glowing gas does not diminish its luminosity or its ability to develop spectra of other substances, but no examination has hitherto been made of any possible effects upon the

chemical activity. This result is in accordance with expectations.

(2) Constantinides has already found that the current which passes between two electrodes of different areas bathed in the afterglow is proportional to the area of the *cathode*, and has therefore concluded that the conductivity of active nitrogen is due to emission of electrons by the metal, either photoelectrically or else under bombardment by the luminous gas. We find that if the electrodes are placed in a thin quartz vessel surrounded by, but not actually containing, glowing nitrogen, no current passes, even under the most varied conditions of experiment both in the electrode chamber and outside. We therefore conclude either that the effect is produced by light of a wave-length less than 1400 A., or that the second of Constantinides' theories is correct, and that it may be regarded as evidence for the presence of a metastable form of nitrogen which is deactivated by the metal surfaces, with emission of electrons, as in the experiments of Oliphant upon metastable atoms of helium. When the electrodes are immersed in the glowing gas, the current depends upon the area of the cathode, as found by Constantinides, but also upon the metal of which it is composed. Attempts are being made to correlate it with the work-function of the metal; such estimates as we have been able to obtain suggest something greater than 4 volts as the minimum energy of the metastable body causing the emission of electrons.

(3) When the glow is destroyed by heating the gas before it reaches the electrodes, the conductivity also vanishes, but the concentration of chemically active nitrogen remains unchanged, as already found by one of us (E. J. B. W.); the observation seems to indicate that another modification of nitrogen is present which is chemically inactive, but able to cause metals to emit electrons, and possesses an energy of not less than about 4 volts. It may be noted that the Cario-Kaplan theory provides for the existence of metastable molecules of *c.* 8 volts, the destruction of the glow by heat being due on the same theory to the deactivation of these molecules on hot surfaces.

(4) We have been able to correlate the observed conductivity and glow intensity with the nature and concentration of the photogens, or other gases, present in active nitrogen.

E. J. B. WILLEY.
W. A. STRINGFELLOW.

Chemistry Department,
University College, W.C.1,
July 23.

Raman Displacements and the Infra-red Absorption Bands of Carbon Disulphide.

THE Raman spectrum of carbon disulphide has been determined by a number of observers (Gavesan and Venkateswaran, NATURE, **124**, 57; 1929; Petrikaln and Hochberg, *Zeit. phys. Chem.*, B. **3**, 217; 1929; and by Schaefer, Matossi, and Anderhold, *Phys. Zeit.*, **30**, 584; 1929). In all cases an intense line displaced by 654-658 cm.$^{-1}$ was observed, together with a weak line corresponding to 795-807 cm.$^{-1}$. The spectrum is of considerable interest, as it has been impossible up to the present to reconcile it with the observed infra-red spectrum as determined by Coblentz.

We have recently reinvestigated the absorption spectrum, using the vapour of carbon disulphide, and have explored the region from 1μ to 22μ. In this range there are four bands, *A*, *B*, *C*, and *D* at 878, 1522, 2179, and 2335 cm.$^{-1}$ respectively; of these, owing to its great intensity, *B* is probably a fundamental band, ν_3. Now it has been previously assumed (Ghosh and Mahanti, NATURE, **124**, 230; 1929; and *Phys. Zeit.*, **30**, 531; 1929; Snow, *Proc. Royal Soc.*, A **128**, 311; 1930) that the two Raman lines are in effect a doublet of the same nature as is given by carbon dioxide, and that this type of Raman spectrum is characteristic of such linear molecules: on this supposition Ghosh and Mahanti have averaged the frequencies of the two Raman lines and attempted to deduce the infra-red spectrum with this value as a fundamental. Nitrous oxide gives only one line, however, and we believe that the two lines for carbon disulphide have different origins. We postulate two additional fundamental frequencies, $\nu_2 = 655$ cm.$^{-1}$ (optically inactive), and $\nu_1 = 150$ cm.$^{-1}$ approximately. The spectra can now be summarised as in the table below. All frequencies are in wave numbers.

THE ABSORPTION SPECTRUM OF CARBON DISULPHIDE VAPOUR IN THE INFRA-RED.

Infra-red Band.	Raman Line.	Origin.	Calculated Value
(150)	—	ν_1	—
—	655	ν_2	—
—	800	$\nu_1 + \nu_2$	805
878	—	$\nu_3 - \nu_2$	867
1522	—	ν_3	—
2179	—	$\nu_3 + \nu_2$	2177
2335	—	$\nu_3 + \nu_2 + \nu_1$	2322

Some bands isolated by Coblentz seem to be characteristic of the liquid state as they are absent from our spectrum.

We would add that we have resolved with certainty two of these bands into *P* and *R* branches with a frequency difference of 12-13 cm.$^{-1}$. Carbon disulphide, then, is a rectilinear molecule with one moment of inertia, the value of which is approximately 312×10^{-40} gm. cm.^{2}

C. R. BAILEY
A. B. D. CASSIE.

Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College, London,
Aug. 5.

Absorption of Sound at Oblique Incidence.

IN the issue of NATURE for July 5 Dr. E. T. Paris discusses some recently published work at the Bureau of Standards on the absorption of sound at oblique angles of incidence. A detailed discussion of Dr. Paris's criticism of our experimental technique does not seem called for at present. These experiments are pioneer work on this subject, and it is much to be desired that others should give the question experimental attention, the more so because the Bureau's results are at variance with previous theoretical conclusions.

Paris (*Proc. Roy. Soc.*, A, **115**, p. 407; 1927) and Larmor (*Proc. Camb. Phil. Soc.*, **27**, part 2, p. 231; April 1930) have investigated the subject mathematically, and have reached conclusions which fail to agree, not only with the Bureau of Standards' results, but also with each other. For grazing incidence, Larmor finds that the absorption should be infinite, while Paris comes to the conclusion that it should be zero.

It would be very desirable that the reasons for this discrepancy in the two theories should be cleared up. It is possible that there is a fundamental inconsistency in the assumption of potential flow and absorption at reflection. This is pointed out in the Bureau of Standards' publication (Bureau of Standards *Journal of Research*, Feb. 1930). Sound absorption depends

upon friction in capillary channels, and must lead to rotational motion, not only in the absorbing material but also throughout a thin layer close to the surface; and in the presence of rotational motion there can exist no velocity potential.

As a similar phenomenon, the Prandtl boundary layer in aerodynamics may be cited. Although at some distance from an airfoil the motion of the air is well represented by potential theory, yet in the immediate neighbourhood of the surface the potential theory fails to give even a rough approximation to the actual motion. It is to the failure of the fluid to maintain irrotational (potential) flow in the neighbourhood of the surface that the whole lift and drag of an airfoil is to be ascribed.

It seems probable that an adequate theory of sound absorption must contain as an essential part a thin layer of air in rotational motion.

PAUL R. HEYL
(Chief, Sound Section).
Bureau of Standards,
Washington, D.C.

Influence of Nitrogen Dioxide upon the Ignition Temperature of Hydrogen-Oxygen Mixtures.

MR. H. J. SCHUMACHER has proposed (NATURE, July 26, p. 132) an explanation of the explosive action of nitrogen dioxide in hydrogen-oxygen mixtures at temperatures in the neighbourhood of 380° C. The ignition occurs according to Thompson and Hinshelwood between sharply defined limiting pressures of nitrogen dioxide. Schumacher's explanation is based upon the assumed competition of the following two reactions:

(1.) $NO_2 + O = NO + O_2 (+51 \text{ cal.})$
(2.) $H_2 + O = OH + H (+8 \text{ cal.})$

It is assumed that the oxygen atoms are produced from nitrogen by collisions with 'hot' molecules. Photochemical production of even greater numbers of oxygen atoms [1] than could originate in this way has been found unable to cause explosions at temperatures at which nitrogen dioxide in the correct concentrations is effective. On the other hand, the formation of water in the region immediately outside both limiting concentrations falls to negligible values, in contradiction to that which would be expected from the mechanisms (1) and (2).

The whole phenomenon is to be attributed to a process occurring at the wall of the reaction chamber [2] where the so-called non-stationary explosions are stimulated by very small quantities of nitrogen dioxide added to the gas and hindered by greater additions which poison the surface.

L. FARKAS.
P. HARTECK.
Kaiser Wilhelm-Institut für Physikalische Chemie und Elektrochemie,
Berlin-Dahlem.
July 31.

[1] *Die Naturwissenschaften*, p. 266, 1930, and p. 443, 1930; also Vortrag: Bunsen Tagung, Mai, Heidelberg, to appear shortly in *Zeitschrift für Elektrochemie*.

[2] H. N. Alyea und F. Haber, *Die Naturwissenschaften*, p. 441, 1930.

Boscovich and Theories of Light.

IN histories of science full justice is done to the perspicacity of Newton in suggesting a compromise between the corpuscular and undulatory theories of light. According to Mr. Dampier-Whetham, "the most striking feature about Newton's theory is its resemblance to quite modern conceptions". Speaking elsewhere of recent views about light, he refers to one which postulates "a complex of particles and waves which recalls even more vividly Newton's ideas".

No mention, however, is made of the efforts of Boscovich to give a working hypothesis which would combine the good points of both conceptions. In Mr. Dampier-Whetham's book "A History of Science" Boscovich is mentioned only in connexion with his theory of matter and then the name is spelled Boscovitch. In his "Philosophiæ Naturalis Theoria" (my copy is dated Vienna, 1759, therefore one year after the first edition) Boscovich certainly sums up in favour of a corpuscular theory and "contra omnes alias hypotheses, ut contra undas, per quas olim phænomena lucis explicare conatus est Hugenius". But he is aware of the strong points of the wave theory and suggests that the light particle has an oscillatory movement. Doubtless the idea is crude and is founded chiefly on the assumption of unequal initial velocities of the components of each particle when expelled from the light source; but it was considered sufficiently important to be noticed by Thomas Young.

W. A. OSBORNE.
University of Melbourne,
June 26.

THE extract from the writings of Boscovich which Prof. Osborne quotes is interesting. Until the reason for the rectilinear propagation of light-waves was explained by the work of Young and Fresnel on interference, the difficulties of an undulatory theory were very great, and it is not surprising that Boscovich, like Newton, "sums up in favour of a corpuscular theory". His attempt to combine with it some of the advantages of a wave theory as described by Prof. Osborne seems to me less successful than the method adopted by Newton.

C. DAMPIER-WHETHAM.

Curling.

IN NATURE of Mar. 15 there appeared a letter by W. H. Macaulay and Brig.-General G. E. Smith in which a theoretical treatment of curling was given. The results or conclusions were so nonconcordant with the known behaviour of curling stones that the authors ended their letter by raising a question as to what important feature of the motion had been overlooked.

As it is obvious that the writers were unaware of the experimental study of this problem made by myself, may I direct attention to the report on this work which was published in the *Transactions of the Royal Society of Canada*, Vol. 18, p. 247; 1924. The experimental work involved not only observing the motion of curling stones on standard ice sheets such as are regularly employed in curling, but also a study of torques transmitted to curling stones by a motor-driven rotating ice sheet. The results definitely pointed to the conclusion that the explanation of the curvature of the path taken by a stone possessing both translational and rotational velocities was to be found neither in the suggestion of Sir Gilbert Walker that the friction was greater on the rear edge of the cup nor in any differential air pressure effects as others have suggested, but rather hinges on the very rapid increase in the ice-stone friction as the velocity of the stone with respect to the ice becomes low and approaches zero. This means that the edge of the cup on which the tangential velocity due to the rotation is in a direction opposite to the direction of the translational velocity of the stone, that is, the slow edge of the cup, will experience a greater friction than the diametrically opposite portion of the rim. The

difference between the two forces—in other words the asymmetry of the retarding forces—and the resulting curvature in the path taken therefore depend not only on the 'speed' and the 'spin' given the stone, but also on the ice conditions, just as is observed in practice.

E. L. HARRINGTON.

Physical Laboratory,
University of Saskatchewan,
Saskatoon, Sask., Canada.

Holes produced in Ground by Lightning Flash.

DURING a thunderstorm of considerable severity which passed over a district near Rothbury, Northumberland, on the afternoon of Tuesday, Aug. 12 last, a flash of lightning apparently struck the ground and produced in it a vertical hole, approximately circular in section, and found on measurement to be 1 ft. 11 in. in depth. The hole is tapered, being 6 or 7 in. in diameter at the surface and about 2 in. in diameter at a distance of a foot below the surface. The hole was made in a grass field which lies on sloping ground and which consists of light loamy soil. The field, about 17 acres in extent, is almost surrounded by trees (chiefly firs). The position of the hole is not at the highest part of the field, but several feet below the highest level, while beyond the field are hills and moorland rising to a height of some hundreds of feet above the field. In the field is a clump of fir trees, close to which is a small hut, distant from the hole about 60 yards. A gamekeeper who was in the hut at the time the flash occurred was thrown violently backwards by the concussion which followed the flash, although he is confident he did not experience any electric shock. A hen in a coop about 10 ft. from the hole was killed, as also were four young pheasants, one inside the coop, and three near, but outside, it. A heavy rain accompanied the storm, which might account for the absence of any sign of burning round the hole. There were also two smaller holes formed at distances respectively of 4 ft. 6 in. and 7 ft. 6 in. from the main hole. The first was nearly horizontal, was open on the surface for some 10 in., and, for the few inches where it penetrated the surface, was about half an inch in diameter. The second was smaller still, slightly inclined to the vertical, and approximately a quarter of an inch in diameter and some two or three inches deep.

Apart from the well-known phenomenon of 'fulgurites', it would be interesting to learn if effects similar to those above described are familiar to meteorologists.

WILFRED HALL.

Hepple, Northumberland,
Aug. 26.

Adsorption of Hydrogen and Carbon Monoxide on Oxide Catalysts.

IN the course of experiments on the heats of adsorption of hydrogen and carbon monoxide on oxide catalysts, it was observed that these gases behaved in a curious manner on desorption. Hydrogen or carbon monoxide adsorbed at room temperature on the $ZnO - Cr_2O_3$ catalysts at equilibrium pressures of 10^{-3}-10^{-4} cm. was evolved on raising the temperature to 100°-120°, but within a period of 20-30 minutes, it was readsorbed on the surface giving a hard vacuum in the containing vessel. On further raising the temperature, no gas was evolved until 350° C., when water vapour or carbon dioxide respectively was liberated. Mixtures of hydrogen and carbon monoxide behaved similarly, being evolved and readsorbed at 100°-120° C. and finally at 350° C. being converted into a mixture of water and carbon dioxide, no appreciable quantities of organic compounds being formed.

Hydrogen on copper oxide gives similar phenomena, as was shown by Mr. M. H. Hall.

Hydrogen or carbon monoxide is thus adsorbed on oxide surfaces in two distinct ways, one occurring at room temperatures, the process being reversible, and the other occurring at higher temperatures, which is irreversible. The reduction of oxides by either hydrogen or carbon monoxide therefore occurs in three stages, (1) the physical adsorption of hydrogen, (2) the chemical combination with the surface atoms, and (3) the desorption of water or carbon dioxide. It is curious that the physically-adsorbed gas must leave the surface before it can enter into chemical combination with the metallic oxides.

W. E. GARNER.
F. E. T. KINGMAN.

Department of Physical Chemistry,
The University,
Bristol.

Capture of Electrons by α-Particles.

EXPERIMENTS, similar to those of Davis and Barnes (*Phys. Rev.*, **34**, 152, 1929; **35**, 217, 1930), have been made, in which a beam of α-particles passed through a stream of electrons, moving parallel to the α-particles. The apparatus differed from that of Davis and Barnes chiefly in that a Geiger counter, with mechanical recording system, was used in place of a scintillation screen, and that the polonium was inside the evacuated vessel. The number of singly-charged particles was always about one per cent of the total. The numbers of both doubly- and singly-charged particles were found to be entirely unaffected by the electron stream throughout the voltage range investigated, namely, from 450 to 750 volts. In particular, no capture was observed when the velocities of α-particles and electrons were nearly equal. Capture by the doubly-charged particles to an extent of less than 0·5 per cent would probably not have been detected, on account of probability error. N. A. de Bruyne was associated with me during part of this work.

H. C. WEBSTER.

Cavendish Laboratory,
Cambridge.

Palæolithic Man in North-East Ireland.

THE series of Late Glacial and post-Glacial deposits reported upon by Dr. R. Lloyd Praeger from the Lagan estuary at Belfast [1] has been described as the most complete stratigraphical record of the post-Glacial sequence in the British Isles. The basal reassorted boulder clay was here overlain by grey sand with cold fauna, an early peat yielding *Cervus megaceros*, and superimposed estuarine clays, the lower of which has been elsewhere shown to have preceded the deposition of the well-known 25 ft. raised beach. We have recently found in such lower estuarine clay, in the neighbourhood of Larne, a derived but well-developed Magdalenian industry in flint. This industry will also be described by Mr. Burchell in his presidential address to the Prehistoric Society of East Anglia for 1931.

J. P. T. BURCHELL.
C. BLAKE WHELAN.

[1] Praeger, "On the Estuarine Clays at the new Alexandra Dock, Belfast": *Proc. Belfast Nat. Field Club*, series 2, vol. 2, Appendix for 1886–87, pp. 29-52, 1887.

Science and Industry in Bristol.

By Engr. Capt. EDGAR C. SMITH, O.B.E., R.N.

NINETY-FOUR years ago the British Association, then but six years old, visited Bristol. After holding its first gathering at York in 1831, it had met at Oxford, Cambridge, Edinburgh, and Dublin, and then breaking away from the universities it came to a city the history of which is bound up with shipping, manufacture, and trade. Bristol to-day possesses its own university, with buildings which in beauty and dignity rival any to be found elsewhere, yet its geographical position and the energy and enterprise of its citizens have made it one of our chief commercial centres, and such it will probably remain. "The story of the trade of Bristol for a thousand years", said Mr. Baldwin when Prime Minister, "is the story of the trade of England", and at the recent summer meeting of the Institution of Mechanical Engineers the Lord Mayor and others referred with pride to Bristol's multiplicity of manufactures, volume of shipping, fine docks, air port, and municipal activities.

From very early times Bristol was a town of importance and a trading centre. When London had but 35,000 inhabitants, Bristol numbered 9000, and to-day it boasts of a population of some 400,000, the great majority of whom are connected with factories, warehouses, docks, and shipping. Declared by an early writer as a port fit and safe for a thousand ships, for the Siege of Calais Bristol provided Edward III. with 24 ships and 600 seamen; its Merchant Venturers stimulated both overseas commerce and exploration, and the noble memorial tower to the Cabots, erected in 1897, is a reminder of the famous voyage of the Bristol ship *Matthew*, which left the port on May 10, 1497, carrying the first Englishmen who ever saw the coast of North America.

If Bristol is a city concerned mainly with grain, fruit, sugar, chocolate, oil, and tobacco, with markets and commodities, it is nevertheless a city abounding in ecclesiastical, archæological, literary, and scientific associations. Few there are who go to Bristol who fail to visit St. Mary Redcliff, described by Leland as "by far the fairest of all churches", or recall the sad story of the unhappy poet Chatterton, whose boyhood was passed beneath its shadow. It was his strange work which brought Johnson and Boswell to Bristol, and led Johnson to remark, "This is the most extraordinary young man that has encountered my knowledge. It is wonderful how the whelp has written such things."

Scarcely less remarkable for his early achievements, but more fortunate in his environment than the Bristol attorney's apprentice, was the surgeon's apprentice from Penzance, Humphry Davy, who, still under the age of twenty, came to Bristol in 1798 to take charge of the laboratory at the Pneumatic Institution of Dr. Beddoes. A student of medicine in London and Edinburgh and sometime reader in chemistry at Oxford, Beddoes thought that the study of the physiological effects of different gases might have important therapeutic applications, and with this in view opened his hospital at Bristol. Known already to the Wedgwoods, to Gregory Watt, and to Davies Gilbert, through Gilbert, Davy joined Beddoes, and on Oct. 2, 1798, began work in the laboratory. If to the Bristol period of Davy's brilliant career belongs the publication of hastily conceived theories and ill-supported conclusions, to it also belongs the discovery of the effect on human beings of nitrous oxide. "A young man, a Mr. Davy, at Dr. Beddoes'," wrote Maria Edgeworth, "who has applied himself much to chemistry, has made some discoveries of importance, and enthusiastically expects wonders will be performed by the use of certain gases which inebriate in the most delightful manner, having the oblivious effects of Lethe, and at the same time giving the rapturous sensations of the Nectar of the Gods!"

At the time Davy was with Beddoes, and when he began his friendships with the Edgeworths and with Southey and Coleridge, the only means of reaching Bristol was by boat or horse or coach, and it was by these means that the members of the British Association came to the meeting of 1836, presided over by the Marquess of Lansdowne. From the north came Brewster, father of the Association, and J. D. Forbes; from Cambridge came Whewell; from London, Babbage, Wheatstone, Lardner, and Roget; and from Plymouth, Snow Harris. Brewster had spent a week with Fox Talbot at Lacock Abbey—"a paradise: a fine old abbey with the square of cloisters entire, fitted up as a residence, and its walls covered with ivy and ornamented with the finest evergreens"—now known to every student of the early history of photography. During the meeting Brewster stayed with "Mr. Daniells, Clifton", as also did the German geologist von Raumer. "The Bristol meeting went off extremely well", wrote J. D. Forbes from Edinburgh, to de la Rive, "and promises admirably for the permanency of the Association." For Forbes and his family, Bristol was to have other memories, for it was to the skill and attention of Dr. J. A. Symonds of Clifton he owed the prolongation of his life. To Symonds, whose house is now a hall of residence for women undergraduates, Forbes in after years sent the first copy of his *opus magnum*, his valuable historical review of the progress of physical science from 1775 to 1850, contained in the 8th edition of the "Encyclopædia Britannica". It was at Clifton, too, that Forbes on the last day of 1868 breathed his last.

If travellers in 1836 had still to submit to the discomforts of the mail coach, they were all acquainted with the progress of the new railways, and no visitor to Bristol could have failed to hear of Brunel, then engaged on the construction of the line from Bristol to London. Brunel with Locke and Robert Stephenson formed the triumvirate of the early railway world, and Brunel's finest monument is the Great Western Railway. A Bristol and London Railroad Company had been formed in the Bristol Guildhall on July 30, 1833, and two

years later Brunel wrote: "I am thus engineer to the finest work in England. A handsome salary, on excellent terms with my directors, and all going smoothly." Opened as far as Maidenhead in 1838, the line was extended to Reading early in 1840, Bristol and Bath were joined in August of the same year, and Bristol and London in June 1841. When next the British Association met in Bristol no fewer than 17,000 miles of railroad had been laid down in the kingdom, and Brunel's bridges and viaducts were the admiration of the world.

Brunel's association with Bristol did not end, however, with the railway. The line from London to Bristol had given birth in his remarkable mind to the idea of a steamship to connect Bristol with New York, and on the banks of the Avon in 1836 was laid the keel of the most famous and most successful of all early trans-Atlantic liners. Designed by Brunel, built by Patterson, and engined by Maudslay of London, the *Great Western* was 236 ft. long, 2300 tons displacement, and 750 horse-power. She left Bristol on her maiden voyage, on April 8, 1838, crossed to New York in fifteen days, and before she was sold in 1846 she had crossed and recrossed 74 times. What George Stephenson's Liverpool and Manchester line of 1830 had been to the railway so the *Great Western* was to trans-Atlantic steam navigation. Neither must it be forgotten that Brunel's *Great Britain*, the first screw ship to cross the Atlantic, was also built at Bristol.

Just as the builders of railways had to fight opposition and disarm criticism, so the promoters of the Atlantic steamships had to face scepticism, and the British Association meeting of 1836 gained a certain notoriety through the public lecture of Lardner, then professor of natural philosophy and astronomy in University College, London, and the recognised and popular exponent of science. Lardner in his lecture saw fit to sound a note of caution regarding the scheme for trans-Atlantic steam navigation, but himself incautiously spoke of it as chimerical. The storm of protest which broke upon his head was more or less deserved, but the letters of Macgregor Laird and others were not half so effectual a reply as the fine performances of the *Great Western*.

Brunel had first become known in Bristol through his plans for a bridge to span the Avon at Clifton. His were not the only plans and Brunel did not live to see the bridge erected, but when in 1864 the fine suspension bridge was opened, incorporated with it were the chains from the old Hungerford footbridge over the Thames at London, built by Brunel in the 'forties, but which had had to make room for Hawkshaw's Charing Cross Bridge. The responsibility for the Clifton Bridge we see to-day was shared by Hawkshaw and Barlow, and it was Hawkshaw who in 1875 came to Bristol to preside over the British Association on the occasion of its second visit to the city.

By 1875 the British Association had become a great national institution, having long achieved that permanency Forbes hoped for, while the names of Huxley, Darwin, Tyndall, and Thomson were on everybody's lips. Serving many causes, it had especially promoted the spread of knowledge, and its second visit to Bristol took place just before the birth of the college which was founded in 1876 and from which has sprung the university which is to-day one of the glories of the city. With an ancient grammar school, and the newly founded Clifton College within its boundaries, Bristol in the early 'seventies was still without the means for higher instruction. But following the lead of London, Newcastle, Manchester, North Wales, and Leeds, and supported by Balliol and New College, Oxford, Bristol on June 11, 1874, at the Victoria Rooms, Clifton, launched the scheme for a college of university rank. Backed by the great influence of Jowett and of Percival, then headmaster of Clifton College, the scheme was further discussed at a meeting in August 1875, while the British Association was in session, and in 1876 the college began its work.

The first lectures of the college were given in a dilapidated old house in Park Row, at the top of Park Street; the first professor of chemistry was Letts; the first principal, the economist Alfred Marshall. The removal of Letts to Belfast and of Marshall to Cambridge opened the path for Ramsay, who at the age of thirty had already made his mark, and under him and his colleagues—Lloyd Morgan (who succeeded him as principal), Orme Masson, Sydney Young, Silvanus Thompson, Sollas, Hele Shaw, and others—the college soon attained to a leading position among the provincial centres of learning and research, and in 1909 it was raised to the dignity of a university. In St. Mary's Redcliff is a window to "the pious memory of men who made Bristol famous in the fourteenth and fifteenth centuries". No such memorial will be necessary for the men who have made Bristol famous in our own day: for their energy, enterprise, foresight, and munificence have already raised an enduring monument in the splendid range of university buildings, associated particularly with the name of the Wills family, which stands at the top of Park Street, where was once the house which sheltered its earliest professors and students.

The connexion of industry and science with Bristol might well be illustrated by references to many other men, places, and events. More than two hundred years ago, the famous Abraham Darby, before removing to Coalbrookdale, founded in Bristol the Baptist Mills Brass Works, where, with the aid of Dutch workmen, he endeavoured to meet a need of the times by casting iron pots in moulds of sand to take the place of the more expensive brass pots; while to Peregrine Phillips, Jr., a Bristol vinegar maker—of whom Sir Ernest Cook wrote in NATURE of Mar. 26, 1926, p. 419—we owe the invention of the contact process for the manufacture of sulphuric acid. Though the particulars of his invention are fully known, it is otherwise with the career of Phillips, details of whose life have escaped both the historians of chemistry and biographers. In our own time there have been few who have furthered the interests of science in

(*Continued on p.* 371.)

Supplement to NATURE

No. 3175 SEPTEMBER 6, 1930

Size and Form in Plants.

By Prof. F. O. BOWER, F.R.S., President of the British Association.

INAUGURAL ADDRESS DELIVERED AT BRISTOL ON SEPT. 3.

TWO years have passed since the British Association last met in Britain. Events have happened in that interval which mark the close of the Darwinian epoch. Down House, in which Darwin lived and worked, has been bought, restored, and endowed by Mr. Buckston Browne and presented by him to the Association, which holds it in custody for the nation. The house is now open as a shrine to those who treasure Darwin's memory. They may enter the study where the "Origin of Species" was penned, or wander out to the Sand Walk, and draw such inspiration as those spots may yet afford to those who are face to face with problems cognate to his own. These years have also severed personal links with Darwin himself. Sir William Thiselton-Dyer, who died in December 1928, had been his frequent correspondent. It was he who, more than any other, carried the evolutionary stimulus forward into the botanical schools of Britain. Sir Edwin Ray Lankester, whose portrait by Orpen was a poignant feature of last year's Academy, died in August 1929. Not only was he the leading zoologist of his time, but he has left a deep impress on general morphology; for he was the first to analyse from the evolutionary aspect the degrees of 'sameness' of parts, whether in animals or in plants. These two octogenarians were among the latest links between Darwin himself and living men of science; so this last meeting of the Association before its centenary next year falls at a nodal point in the personal history of evolution.

Morphology, or the study of form, was closely interwoven with the life's work of Darwin, and—to use his own words—"it is one of the most interesting departments of natural history, and may almost be said to be its very soul". Since the Association has seen fit to choose as this year's president a botanist whose work has dealt specially with form in plants, the occasion seems apt for considering certain morphological questions that present themselves in this eighth decade since the "Origin of Species" was published.

The word 'morphology' was applied by Goethe in 1817, in a general sense, to the study of form. Though a pre-Darwinian, he showed rare foresight in insisting that the living form is only momentarily stable, never permanent. But years elapsed before that instability of form of living things, which he clearly saw, became the very focus of evolutionary theory. Even Goethe's prophetic gaze was blurred by the hazy imaginings of idealistic philosophy. The clarifying mind of Schleiden resolved that mist by resort to naked fact. In 1845 he stoutly asserted that the history of development is the true foundation for all insight into living form. This opened the way for a host of workers, who patiently observed and compared the facts of individual development, particularly in plants of low organisation. By them the field was prepared for the magic touch of Darwin; and, in the enthusiastic words of Sachs, "the theory of descent had only to accept what genetic morphology had actually brought to view".

The effect of that theory should have been to sweep aside all idealistic morphology based on the higher forms, and to rivet attention upon organisms low in the scale. It was the habit of starting comparison from the highest state of organisation that was the fundamental error of the idealistic

Nature-philosophers; even now traces of it still persist. An illuminating alternative was presented by that noble passage with which the "Origin of Species" ends. Speaking of his theory, Darwin wrote: "There is a grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or into one; and that—from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved." He forecast from the application of his theory that "our classifications will come to be, as far as they can be so made, genealogies; and they will then truly give what may be called the plan of creation".

Whether there was only one original form of life or many is still an open question. Nevertheless, among the welter of organisms rightly held as primitive, the Flagellata may with some degree of reason be named as combining in their motile and sedentary stages respectively the animal and vegetable characters. They suggest a sort of starting-point from which the two kingdoms might have diverged. The probability of their common origin is strong; but the divergence must have been early, each taking its own independent course, with increasing size and complexity of the individual. In tracing this I would ask special attention to the kingdom of plants.

The first of the laws laid down by Lamarck in his "Histoire Naturelle" as fundamental in the evolution of animals and plants ran thus: "Life by its intrinsic forces tends to increase the volume of every living body, and to enlarge its parts up to a limit which it determines itself." When in unicellular organisms, following this law, a certain size has been reached, fission follows, and the equal halves separate as new individuals. In pluricellular bodies, however, the products of cell-division do not separate, but continue a communal life; and the individual may increase, with further division of its cells, to large size and complexity. We may picture how, based upon the mobile stage of a Flagellate, the aggregate might form an animal body with motility as a leading feature; on the other hand, based upon the sedentary stage, an immobile plant body would result. The animal, adopting a predatory habit and colourless, might progress along lines of dependent nutrition, finding and ingesting food already organised; the sedentary green plant might evolve along lines of physiological independence, constructing its own organic supplies. Whether or not this be a true picture, the whole organisation of the two kingdoms diverged on the basis of nutrition. Herbert Spencer contrasted them physiologically, showing how animals are expenders, while plants are accumulators; that the former are limited in their growth by the balance of expenditure against nutrition; in the latter, growth is not so limited. Thus the problems that follow on increasing size may be expected to work out differently in view of the animal kingdom comprising organisms of high expenditure and not self-nourishing, while plants are self-nourishing accumulators.

The result of this difference may be illustrated by contrasting some of the highest examples of either kingdom: for example, the elephant with the trees of the forest through which he roams; on one hand, the relative fewness of the mobile elephants, their less stature and compact form, their columnar legs needed to support the barrel-like body, the receptacle for ingested food, the economy of external surface and the highly developed internal surfaces; on the other hand, the height, immobility, and large number of the trees, with their massive stems and highly complex shoots and roots, so necessary for acquiring food directly from the air and soil. We may further contrast the genesis of the individual in either case. In the mammal the parts are formed once for all, its embryology being an incident closed early in the individual life; but in the tree, embryology may be continued for centuries, and is theoretically unlimited, except by death; during life it has the power of producing leaves and branches from every distal bud. The fact is that, though certain underlying principles are the same for both kingdoms, the working out has been distinct from the first. Hence the morphology of plants must stand on its own feet; indeed, it has been said with some degree of truth that whenever botanists have borrowed their morphological outlook from the sister science they have gone wrong.

The normal development of a multicellular plant starts from the fertilised egg, and elaboration both external and internal follows on increasing size. Polarity, that is the distinction of apex and base, is defined in most plants of high organisation by the first cell-cleavage. The apex adopts at once the continued development that is its characteristic. Branching of various types follows in all but the simplest, to constitute the complex shoot, while correlative basal branching gives the root-system that fixes the non-motile body in the soil. The scheme of growth and branching thus started is theoretically open to unlimited increase, and the initiation of new parts is in point of number on a geometrical scale. This

is suitable enough for organisms able to accumulate material, as plants do; indeed, the elaboration of the vegetative system will enhance its powers of self-nutrition, so far as the parts become functional; but this is never fully realised beyond the earlier steps.

The focus of all such development is the growing point, respectively of root or shoot. Anyone who carefully dissects a suitable bud, peeling off the successively smaller leaves, may finally see with the naked eye or with a simple lens a pearly cone of semi-transparent tissue at the tip of the stem. This is the growing point itself, which possesses theoretically unlimited formative power. It is like a permanent sector of the original embryo that is fed continually from the mature tissues below, and as continually forms fresh tissues at the tip. But as the tip advances, lateral swellings of the surface appear in due order, which are new leaves and buds. Various attempts have been made to link the genesis of these outgrowths of the radial shoot with the outer world as regards their position and number. But we have it as the latest authoritative statement on this point that such a relation does not exist. " This much is proved," says Prof. von Goebel, that, " so far as we can see, the question relates to conditions of growth and symmetry that arise in the growing point. All theories as to leaf-position that allotted a passive rôle to the growing point were mistaken, however acute the reasoning that was brought to bear thereon" ("Organographie", 3rd ed., part I., pp. 299-300). This is Von Goebel's summing up for external parts. On the other hand, within the growing point, and often, though not always, related to the external parts, there is a progressive formation of internal conducting tracts, continuous from the adult region upwards to the tip. A like reference of the origin and disposition of these vascular tracts to the growing point itself appears to be equally justified. In fact, the tip possesses the initiative for both.

The complex shoot that results from such initiation is exposed as it matures to external conditions which modify its form. Their effect is very obvious in the young shoot of the higher plants. As the shoot elongates, its young tissues are soft and plastic. While in this state its form may be influenced by gravity, the incidence of light, mechanical contact, and other causes which produce reactions of form called 'tropisms'. All of these promote the well-being of the whole. The net result becomes fixed as the part matures, and its constituent tissues harden. Thus the adult form is the consequence of the primary initiation at the growing point, modified by the conditions to which the plant may have been exposed during the plastic period. This is a commonplace of the text-books. But amid all the careful analysis and experiment that has been devoted to the influences which thus affect form, one factor, insistent and unavoidable, has been habitually left out, namely, the influence of size. Reference is occasionally made in text-books to the effect of surface tension in determining the simple form in minute organisms, such as unicellular Algæ and Bacteria; and to the deviations from that simple form as the size increases, and the influence of surface tension ceases to be dominant. At the other end of the scale of size, mathematicians have calculated the extreme stature mechanically possible for a tree-trunk constructed after the ordinary plan, and of materials of known strength. The result is about 300 feet, and this coincides approximately with the limit of height of the canopy of a tropical forest. But in point of size practically the whole of the vegetable kingdom lies between the microbe and the forest tree. Unfortunately, the study of these middle terms, from the point of view of change of form as the size increases, has not been pursued by botanists with the same perception as zoologists have shown in the study of animals.

At the back of all problems raised by increasing size stands the well-known principle of similarity, which applies to all structures, inorganic as well as organic. It involves among other consequences that where form remains unaltered bulk increases as the cube, but surface only as the square of the linear dimensions. But in living organisms it is through the limiting surfaces, or 'presentation-surfaces', as they are called, that physiological interchange is effected. Provided a surface be continuous and its character uniform, it may be assumed that such interchange will be proportional to the area of surface involved. If, then, the form of the growing organism or tissue were retained as at first—for example, a simple sphere, oval, or cylinder—its surfaces of transit would increase at a lower ratio than the bulk which they enclose. There would be with increase in size a constantly decreasing proportion of surface to bulk, and as constantly an approach to a point of physiological inefficiency. But any change from a simpler to a more complex form would tend to uphold the proportion of presentation-surface. Thus the success of a growing organism might be promoted by elaboration of form. Naturally, other factors than that of size co-operate in determining form.

Nevertheless, the recognition of such elaborations of form, whether external or internal, as do tend in point of fact to maintain a due proportion of surface to bulk as growth proceeds, should help to make morphology a rational study. The diffuse form habitual for plants, even the origin of leaves themselves, becomes intelligible from this point of view.

In the construction of any ordinary vascular plant there are three of these 'presentation-surfaces' or limiting surfaces of transit, that are of prime importance: (i) The outer contour by which it faces the surrounding medium; (ii) the sheath of endodermis which envelops the primary conducting tracts; and (iii) that collective surface by which the dead woody elements face upon the living cells that embed them, through which water and solutes pass in or out. Each of these may vary independently of the others, and each would be a fitting subject for observation as bearing on this problem of size. But as a test case of the relation between size and form, it is the collective surface where dead wood faces on living cells that will meet our requirements best, for its study can be pursued among fossils almost as well as in living plants. The problem is one not merely of current physiology of the higher plants: it is one of adaptive progress. Accordingly, measurements must be made of the wood of fossils as well as of living plants, and of young sporelings as well as of the adult.

We have seen that plants are essentially accumulators of material. A natural consequence of this is that primitive types, endowed with apical growth but with no secondary cambium, will enlarge from the base upwards. Any sporeling fern shows this. The leaves themselves increase in number; each successive leaf is as a rule larger than the one that came before, and the stem that bears them also expands upwards. In fact, it takes the form of an inverted cone. To grasp the size problem for primitive plants the mind must be rid of the idea of the forest tree, with its stem tapering upwards, for that is a state of highly advanced organisation. The primitive form of stem is that of an inverted cone, enlarging upwards, with a solid core of wood within. A cone standing upon its tip is obviously unpractical. Not only is it mechanically unstable, but if the original structure be maintained so that the larger region above is structurally a mere magnified image of the smaller below, a constantly diminishing proportion of presentation-area to bulk must needs follow, in respect of all the limiting surfaces. Such stems would all tend to become physiologically insufficient. Our immediate problem is with the woody column. How can that due proportion of presentation-surface of the dead wood to the living cells, which physiologists hold to be essential, be maintained in the expanding stem, so as to meet the increasing requirements of transit and distribution of the sap?

This is not the place for a recital of the details of elaboration of the wood which have been observed and measured. It must suffice to state in general terms how primitive woody plants have met the difficulty in the absence of cambial thickening. The starting-point is a minute cylindrical strand composed of dead tracheids only. Some primitive types show nothing more than a conical enlargement of this upwards, with the cells more numerous than before. The approach of a locomotive at speed along a straight track may visually suggest such increase in size without change of form; successive photographs of it might be compared with successive sections of those simple stems enlarging upwards without change of plan. The largest examples of this are found in some of the early club mosses and ferns, in which there is an enlarging solid woody core. But for want of resource in this and other features they have paid the penalty of death. Most plants having this crude structure are known only as fossils, and no really large vascular plant lives to-day which shows it. Under present conditions, it is only where the size is small that a simple mass of dead tracheids seems to be effective for water transit. Thus we see that simple enlargement without change of form does not suffice.

In more resourceful plants a remedy is found in elaboration of the form and constitution of the primary wood. The changes which actually appear in it, as the size of the individual or of the race increases, are very various, but they all tend towards making the wood a living whole. The most efficient state would be that in which each dead woody cell or element faces upon one or more living cells, and this structure is approached in modern types of wood. In tracing the steps which have led towards it, whether in the fossil story or in the individual life of plants, we follow up an evolutionary history of high functional import. Actual measurements and calculations have shown in living plants the advantage that follows. It has been found that changes in the elaboration of form and structure of the primary woody column have saved, in specific instances, about 50 per cent of the contingent loss in that proportion of presentation-surface to living tissue which would

have followed if a simple cylindrical core had been retained. The structural changes do not, it is true, maintain the full original ratio of surface to bulk, but it may well be that saving even half of the contingent loss would bridge the acute risk and lead to survival.

The moulding and subdivision of the primary conducting tracts as a whole, or of the woody masses which they contain, present the most varied features. Their contours often appear arbitrary and even irrational, so long as no underlying principle is apprehended. They have presented a standing problem to anatomists. But when it is realised that as the size increases there is a physiological advantage in any elaboration of form whatsoever, a rational explanation is at hand. The variety of the forms assumed suggests the common principle underlying them all, which is that thereby a due proportion of presentation-surface tends to be maintained.

One of the simplest and most frequent examples of such elaboration of form is that of the fluted column, which in transverse section gives the familiar stellate figure characteristic of roots. It is also seen in many stems, and is described as 'radial'. Where the part is small the woody strand is roughly cylindrical, but where larger it often becomes fluted, with varying number and depth of the flanges. In many instances the ratio of their number to the diameter of the whole tract is approximately constant. The structure is in fact adjusted to the size. This is so in roots generally, in leafy stems, and in leafless rhizomes—and a similar size relation is even found in the fluted chloroplasts of certain Algæ. In all of these an obvious risk following an increase in size tends to be eliminated, namely, an undue loss of proportion of surface to bulk.

The somewhat technical facts thus briefly described may be taken as examples of a relation of form to size which is very general. They suggest the existence of a 'size factor', which is effective in determining form. The susceptibility to its influence resides in the part that shows the results. The internal contours are defined *ab initio*, instead of coming into existence during the course of development, as is the case with the convolutions of the mammalian brain. In the stem and roots of vascular plants the fully matured conducting tracts may be traced upwards, with their outlines already defined, through successive stages of youth towards the growing point, which has been their source. Their form may be seen already outlined in its young tissue closely short of the extreme tip. This fact suggests that the susceptibility to the size factor resides in the growing point itself, for immediately below it those tracts possess that form which will aid their function when they are fully developed.

Of all the factors that contribute to the determination of form in growing organisms, there is none so constant and inevitable in its incidence as this size relation. Its operation becomes manifest with the very first signs of differentiation of the embryonic tissues. The effects of other factors that influence form, such as gravity, light, temperature, contact, and the rest, appear later in point of time. Their influence is liable to diminish as the organism reacts to them by curvature or otherwise, and to vanish when the reaction is completed. Under experiment they may be controlled or even inhibited. But the operation of the size factor is insistent; it cannot be avoided either under conditions of Nature or by experiment, though the size itself may be varied under conditions of nutrition, and the permeability of the presentation-surfaces may not be constant, with results as yet unknown. When we reflect that all acquisition of nourishment and transit of material in plants of primary construction is carried out through limiting surfaces, the essential importance of the size factor is evident, for upon its influence the proportion of each presentation-surface itself depends.

The evidence that size itself is, among other factors, a determinant of form rests upon the constancy with which, in an enlarging organism, changes of primary form tend to maintain a due area of presentation-surface such as active transit demands. That evidence has been derived chiefly from the conducting tracts of primary individuals as they enlarge conically upwards, and from parts belonging to distinct categories, also from comparison of different individuals not necessarily of close alliance. Very cogent evidence lies in the variety of the changes of form by which the same end is attained. Finally, the converse facts bring conviction when, as often happens, a distal diminution of size in stem or leaf is accompanied by simplification along lines roughly the converse of those that follow increase.

All this shows that a real relation exists between size and primary form. The term 'size factor' has been used to connote that influence which affects form in relation to size, but without defining it except by its results. Nevertheless, we have seen that its action may be located in near proximity to the growing point, or in the embryo itself.

It has not, however, been found possible to assign to that effect an immediate cause. The attitude thus adopted towards an undoubted factor seems justified by the broad logic of science, and by the practice of its highest votaries. When Newton put together his great physical synthesis, he pointed out at the close of the "Principia" that the cause of gravitational force was unknown. "Hitherto I have not been able to discover", he said, "the cause of these properties of gravity from phænomena, and I frame no hypotheses." Likewise, in its own more restricted field of botanical phenomena, the size factor may be recognised as effective in development, though the immediate cause of its effectiveness is still unknown.

The position thus adopted assumes the shoot to be a unit, not a congeries of 'phytons'. The elaboration of its form, whether external or internal, would be a function of the increase in size of that unit, and the result would tend to maintain the adequacy of the presentation-surfaces. This conception of the shoot and of its parts would accord with the views of General Smuts, as stated in his remarkable work on "Holism", published in 1926. Many who heard his address in Cape Town last year, when opening the discussion on "The Nature of Life", will value this masterly statement in brief of his theory. I suggest that the operation of the size factor, whether in relation to external leaf-development or in the elaboration of internal conducting tracts, illustrates that "measure of self-direction" ascribed by him to every living organism ("Holism", p. 98).

The discussion of the problem of size and form in plants, which has occupied our attention thus far, raises questions of profound significance in the sphere of pure botany. There is, however, another interest inherent in the study of plants beyond that of pure science. I mean botany as applied to the needs of man. To-day this touches human life more closely than ever before. Every meal we eat, many of the clothes we wear, timber, rubber, a whole volume in itself; the drugs, narcotics, dyes, and scents, and most of that vast tale of accessories that ameliorate life, depend for their supply, quality, and often for their existence upon the skilled work of the botanical expert. He is trained in our schools and universities. His experience there is perfected by work on farms and plantations, in forests and in factories, often by adventurous life abroad. It would be superfluous for me to enter into detail on such matters, for happily the Director of Kew presides over the Botanical Section, and he can speak with the fullest knowledge on the application of botanical science to modern life.

Government departments are now linked more closely than ever with universities and technical colleges by the golden chain of grants. The botanical institutes that have sprung from this joint source are mostly focused at such centres as Kew and South Kensington, Cambridge and Oxford, Harpenden and Merton, Long Ashton and Corstorphine, Plymouth and Millport, with important outliers such as Dehra Dun in India, the Imperial College of Tropical Agriculture in Trinidad, and the Research Station at Amani, East Africa; while similar stations are to be found in Canada, at the Cape, in Australia and New Zealand. Their activities are as diverse as their position. Agriculture, forestry, plant-breeding and distribution, seed-testing, mycology, and plant pathology—these are but a few of the headings under which applied botany is now pursued; and a duly qualified staff is required for each. Kew itself, thanks to the foresight of the Empire Marketing Board, is developing ever more and more as a co-ordinating centre for the whole Empire. Highly specialised study such as this has sprung into existence in the last half-century. As regards Britain, its origin may be traced to the biological laboratory of the old Normal School of Science at South Kensington, where biological research was revived under Huxley and Thiselton-Dyer.

The first botanist there trained in pure science who turned the newly acquired vision to practical account in the interests of the Empire was Marshall Ward. For two years he investigated the coffee disease that had half ruined Ceylon. It is a long step from this individual effort in the East to the firmly established and efficient Imperial Mycological Bureau, recently housed at Kew in a new building devoted to the world-wide study of the fungal diseases of plants. Such advance along a single line of applied botany may be taken as an index of the progress from simple beginnings in pure botany to that widespread attack now being made upon the economic problems that face Imperial agriculture. The history of it thus briefly suggested may be read as a parable, showing how natural is the progression from the study of pure science to its practical application. For there is no real distinction between pure and applied science. As Huxley told us long ago, "What people call applied science is nothing but the application of pure science to particular problems".

At the moment there is an unprecedented demand for botanical specialists to fill investigational

and advisory posts at home and abroad, and there is a shortage of applicants. The realisation of this will doubtless be transmitted through the universities and colleges to the schools of the country, and lead to an increased supply. On the other hand, it lies with the Government to react as other markets do in taking steps to equalise supply and demand. A condition of the success of a specialist will always be a thorough foundation upon pure science, and this will be fully realised in the selection of candidates. Government, whether at home or in the wider Imperial field, can make no better investment than by the engagement of the best scientific experts available. In respect of botany this has been attested by many well-known instances.

Some reference will naturally be expected here to the remarkable address given by Sir William Crookes in 1898, when the Association last met in Bristol. He then forecast that, in view of the increase in unit-consumption since 1871 and the low average of acre-yield, "wheat cannot long retain its dominant position among the foodstuffs of the civilised world. The details of the impending catastrophe no one can predict, but its general direction is obvious enough. Should all the wheat-growing countries add to their area to the utmost capacity, on the most careful calculation the yield would give us . . . just enough to supply the increase of population among bread-eaters till the year 1931." The problem is one of applied botany, with a setting of world economics and a core of physical chemistry. After raising the spectre of wheat shortage before the eyes of his audience of 1898, Crookes laid it again by the comforting words, "The future can take care of itself. The artificial production of nitrate is clearly within view, and by its aid the land devoted to wheat can be brought up to the 30 bushels per acre standard." We who are living within a few months of the fateful year of 1931 are unaware of any wheat shortage. Sir William Crookes's forecast of 1898 as to the advance in the production of combined nitrogen has been fully realised. Artificial fertilisers are not in view only, but at hand and in mass. Moreover, the northern limit of successful wheat culture has been greatly extended by the production of new strains with ever shortening period between sowing and reaping, while the establishment of new varieties is extending the productive area in South and West Australia into regions where the rainfall is of short duration, and restricted in amount.

The future, since 1898, has indeed taken care of itself; so that, notwithstanding the warning of so great a man as Sir William Crookes, the wheat-eating public is still able to sleep well at night so far as the wheat shortage is concerned. What better example than this could we desire, not only of the importance of applied botany, but as showing also how its advance follows on research independently pursued? For the production of synthetic nitrogen, which has now become a commercial proposition, and the improvement of the strains of wheat by selective breeding along Mendelian lines, are both involved in solving this crucial question of food-supply; and both owe their origin to advances in pure science.

In conclusion, we shall all be conscious of the fact that a most distinguished former president of the Association has lately passed away, one who more than any man has influenced the policy of government in relation to science. I mean Lord Balfour. We recall how in 1904 he, so thoroughly imbued with the spirit of his *Alma Mater*, presided over the meeting in Cambridge. He was distinguished as a philosopher, great as a statesman, and particularly so under the stress of war. He it was who, after peace returned, used his rare influence in transforming the war-time experiment of a committee of the Privy Council for Scientific and Industrial Research into a permanent and essential part of modern government. But this was not all. His critical, constructive, and experienced mind was led to formulate a still wider plan. A Cabinet Committee for Civil Research was to be established on the lines of the Imperial Defence Committee. He designed it so as to bring the whole national administration within the range of scientific influence. The Department of Scientific and Industrial Research, so wisely kept in being after 1919, now forms part of that larger scheme. This department is responsible for making recommendations as to the expenditure of funds voted by Parliament for research, especially in relation to industry. Thus science is welcomed into the inner circle of Imperial administration. This the State owes to Lord Balfour.

And so in this hundredth year of its existence, the British Association sees research recognised and fostered in the service of the State in a way never dreamed of in 1831, when a small body of enthusiasts met at York for the advancement of science. But though the individual seeker after truth may thus be involved in official harness, as of old an inner voice will yet speak to him. He will himself be as near to Nature to-day as he was in the simpler days that are gone.

Summaries of Addresses of Presidents of Sections.*

Terrestrial Magnetism.

THE subject of Dr. F. E. Smith's presidential address to Section A (Mathematical and Physical Science) is "Theories of Terrestrial Magnetism". He begins by referring to early magnetic conferences and resolutions urging international co-operation, but while believing the spirit of international co-operation in terrestrial magnetism to be excellent, the question is put: "Do we make our plans sufficiently well?" While it is to the International Union of Geodesy and Geophysics that we must look to plan lines of attack, Dr. Smith makes a plea for the adoption by many of the first class magnetic observatories of a programme including observations at the same time and with similar instruments of great sensitivity. Later in the address, when the question of simultaneity of magnetic storms is considered, this plea for similar instruments is revived, and the opinion is expressed that it should not be difficult to obtain a decisive answer to such a question by proper organisation. A point emphasised is that while each observatory should have its own particular problems and its own special methods of attacking them, and thus preserve its individuality, it should in addition have part of its equipment of an international type and part of its programme truly international in character.

The general character of the earth's magnetic field is described, theories relating to the permanent field being considered first. Our knowledge respecting changes in the permanent field is very limited, the secular variation being the only one of which we have trustworthy data. Schuster put forward the theory that the secular change is caused by the magnetic field inducing currents in an outer conducting medium not moving with the earth, or moving relatively to it. It is pointed out that it is not necessary to assume a large volume of outer space to have uniform conductivity to produce the effect. An outer layer will suffice and the conductivity may be uniform or patchy. The irregularities in the secular change are possibly due to the conductivity of the layer varying over considerable areas, and the relative motion between the earth and portions of the layer may also vary.

The question of electric currents circulating round the earth is next dealt with, a possible source of the electromotive force being due, as Larmor has suggested, to the existence of a residual internal circulation in meridian planes, which, cutting such a magnetic field as that of the earth, acts as a self-exciting dynamo. Another theory due to Gunn is that the inner earth has a temperature of the order of 1000°, and that it is highly ionised and a good conductor. A primary current system is supposed to be set up from the motions imposed upon ions by the internal gravitational electric field at right angles to the magnetic field, the action being a regenerative one.

The possibility of the magnetic field being due to the earth's rotation is fully considered, the associated effects of surface charge, volume charge, and gyromagnetic action being dealt with in turn. Owing to so many difficulties presenting themselves when the theories are analysed, modifications of the laws of electrodynamics have been suggested, but the theories are not satisfactory. Dr. Smith concludes that our knowledge of the cause of the earth's magnetic field is little more than conjectural, for, of the theories put forward, all that have been put to a practical test have been found wanting in some respect.

Dr. Smith then discusses vertical electric currents; while Bauer was justified in drawing his conclusions as to the existence and magnitude of such currents, the data he used are not sufficiently trustworthy. The existence of the currents is exceedingly doubtful, but sufficiently precise measurements could be made over a carefully chosen area, which would enable a definite decision to be reached.

Three theories of diurnal variation are dealt with: the 'dynamo theory', in which conducting layers of air cut the earth's permanent field and so induce electric currents; the 'diamagnetic theory', in which a diamagnetic layer is formed by ionisation, the shape of the layer being that of a hemispherical cap; and the 'drift current theory', which depends on the drift of ions and electrons in the diamagnetic layer. A direct effect of the diamagnetic layer is considered to be certain, but with it is associated an effect due to the drift currents which is much larger, and the direct effect of the diamagnetic layer is therefore considered to be of secondary importance. The dynamo theory is favoured less than the drift current theory. The other variations considered are those due to solar eclipses and magnetic storms.

The address concludes with a plea for the pro-

* The collected presidential addresses delivered at Bristol are published under the title "The Advancement of Science, 1930". The volume is obtainable at 5*s*. of all booksellers, or at the Reception Room, Bristol, by members attending the meeting, 3*s*. 6*d*.

duction of data of a more precise kind, the final paragraph quoting a passage from Rücker's address in Bristol in 1898, which emphasises the need for more perfect organisation.

A State Experiment in Chemical Research.

The subject of Prof. G. T. Morgan's address to Section B (Chemistry) is the Chemical Research Laboratory at Teddington which was originated about five years ago by the Department of Scientific and Industrial Research in order to bring together scattered groups of research workers who were then engaged in various localities on chemical investigations of national importance. The site selected on the Bushy Park Estate in close proximity to the National Physical Laboratory allows of ample scope for future expansion. Three laboratory units were contemplated originally, and after five years rather more than one half-unit has been completed and occupied.

A Chemistry Research Board advises the Department on the programme of research and exercises general supervision over its execution. Six investigations have been prescribed at various times, and are described by Prof. Morgan in the order in which they have come under his notice.

1. Synthetic resins, employed in the manufacture of moulding powders, electric components, and shellac substitutes are of growing importance in chemical industry, and since May 1925 an investigation on the production of resins from formaldehyde and the cresols and xylenols has been in progress. Resins of high dielectric capacity have been obtained and fresh information has been gained concerning the chemistry of these condensations.

2. In collaboration with H.M. Fuel Research Station a systematic study has been made of the chemical constituents of the tar derived from low temperature carbonisation. The isolation from this and other tars of four chemical groups of resins is an outstanding result of this research, which has also led to the characterisation of several methyl derivatives of anthracene contained in the less volatile oils of low temperature tar.

3. An investigation, involving a concerted effort by chemist and chemical engineer, has been initiated on the use of pressure in facilitating chemical reactions. By the interaction of carbon monoxide and hydrogen in contact with various catalysts at high temperatures and pressures, many members of the homologous series of alcohols, aldehydes, fatty acids, and esters have been synthesised. Methyl alcohol remains the predominant product, but ethyl alcohol has appeared to a not inconsiderable extent.

4. The corrosion of metals either in air or when immersed in water or salt solutions is of interest to the metallurgist and industrial chemist. Both these aspects of corrosion are under examination at Teddington. A quantitative study of immersed metals shows that their corrosion is not inherently erratic but controllable and quite a suitable subject for physico-chemical investigation.

Two noteworthy discoveries have been made during these researches in regard to the composition of the green patina which develops on exposed copper surfaces. Contrary to the belief of the last 100 years this corrosion product, as developed in England, is not basic copper carbonate but consists mainly of basic copper sulphate, the carbonate, if present at all, being only a minor constituent of the patina. Under marine conditions the basic sulphate becomes more or less replaced by basic copper chloride. Moreover, in patinas of at least 70 years' growth the composition of the basic sulphate corresponds with that of the mineral, brochantite, $CuSO_4,3Cu(OH)_2$. Similarly the marine patinas tend towards the composition of atacamite $CuCl_2$, $3Cu(OH)_2$.

5. In collaboration with the Chemotherapy Committee of the Medical Research Council a group of workers is engaged in the preparation of organic compounds of therapeutic interest. Analogues of Bayer 205 or Fourneau 309 have been submitted to the Committee together with many organic derivations of arsenic and antimony. So far the organometallic series has furnished the more promising results as regards trypanocidal activity.

6. During the last two years experiments have been in progress under the auspices of the Water Pollution Research Board on the base-exchange (zeolite) method of water softening. One objection raised against this process is that the water might become contaminated with silica and alumina arising from the disintegration of base-exchange material. Experiments have shown, however, that this fear is groundless; the silica content is not increased seriously and is not greater than that often encountered in untreated waters. Along with these practical tests, a report summarising existing knowledge of zeolite water softening has been compiled and published.

In addition to the foregoing prescribed investigations a certain amount of general research has been carried out on complex aromatic hydrocarbons including acenaphthene and diphenyl, waxes and higher fatty acids, cyclic systems containing

selenium and allurium, and co-ordination compounds of copper, silver, and gold.

The address is fully illustrated by an exhibit of preparations, diagrams, and items of chemical plant arranged by the staff of the Chemical Research Laboratory.

In concluding, Prof. Morgan pleads for more organised research in inorganic and mineral chemistry and in the organic chemistry of vital products. Political and economic forces are bringing into prominence the urgency for a mutually advantageous interchange of commodities between the constituent nations and colonies of the British Empire, and in this pooling of natural resources these two branches of practical chemistry must play an essential part.

Geological History of the Bristol Channel.

In his presidential address to Section C (Geology) Prof. O. T. Jones deals with some episodes in the geological history of the Bristol Channel region. Among them the Triassic planation, the formation of the Mesozoic Cover, and the Miocene earth movements are regarded as the most important. During the Triassic period, intense erosion under arid continental conditions removed an enormous thickness of Palæozoic strata which had been folded by the Armorican movements commencing in late Carboniferous times. As a result, almost even-surfaced tracts of great extent were formed bordered by escarpments, among them one on each side of the Bristol Channel. There was then no indication of a tectonic basin in the region; rather it appeared that the channel area stood at a relatively high level, thus allowing the products of erosion to be largely removed to lower-lying areas of deposition. By analogy with the escarpments along the south side of the South Wales coalfield which have been proved to be of Triassic origin, it seems that the great plateau of Central Wales around the mountain masses such as Cader Idris and others that rise steeply above its surface may have been developed mainly by desert planation in the Trias. Afterwards the Channel region and neighbouring areas were invaded by the Mesozoic seas; the probable extent of the invasion of the Palæozoic areas of the west by the sea at various Jurassic periods is discussed in relation to the lateral variation of the Mesozoic formations.

During the Upper Cretaceous, it is fairly certain that the greater part, if not the whole, of the Palæozoic region had been covered by a considerable thickness of sediments.

The Miocene movements which are so largely responsible for the physical features of the south-east of England penetrated also into the south-west, both north and south of the Bristol Channel. The variation in the present level of the base of the Lias in the Vale of Glamorgan and in the Mendip region shows that the formation has been affected by considerable folding since its deposition; the type and scale of the folding are so similar to that of the Miocene movements in the south-east of England and northern France as to tend to the belief that the movements in the west were also in the main of Miocene age. Several axes of folding have been traced from the south-east of England into the Channel region. By these movements also the ancient plain of erosion traversing the Palæozoic areas of Wales and Devon was warped.

Comparison of the physical features in relation to axes of folding leads to the conclusion that those in the west are together almost a mirror image of those in the east. Thus the central plain of Devon is a continuation of the Hampshire basin; the high ridge of Exmoor represents an upfold of the ancient plain of erosion comparable with the anticline of the Weald, while the Bristol Channel is a syncline corresponding to the Thames Basin. North of the Channel the great plateau of Wales was warped in a south-westerly direction, thus leading to many important modifications in the drainage systems of that area.

The Species Problem.

In his presidential address to Section D (Zoology) Dr. W. T. Calman discusses "The Taxonomic Outlook in Zoology". Dealing first with the primary task of the systematist, the identification and description of the species of living animals, it is pointed out that one of the obstacles to obtaining a census of the animal kingdom lies in the fact that great sections of it are so imperfectly surveyed.

The intimate personal knowledge of the specialist, which in the days of Linnæus could embrace all the species then known, can now only cover a small portion of the field, and monographs, synopses or revisions which should be intelligible to the non-specialists are not available for many important groups. Attempts at a rewriting of the "Systema Naturae", like the British Museum Catalogues or the German "Das Tierreich", cover only a small part of the ground and are rapidly becoming obsolete. Meanwhile, the successively expanding volumes of the *Zoological Record* give a picture of systematic zoology being smothered under the products of its own activity. The confusion will grow steadily worse unless systematists come to

realise that the description of new species is a far less important thing than the putting in order of those that are already 'known', and until zoologists cease to regard taxonomy as a kind of menial drudgery to be performed by museum curators.

Even identification requires some kind of classification if it is only the classification of the dictionary. Since the time of John Ray, zoologists have believed in the existence of a natural system, and since Darwin it has been clear that this must be based in some way upon phylogeny. Dr. Bather, impressed by the prevalence of polyphyly and convergence, seems to think that phylogeny must be abandoned as a basis of classification, though it is not clear what he would substitute for it. Much current work and current speculation suffers from neglect of the taxonomic and phylogenetic outlook. Those departments of zoology most actively studied at the present day are preoccupied with the interplay of forces acting here and now and ignore the impressions that time may have left on the material of their study. It is as though a crystallographer studying a pseudomorph should endeavour to explain its form in terms of its chemical composition and the forces governing the arrangement of its molecules, without taking account of its history.

A few have even gone so far as to deny the existence of phylogeny. Prof. Przibram, in his theory of apogenesis, suggests that every species of metazoan has developed, independently of all the others, from a distinct species of protozoan. This is either one of the most significant results of recent biology or it is the *reductio ad absurdum* of much contemporary work. Although called a theory of evolution, it is, as regards the origin of species, no more than a doctrine of special creation at one remove. If we are to abandon belief in community of descent, the whole architecture of the "Systema Naturae" becomes meaningless.

It is significant that only on one point does Przibram speak with a hesitant voice, and that is where he mentions the geographical distribution of organisms. It is to be recalled that the opening words of the "Origin of Species" deal with geographical distribution. Przibram ends where Darwin began, and what for the one is merely the negligible residue of unexplained facts was for the other the very heart and core of the problem he set himself to consider.

Human Geography.

The subject of Prof. P. M. Roxby's address to Section E (Geography) is the scope and aims of human geography, a term now frequently employed in geographical literature, but liable to a more than ordinary degree of misconception.

The emergence and significance of human geography are discussed in relation to the modern conception of geography as a whole. The subject is of great antiquity, and the Greek view of it was in the main philosophical and scientific, but it suffered greatly from medieval formalism. It was Ritter and Humboldt who rescued what seemed to be a moribund subject and gave it individuality, coherence, and an immensely enhanced significance. This they did by claiming for it not a distinctive *segment* in the circle of knowledge—which is to destroy its very essence—but a distinctive method and objective in the handling of data common to other subjects. Ritter gave the keynote to the whole modern development of geography when he said: "It is to use the whole circle of sciences to illustrate its own individuality, not to exhibit their peculiarities. It must make them all give a portion, not the whole, and yet must keep itself single and clear." The same conception permeates the work of Vidal de la Blache, the founder of the French school of human geography, "Ce que la géographie, en échange du secours qu'elle reçoit des autres sciences peut apporter au trésor commun, c'est l'aptitude à ne pas morceler ce que la nature rassemble".

From the time of Ritter and Humboldt, workers in many fields of geography (geomorphology, climatic and biological geography, and human geography) have been guided by the same fundamental principles and methods, the central object being to exhibit the earth as a whole made up of related and interacting parts. Granted this unifying conception, the increasing capacity, on one hand, to formulate valuable and far-reaching generalisations as to the distribution and relationship of phenomena, and the imperative need, on the other, for a synthetic view of the earth, owing to the growing interdependence and inter-sensitiveness of its different regions, have inevitably increased the value and significance of geography in modern times.

Some of the principal contributions to the philosophy of human geography are next considered, and a comparison is made of the so-called 'Determinism' and 'Possibilism' of the schools of thought associated with the names of Ratzel and Vidal de la Blache respectively. The value is discussed in relation to such movements as that of regional planning of Febvre's dictum: "There are no necessities, but everywhere possibilities; and man, as master of the possibilities, is the judge of their use".

Human geography is then defined as the study of

(*a*) the adjustment of human groups to their physical environment, including the analysis of their regional experience, and of (*b*) inter-regional relations, as conditioned by the several adjustments and geographical orientation of the groups living within the respective regions. The adjustment has distinct but usually closely related aspects which form the main branches of human geography. These are discussed under the terms racial, economic, social, and political geography. It is permissible and desirable to pursue special studies of these various aspects, but they find their fullest fruition when they are brought together and inter-related in a full and comprehensive 'human ecology' of regions such as Cjivič has given us in his "La Péninsule balkanique: Géographie humaine". A plea is made for the study of historical geography as essentially human geography in its evolutionary aspects.

It is claimed that the point of view and type of outlook which human geography fosters were never more needed than in the present critical stage of mankind's development. Not only through its value as an educational instrument, but also through the programme of constructive work which it advocates, can it contribute to the realisation of the ideal of 'unity in diversity', and that seems the only possible ideal for the life of humanity on a planet which, however small applied science may make it, will always retain its infinite variety.

Rationalisation and Technological Unemployment.

Prof. T. E. Gregory's presidential address to Section F (Economic Science and Statistics), entitled "Rationalisation and Technological Unemployment", examines the bearing on unemployment of that reorganisation of industry which is now commonly known as rationalisation. The terms 'rationalisation' and 'technological unemployment' have obtained a widespread currency, and this has created an unfortunate impression that the world is now confronted by vast and mysterious economic problems of a kind hitherto unknown. The problems involved are indeed of the utmost importance, but when their character is analysed, it will be found that they derive their importance more from a change in scale than from the novelty of their nature.

The name of rationalisation has been given to a conscious process of industrial reorganisation which is taking place throughout the world, and of which the characteristic results are a growing control over markets, an increasing standardisation of processes and product, and a greater output per worker. These changes economise the amount of labour *directly* required per unit of output and effect, in so far as the distributive services are rationalised, a net reduction in the amount of labour required to place a unit of output in the hands of the final consumer. Given this trend, it may be asked does rationalisation inevitably cause unemployment as the result of the technological reorganisation involved?

Similar problems were discussed by the classical economists under the title of "The Influence of Machinery upon the Conditions of the Labouring Classes". They resolved the problem into its constituent parts, and these are still the fundamental issues to be faced. Does rationalisation involve unemployment (*a*) in a single industry, (*b*) in all industries taken together? Or is there some 'inherent' principle of human nature which will solve the problem, after transitional effects have been overcome? To-day we are again forced back upon general economic reasoning because the available statistics only suffice to establish a presumption that rationalisation has been responsible for part of the existing unemployment.

Since the rationalisation movement is international in character, and since it generally reduces cost per unit of output, no single country engaged in international trade can hope to contract out of its consequences. This in itself is sufficient reason for pushing ahead with rationalisation in Great Britain.

In the short run, rationalisation is not a remedy for unemployment, and on the contrary it may increase unemployment except to the extent that it stimulates demand in the constructional and equipment industries. In the long run, since rationalisation effects a lowering of real costs, there is no reason to suppose that the volume of unemployment will not again fall. It is impossible, however, to tell in what directions an increased demand for labour will manifest itself. Possibly in the future the occupied population will be less industrialised than in the immediate past. In this transition, whatever form it may take, a grave transfer problem is involved, and therefore the first and most obvious ameliorative measure must be an increase in the mobility of the working population.

Interdependence of Science and Engineering.

The presidential address to Section G (Engineering) by Sir Ernest Moir is entitled "The Interdependence of Science and Engineering, with some Examples". It begins with some interesting personal appreciations of some of the eminent engineers of the past, but in general is an attempt to indicate the interdependence of the engineer on the science of the physiologist, the bacteriologist, the economist and the all-important science of finance, all of which enable the engineer to carry out his destiny by entering new paths and opening up, by the aid of railways and roads, vast areas, to enable them to be made fruitful and suitable habitations for his fellows.

The three main sections of the address deal with (1) voids, (2) bacteriological and entomological sciences and their influence on civil engineering, and (3) economics of engineering construction. The influence of air- and water-filled voids is felt in such widely different instances as the combustion of fuels, the action of explosives, the drainage of subsoils, and the solidity of great marine structures subjected to the action of the sea. Special reference is made to the great breakwater at Valparaiso founded in 187 feet of water, upon a sand-

bank deposited by dredgers which has so consolidated itself that the fluke of an anchor let fall upon it does not penetrate its surface. Upon the sandbank have been placed layers of quarry rubbish and selected rock upon which rest 60-ton blocks. During a storm, a small movement of these blocks took place and this was attributed to the falling masses of water acting as hydraulic rams in the voids between the blocks. This is but one example which goes to show that the exact action of the sea on structures is waiting the solution of the scientific worker to determine what forces exist and are exerted by moving masses of water in great storms.

The execution of many great engineering works, such as the Panama Canal, has been possible only through the discoveries of Manson, Bruce, Ross, and others in connexion with the disease-carrying power of mosquitoes. During the construction of the Port of Para in Brazil, yellow fever was not entirely eliminated but there were few deaths. Research, however, is necessary on the Varugus disease, which causes trouble in the Varugus Valley through which the Central Railway of Peru runs; on bilharziasis, which is hindering the work on the dams and canals on the Blue and White Niles; and on blackwater fever, sleeping sickness, and the tsetse fly. Caisson disease, diver's palsy, or 'bends' has been largely prevented by the decompression method first used in the Hudson Tunnel, New York, in 1890–92; here the civil engineer has helped the science of medicine, thus making a return for some of the benefits received from the bacteriologist and medical man.

The third section of the address, on the economics of engineering construction, is a brief sketch of the various points which have to be considered by the contracting engineer, written with special reference to the carrying out of large civil engineering enterprises abroad and mostly undertaken for foreign governments.

Evolution in Material Culture.

In his presidential address to Section H (Anthropology), Dr. H. S. Harrison outlines and discusses a point of view, and an analytical method, in relation to the processes and steps through which the evolution of man's material culture has been effected, both subjective and objective aspects of various problems being considered. Stress is laid upon the predominant part played by opportunism in discovery and invention, and upon the extremely limited range of human foresight; aims and ends, as well as ways and means, are products of evolution, and only come into view as they are closely approached by an opportunist route. It is suggested that the "common faculties of the human mind", upon which so much weight is often carelessly laid, are so general in their nature, and so limited in their working by the conditions of the natural and artificial environment, as to be incapable of bringing about similarities in the products of discovery and invention, except in very simple cases. Man has always and everywhere an environmental mind, and environments differ so greatly that starting-points and opportunities are rarely the same, or even similar, except within the limits of common or intercommunicating cultures.

In the analysis of discovery and invention, a discovery may be regarded as a subjective event, which may or may not be applied objectively to material ends, and it is with applied discoveries alone that the technologist is concerned. These play a relatively smaller part in the evolution of artefacts or inventions, than in that of the methods and processes which constitute techniques, which may be called discovery-complexes. Artificially prepared substances, such as bark-cloth or bronze, may be termed discovery-products. All techniques owe their character to discoveries, few or many, usually of necessity following each other in a certain sequence, and parallelism in evolution ('independent invention') makes a big demand on coincidence, except where the sequence is short.

The term inventions, in its general vague sense, may be applied to all shaped or constructed artefacts, without prejudice to the need for a clear definition of the true inventive process and of the 'inventive step'. The 'small modifications' which have long been recognised as steps in the evolution of artefacts, are placed in two chief categories—those which may be called *variations*, no one of which produces an important change in the artefact in which it appears, though by summation the final result may be conspicuous; and those which represent definite and discontinuous steps in advance, and which may be called *mutations*. Variations may be casual, selective, or adaptive, and they do not necessarily influence functional efficiency; mutations, on the other hand, are always selective and adaptive, and their purpose is to increase efficiency. Two well-defined kinds of mutation can be identified; (1) those which owe their origin to discoveries made during the manufacture or use of the artefact involved (free-mutations), and (2) those which result from a prediction that an artefact may be improved by grafting on it a feature or a device which has developed in another context (cross-mutations). Since free-mutations arise out of discoveries, they are not inventions, and this term, in the strict sense of single inventive steps, may be confined to cross-mutations. From this point of view, true invention is a process of combination or hybridisation, in which foresight is necessarily involved.

The system of analysis proposed does not provide definite criteria for decisions on questions of independent evolution, but it enables a clearer conception to be formed of the evolutionary process, and of the probable discoveries, mutations, and variations, which have been traversed in sequence by material products of human ingenuity and industry. The general conclusion is strongly against the prevalence of independent evolution, on any significant scale, as a factor in human progress.

The Synthetic Activities of the Cell.

Prof. H. S. Raper's presidential address to Section I (Physiology) deals with the processes of synthesis in the animal cell. Up to the present

the catabolic activities of the cell have yielded more to the investigator than the anabolic. This is largely due to the fact that the former may be studied after death, whereas the latter are essentially those which occur only during life. Methods of experiment are thus very limited.

The great importance for physiology of elucidating the structure of organic substances produced by living organisms is emphasised and the debt due to organic chemistry for this is acknowledged. The usual synthetic methods of the organic chemist can, however, seldom have place in the living cell, owing to the severe limitations imposed by its extreme sensitiveness to environmental changes. The raw materials for synthesis are also very limited.

Our knowledge of the modes of synthesis of some of the more common components of animal organisms is dealt with. These include the bile acids, cholesterol, and the purine bases, where the raw material for synthesis cannot yet be said to have been ascertained. The possible synthesis of adrenaline from tyrosine and phenylalanine, to which it is closely related structurally, is discussed and the difficulties of the proof that such a process takes place in the cell are pointed out.

The synthesis of fat from carbohydrate, which was established by Lawes and Gilbert seventy years ago, is an instance in which the raw material for the synthesis is known with certainty but the chemical transformations involved are as yet obscure. A brief summary is given of the types of reaction which may well account for this synthetic process and the possibility of their occurrence in the cell is discussed.

The synthesis of glycogen is next dealt with. The evidence for and against its production by enzyme action is considered and it is concluded that the available information makes it probable that more than a mere reversal of enzyme action is concerned. This synthesis has so far never been obtained except in the living cell, and it seems probable that the substances from which glycogen is produced must at some stage form an integral part of the living protoplasm.

The raw material for protein synthesis, like that of glycogen, is known, but the mechanism by which the amino acids are joined together to form the very varied proteins which are produced by animal cells can only be guessed at. Here, again, the reversal of action of proteolytic enzymes has been invoked to account for the synthesis; but even if this did occur, it leaves the major difficulties unexplained. Protein synthesis, like that of glycogen, only occurs in the living cell, and the problem of its mechanism will probably only be solved when we know how protoplasm itself is produced. It is possible that cyclic changes in the cell may account for the production, time after time, of a protein of unvarying pattern. The change of an enzyme or its 'carrier' in cyclic fashion might produce changes of configuration which would lead to particular syntheses occurring optimally at various phases of the cycle.

The question of the site of protein and other syntheses in the cell is not without interest; it is possible that the nucleus of the cell is the main seat of synthetic activity. Many of the problems concerned in synthesis in the cell are problems of organisation, and for their solution a much more satisfactory objective picture of cell structure than we possess at present is essential.

Foundations of Child Psychology.

In his presidential address to Section J (Psychology) Prof. C. W. Valentine discusses the foundations of child psychology and their bearing on some problems of general psychology. He opens by enumerating the values of the study of the early years as: (1) the fascinating interest for those who love children or who marvel at the wonder of the developing mind, (2) to throw light on what is innate in the human being, (3) to counteract the tendency to interpret later childhood on the lines of adult experience, and to act as a check on the tendency to rationalise adult behaviour.

In recent times three schools of thought have devoted special attention to the study of early life. Psycho-analysts maintain that the first four or five years are the most important in the fixing of character. The behaviouristic school asserts that there are few genuine innate tendencies in man, and holds that any infant, if taken in hand early enough, can be 'conditioned' into almost any type of character. Lastly, the pioneer work of Dr. Arnold Gesell has provided tests suitable for infants of a few months old, and he claims that the results of such testing afford some evidence of correlations with normal mental development. Such tests, however, are themselves in need of testing, since little work has been done with young children and the present testers of young children are in the position of the testers of older children about twenty-five years ago.

Some criticisms that can be made are: (1) that the child of twelve months may be able to do some of Gesell's tests for the two-year-olds and yet fail in some of those for his own age; (2) that the tests are too dependent on the passing mood of the child; (3) that although Gesell maintains that fatigue and illness do not completely mask the stage of development, yet this would seem to be true only of the well established reflexes and not of the *nascent* functions.

As a result of a careful study of thought in little children, one is left with a strong impression that elementary thought processes appear very early. Evidence is brought forward that the spatial relation, causal relation, relation of likeness, and relation of evidence are apprehended at about three years of age. This is in direct opposition to the view of Piaget, who would not place such processes before the age of seven. It is necessary to guard against the assumptions that thought only develops when the corresponding word is used and that one word used by a child must necessarily have the same content of mean-

ing as when used by an adult. These thought processes, though, only appear at first sporadically, hence the necessity for careful daily observation in the child's own environment.

The outlook for the future is hopeful, and we may look forward to being able to test at about six months old a child's intelligence, its capacity for linguistic development, and its probable characteristic temperament. It must be admitted, however, that the field of infant psychology is still largely unexplored and that the method and technique are greatly in need of improvement.

Problems in Taxonomic and Economic Botany.

Dr. A. W. Hill's presidential address to Section K (Botany) is entitled " Present-day Problems in Taxonomic and Economic Botany ". In his opening remarks he refers to the work of J. S. Henslow, Thiselton-Dyer, and Harold Wager, and compares their services as teachers of botany. He then discusses some of the present-day problems in systematic botany connected with the ' species concept ' and the work of our great herbaria. Reference is made to the prevalence of hybridisation in New Zealand and to the work of Dr. Cockayne and of Dr. Lotsy and to the important effects on taxonomic work which must result from the fuller recognition of natural hybrids.

The question of physiological varieties is also referred to, and examples are brought forward from South Africa, in connexion with physiological varieties of *Pentzia* and *Salsola*, and of *Eucalyptus* in Australia, and other plants. The need of careful experimental work in connexion with taxonomy is emphasised, and a general review of the experiments that have been made in cultivating plants at different altitudes and under different soil conditions is given. Particular attention is paid to the work of Turesson in Sweden, and to the work which is being carried out in England, in co-operation with the British Ecological Society, at Potterne, in Wiltshire. These experiments are showing that, with individuals of known genetic origin, some remarkable changes can be produced when certain plants, particularly *Plantago major* and *Silene maritima*, are grown on different types of soil. The soils used in the Potterne experiments are clay, sand, calcareous clay, and calcareous sand. The importance of keeping accurate records in herbaria of the plants used in connexion with genetical and hybridisation work is referred to, and an account of the arrangements that are being made at Kew in these directions is given.

With regard to economic botany, some particulars are given of the interesting observations which have been made of the flower behaviour of Avocado pears in America, and also with regard to the fertilisation of the date palm, and the economic importance of physiological varieties is pointed out in such economic plants as para rubber, camphor, and *Eucalyptus dives*, the essential oil of which is used for the manufacture of thymol and menthol. Attention is also directed to the tung oil trees (*Aleurites*) which are now being introduced to our Dominions and Colonies, since it seems likely that they also may show various physiological types.

The importance of combining herbarium work with studies in the field is emphasised, and an account is given of the new activities in this direction which are being carried out at Kew, thanks to the grant made for this purpose by the Empire Marketing Board.

In conclusion, attention is directed to the need of more and better-trained workers in the fields of taxonomic and economic botany. The question of recruitment is discussed in the hope that it may be possible to widen the interest in biological science among those who are now being trained in the schools and universities of Great Britain.

A Policy of Higher Education.

Lord Eustace Percy's presidential address to Section L (Educational Science) is a plea for an appreciation of realities. What, in the rapidly changing conditions of contemporary life, are the changes actually required to enable our schools to meet the higher educational needs of the individual boy and girl ?—needs which are largely determined by the character of the services society will demand of them when they leave school. There is a tendency to-day to assume that full-time schooling up to sixteen years of age must be good for everyone, and that all we require is a sufficient variety of schools and curricula. The assumption ignores the fact that higher education worthy of the name is the very antithesis of the ' forcible feeding ' largely and necessarily prevalent in the elementary stage.

Higher education cannot work by compulsion, and the attempt to force pupils through this stage is foredoomed to failure. We are in face of an imminent danger of the methods of elementary education being pushed up into the higher sphere, wherein should be paramount the influence of " those standards of academic freedom and intellectual authority which it is the peculiar function of the universities to maintain ". Now, the university and technical college are in a special sense the mediators between the schools and society's demand for their product. The key to a new policy in higher education is the popularisation of the idea, already familiar to university appointments boards, that industry is the chief, and indeed the only direct, agent of social welfare. In supplying to it men trained for its practical requirements, the universities and colleges will be merely fulfilling their traditional function of synthesising research into doctrine and keeping new learning up-to-date with new knowledge. Their courses of training should be designed to react upon industrial practice, and their designers should aspire to acceptance by industry not merely as subservient trainers but as intelligent advisers. It is by such acceptance that American industry has been helped in some directions to eclipse that in Great Britain.

How are we to interpret industry's demand as conditioning practical measures of school reform? It is a demand for mental keenness rather than for physical skill, and though there are signs of a revival of the craft element in, for example, the furniture industry, it is broadly true that the demand for manual labour, skilled or unskilled, is giving place to a demand for labour involving at least some measure of abstract thinking and planning. This points to longer schooling. It would be a mistake, however, while we are still in this transitional stage, to risk starting the full-time schools of the future on wrong lines by forcing them to assimilate a mass of pupils who would stay on at school with no clear object. Our first aim should be to develop part-time education in technical schools and continuation classes for all children over fourteen.

The Hadow Report ideal of four-year courses of full-time schooling for all from eleven to fifteen years of age should be expanded into the wider ideal of five-year courses from eleven to sixteen, the first three in full-time schools and the last two either in full-time or part-time according to the pupil's needs. The full-time school should at every stage work in with the technical school so that the five-year course may be made a really continuous one. Above this stage there will be our traditional type of secondary school and our senior technical courses, bringing the pupil up to the college stage of higher education whether in the technical college or the university.

Veterinary Science and Agriculture.

Dr. P. J. du Toit, the director of Veterinary Services and Animal Industry for the Union of South Africa, in his presidential address to Section M (Agriculture), gives a general outline of some of the most notable achievements of veterinary science in recent years, and indicates the close relationship between this science, agriculture, and other sciences.

In the group of diseases caused by trypanosomes considerable progress has been made both in the treatment of infected animals by means of drugs, and in the campaign against the transmitter, the tsetse fly. Nevertheless, Dr. du Toit urges that the work be supported more liberally, since these diseases are holding up the advancement and civilisation of Africa.

Similar progress can be recorded in the elucidation of and the fight against the diseases caused by piroplasms. Drug treatment of some of these diseases is eminently successful. In others, for example, anaplasmosis, satisfactory methods of immunisation have been found. In yet others, reliance has to be placed on the control of the transmitting agent, the tick. The discovery of the rôle played by the tick in the transmission of these diseases is one of the landmarks in the history of biological science.

Amongst the diseases caused by ultra-visible viruses, rinderpest is a good example of a disease which has been eradicated from most countries by the application of modern methods. Great advances have also been made in the study of foot-and-mouth disease, rabies, and many other members of this group. Similarly, recent advances made in the science of bacteriology have rendered possible the control of various bacterial diseases, such as glanders and pleuro-pneumonia. Considerable interest is now centred on the problem of tuberculosis; work recently carried out in many countries with the so-called B.C.G. vaccine of Calmette and Guerin seems to indicate that a new weapon against this disease has been found.

Dr. du Toit further refers to the great importance of internal parasites (worms) to the livestock industry. Very good results have been obtained in the case of some of these infections (for example, stomach worms of sheep, *Hæmonchus contortus*) by means of drugs. Emphasis is laid on the fact that all available scientific knowledge must be applied to the control of parasitic worms, or else the sheep farming industry will be ruined. Great progress has also been made in the eradication and control of diseases caused by external parasites and poisonous plants. The problem of deficiencies, especially mineral deficiency in animals, is briefly referred to and it is shown how the cattle breeding industry has benefited from the application of the results of recent research work on this problem.

In conclusion, Dr. du Toit mentions the importance of nutrition and breeding for the livestock industry, and indicates how these problems are inter-related with the problems of animal disease. He pleads for further research on all these problems, and shows how South Africa has profited from the results of work carried out at the Veterinary Research Laboratory, Onderstepoort, Pretoria.

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

Bristol more than Lord Justice Sir Edward Fry, F.R.S., the great international lawyer, who was born in Union Street, Bristol, and was a local naturalist of national reputation; John Samuel Budgett was a well-known local naturalist; while the third meeting in Bristol of the British Association, which took place in 1898, will always be remembered for the remarkable presidential address of Sir William Crookes, in which he directed attention to the limitations to the world's wheat supply and forecast the production of nitrogenous fertilisers from the air.

Recent Hydro-Electric Developments in the Alps and the Apennines.

By Dr. BRYSSON CUNNINGHAM.

THE widely extended and systematic exploitation within recent years of the valuable water power resources of Switzerland and Italy, hitherto lying latent among the mountain chains of the Alps and the Apennines, is one of the most striking features in connexion with the modern industrial and commercial developments of the countries in question, and it has been, and is being, attended by economic repercussions affecting various nationalities, including our own. Coal, the usual source of energy for power purposes where it can be mined, is lacking as a natural deposit, and, in the past, manufacturers using mineral fuel have had to rely in the main on importations from abroad, a very considerable portion of which came from Great Britain (South Wales and the Tyne district). The acute experience during the War, when these external supplies were cut off, brought home to the Swiss and Italian peoples the necessity of finding some internal means of making good a deficiency which tended to hamper, and even to paralyse, their industrial activities and placed them at the mercy of foreign interests. Not surprisingly, their attention was directed to the great potential value of the streams and lakes in the mountainous districts, where an untold quantity of water lay ready for utilisation and was capable, in a very large measure, of meeting commercial and industrial needs. These elevated reservoirs and mountain streams could be harnessed so as to produce electric current, which, in turn, could be distributed far and wide to suitable points of application.

The visitor to northern Italy and Switzerland at the present time cannot fail to notice the growing network of transmission lines which is spreading over the face of the country, scaling mountain flanks and ridges, traversing hills, valleys, and plains, and linking up cities and centres of population with an enormous spider's-web of copper and aluminium wire. Where, in past days, the landscape's most conspicuous artificial features were picturesque campaniles and church steeples, there are now to be seen, in challenging competition, lofty steel-framed pylons and standards, ranged in long files which, like the telegraph poles alongside a railway track, attend the traveller throughout his journeys.

The utilisation of water power for the generation of electricity, or rather its systematic exploitation for the purpose on a large scale, is a comparatively recent enterprise. Until the close of last century electricity was generated almost entirely by steam power. Canada—a country similarly handicapped to Italy and Switzerland in regard to its lack of natural coal deposits—which has now no less than six million water horse power harnessed to its electric generating stations, possessed in 1900 less than 250,000 realised horse power. In Italy, pioneer steps were first undertaken towards the end of the 'eighties, when in 1888 the city of Trento installed a plant of 500 kw., and between 1892 and 1895, when at Tivoli and Paderno scarcely less modest installations were inaugurated, the former to supply current to Rome at 5000 volts and the latter to Milan at 13,000 volts. It may be affirmed that these small undertakings marked the initiation in Europe of the great movement in hydro-electric exploitation which is so actively in progress at the present time throughout the world and has revolutionised in no small measure the methods and operations of manufacture and industry.

In this and two succeeding articles it is proposed to give a brief description of the conditions and present position in regard to hydro-electric developments in Switzerland and Italy, and to set down certain personal impressions formed during a recent series of visits to some of the leading and most modern installations.

Both countries have mountain systems of great magnitude and extent. The towering heights attained by the ranges have naturally a very marked influence in conferring a notable degree of head, or pressure, on supplies of water which can be collected, diverted, and utilised for power purposes. In this respect, however, it is desirable to point out a distinction between the two classes of mountain ranges. The essential characteristic of the Alps is their abundance of glaciers, with extensive areas of frozen snow and ice, which cover their summits and topmost slopes practically in perpetuity. From the gradual and periodical melting of these masses of ice and snow come the streams and waterfalls which constitute so charming a feature of the landscape. But the flow is intermittent and limited to those seasons of the year in which the temperature is sufficiently high to cause thawing. In other words, it is only during the summer months that supplies of flowing water from these sources are available. During the rest of the year they are imprisoned in a solid state.

Fig. 1 shows a view of the Piz Palü and the Palü Glacier in the Bernina Range, one of the sources of supply of the Brusio Power Works in the Canton of the Grisons, Switzerland.

In the Apennines, on the other hand, there is an absence of glaciers and very rarely do these heights

FIG. 1.—Piz Palü and Palü Glacier, Bernina Range, Canton of the Grisons, Switzerland. By courtesy of the Brusio Kraftwerke, Poschiavo.

reach the level of perpetual snow. The consequence is that, as regards water supplies, an entirely different regimen prevails. It is not from glaciers and snowfields that the watercourses of the defiles and valleys are fed, but from the ordinary rainfall, which is seasonal and chiefly in evidence during the autumn and winter, whereas the summer precipitation is slight.

The difference may be summed up by saying that the hydro-electric installations among the Alps are, in general, actuated by lofty heads and small (even, in some cases, exiguous) supplies, with a service which is only fully effective during the summer, whereas those among the Apennines have a more moderate fall with better and more copious supplies, frequently in association with impounding reservoirs in the lower levels, the seasonal activity being most pronounced during the autumn and winter.

Impounding reservoirs, however, are not limited to the Apennine regions: they are also a feature of certain Alpine installations, though in that case they are located at considerably increased heights, and their area is naturally more circumscribed. Moreover, they have been formed under greater constructional difficulties than those on the lower slopes, which, although in some cases requiring dams of greater length, are more readily and easily accessible. The impediments in the way of the conveyance of material and the carrying on of works in the higher regions are obviously very great and the cost of such operations is correspondingly heavy.

In the formation of storage reservoirs, regard has naturally been had to the possibilities of utilising the configuration of the district to the best advantage. Despite the existence, however, among the mountain ranges of quite a number of natural lakes which form admirable reservoirs of water suitable for power purposes, the physical conditions have not always been favourable, and, the distribution being irregular, in many cases, use has had to be made of other sites which have required extensive constructional operations in order to develop them adequately as basins of supply. Some of these artificial basins, especially those of low or moderate altitude, are of remarkable size; there are about fifty or so in Italy alone, each containing more than one million cubic metres of water. Perhaps the most notable of recent years is the reservoir of Tirso, in Sardinia, which has a maximum capacity of about 400 million cubic metres.

One of the earliest examples is the reservoir at Cismon, in the province of Belluno, by means of which the Società Adriatica d'Elettricità has been able to impound four million cubic metres. It possesses some interesting features. Constructed between 1905 and 1908, and the first of its type in

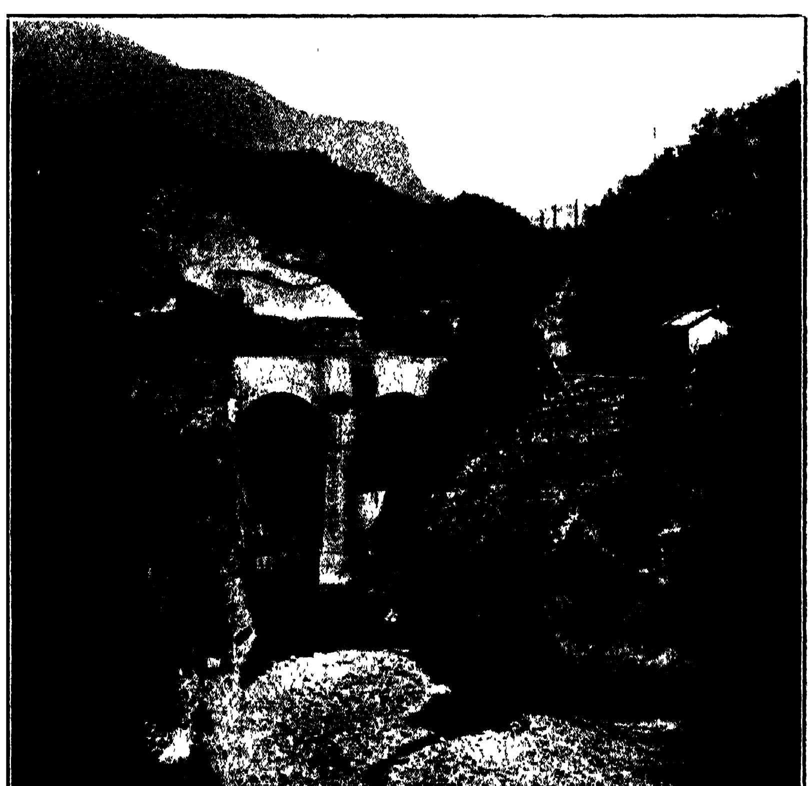


FIG. 2.—Cismon Dam. By courtesy of the Società per l' Utilizzazione delle Forze Idrauliche delle Veneto.

Italy, the masonry dam, which is shown in Fig. 2, is in the form of a slender arch supported by rock abutments on each side so closely adjacent that the chord of the arc is only 40 metres in length. The thickness of the dam at the top is 3 metres, increasing to 12 metres at the base. The height is 44 metres. The overflow, sometimes 2 metres in depth, passes over a rectilinear crest supported by the flanks of the dam and a central pier. The conduit to the power station (shown in Fig. 3) takes the form of a tunnel 1½ kilometres in length, at the end of which are two pressure tubes of 1·9 metre diameter. These, with a fall of 52 metres and a flow of 18 cubic metres per second, feed two generators, the joint capacity of which is just under 10,000 horse power.

Another point to which attention may be directed as characteristic of both Alpine and Apennine installations, arising out of the intermission of their supplies, is that for the purpose of securing constant supplies of power it has been necessary to supplement them in a number of cases by 'thermic' or steam generating stations, in which current is generated by power derived from the consumption of fuel. Thus it will be seen that, as distinct from purely hydro-electric power stations, such as those in eastern Canada, which are more or less in constant action under the energy derived from streams and rivers at low altitudes with plentiful supplies of water, the power stations of northern Italy are worked in conjunction with thermic stations which come into operation when the natural water power is suspended or is insufficient. These two sets of stations have to be connected and linked up in a compensatory system, which complicates matters a little more than would be the case if the energy were forthcoming from a single source. The six leading hydro-electric systems in the Italian peninsula, namely, the S.I.P. (Società Idroelettrica Piemonte), Edison, Adamello, Adriatica, Central and South Groups, have six thermic stations, at Turbigo, Genoa, Raconga, Marghera (Venice), Leghorn, and Naples respectively.

Attempts have been made from time to time to determine within reasonably close limits the total available supply of hydraulic energy in various countries. In all computations of this kind there is much scope for error, due to the unreliability and insufficiency of the data at hand. Conclusions, therefore, have necessarily been of the nature of mere approximations, subject to correction as further investigations have been made and the results of actual utilisations have become known. At the present time, estimates are still too vague to permit of any close or rigorous figures, but for the purposes of this notice it may be said that such statistics as are published lead to the conclusion that the available water horse power of Italy is of the order of five to six millions,[1] and that of Switzerland rather less—say four millions.[2] These figures must be taken with reserve; they are probably, almost certainly, under-estimates, but they may serve as the basis of an interesting comparison with similar estimates applicable to Canada, where, as noted in a recent article in NATURE,[3] the available horse power is calculated to exceed forty millions. On the other hand, the area of Canada is more than thirty times as great as Italy and 233 times as great as Switzerland. Accordingly it will be seen that, despite the magnitude and impressiveness of the developments which have been proceeding on the North American continent, the potential intensity of development on an area basis is much greater in the European countries.

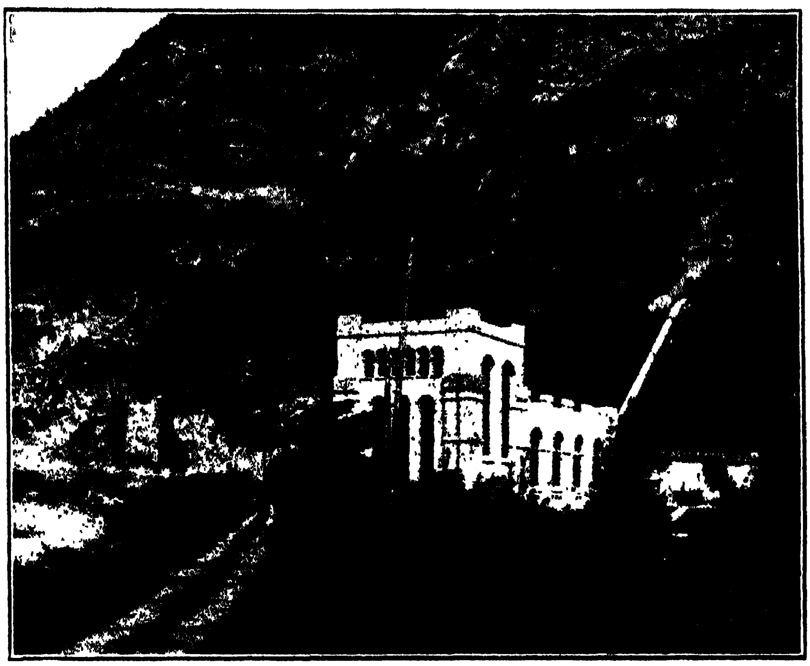


FIG. 3.—Cismon Power Station. By courtesy of the Società per l' Utilizzazione delle Forze Idrauliche del Veneto.

During 1929, some 400,000 additional water horse power was installed in new, or extended, hydro-electric stations in Italy, bringing the aggregate of installations up to about 4½ million horse power. The latest available figures for Switzerland indicate that some 2½ million horse power had been realised in various installations up to the end of 1929. It must be admitted, however, that the difficulties in the way of instituting an exact census of all installations, large and small, public and private, direct acting and transmissional, are such that the returns, while substantially correct, may not be quite precisely so. At a stage when progress is rapid and the situation changes from month to month, absolute accuracy is, perhaps, of no great account.

[1] *Vide*, Table IV., "Power Resources of the World"; published by London World Power Conference, 1929.

[2] This is the official estimate of the Swiss Service des Eaux as contained in the *Rapport du Conseil Fédéral sur sa Gestion en 1929*. A much higher figure is given in the London World Power Conference Report.

[3] May 31, 1930.

Obituary.

J. A. LE BEL, FOR.MEM.R.S.

THE death of Joseph Achille Le Bel, which occurred in Paris on Aug. 6, removes a veteran who had been closely associated with the rapid development of organic chemistry during the latter part of the last century. Le Bel was born at Pechelbronn, Alsace, on Jan. 21, 1847, and was a nephew of Boussingault, the agricultural chemist. He was a student at the École Polytechnique from 1865 to 1867 and became successively assistant to Balard, the discoverer of bromine, at the Collège de France, and to Würtz, at the École de Médecine, in Paris. For some time he was in charge of the petroleum workings at Pechelbronn, in which his uncle was interested; he became and remained an ardent partisan of Mendeléeff's view that the petroleum deposits result from the action of steam on metallic carbides at volcanic temperatures.

Le Bel holds an honoured position in the history of science as one of those eminent French natural philosophers who discovered and worked out the earlier consequences of optical rotatory power. Arago observed in 1811 that the plane of polarisation of a beam of polarised light is deflected by passage through a plate of quartz cut perpendicular to the optic axis; in 1815 Biot found that certain organic liquids, such as turpentine, are also optically active in the same sense. In the 'fifties and 'sixties, Pasteur concluded from his classical investigation of the tartaric acids that the optical rotatory power of aqueous solutions of these organic compounds arises from asymmetry of their molecular configurations. No progress was made, however, in the problem of ascertaining the definite arrangement in three-dimensional space of the atomic components of optically active molecules, called for by Pasteur's fundamental conclusion, until the doctrine of the asymmetric carbon atom was enunciated.

The theory of the asymmetric carbon atom was put forward independently and practically simultaneously by van 't Hoff and Le Bel in 1874; after a brief period of discussion, accompanied by a certain amount of lively ridicule, the theory became universally accepted and to-day forms the foundation of the vast subject of the stereochemistry of carbon compounds. The theory was evolved in a somewhat different fashion by its two authors. Van 't Hoff proceeded from the assumption that, in such a molecule as that of methane, CH_4, the four valency directions of the carbon atom are directed from a centre, representing the carbon atom, towards the apices of a regular circumscribing tetrahedron, the four hydrogen atoms being centred at those apices. In the substitution derivatives of methane of the types, CX_3Y, CX_2YZ, X, Y and Z being univalent radicles, no isomerism should exist if the four radicles lie at the apices of the tetrahedron as foreshadowed by the theory; when all four radicles attached to the central carbon are different, as in the type CWXYZ, two isomerides should exist, the space configuration of one being the mirror image of that of the other. A carbon atom so attached to four different radicles is termed asymmetric, and, in accordance with the conclusion of van 't Hoff and Le Bel, all substances which contain one asymmetric carbon atom in the molecule have been found to exist in two mirror image, or enantiomorphously related, configurations, of arithmetically equal but algebraically opposite rotatory powers.

Le Bel arrived at the theory in a somewhat different manner. He discussed the mode in which the four univalent radicles attached to a quadrivalent carbon should arrange themselves as a pure question of equilibrium, and hence arrived at the tetrahedral environment of the central carbon atom with the same consequences, as regards asymmetry, as those of van 't Hoff. It is not yet settled whether van 't Hoff's view, that the carbon atom carries four valency directions directed towards the four apices of a circumscribed regular tetrahedron, is preferable to that of Le Bel, but the tendency of modern organic chemistry is certainly towards the Le Bel implication that the four carbon valency directions are not so fixed. Probably, however, both men were making in 1874 an incomplete statement of the same thing; although more than half a century has elapsed, it is not yet possible to state the theory of the asymmetric carbon atom in more definite and explicit terms than was done at that date.

Le Bel was the first to separate an optically active component from the synthetic mixture of the two mirror image components of a compound containing an asymmetric carbon atom; he did this in most cases by taking advantage of the selective destructive action of lower organisms on the laevo- and dextro-isomerides. He was also the first to show that when the asymmetric carbon atom of an optically active substance of the type, CWXYZ, becomes symmetric by conversion into the allied compound, CX_2YZ, the optical activity disappears.

Later, Le Bel extended his stereochemical conceptions to quinquevalent nitrogen compounds and announced in 1891 that he had been able to obtain optically active methylethylpropylisobutylammonium salts; this observation could not be confirmed by others, and is no doubt mistaken. The laboratory technique for dealing with such complex substances had not then been sufficiently worked out, and it was not until 1899 that the first optically active substituted ammonium salts containing an asymmetric quinquevalent nitrogen atom, but no asymmetric carbon atom, were first prepared.

Le Bel did not publish a great amount of experimental work, probably because he held no academic post and so found few collaborators; his writings cover, however, a wide range of subjects and are permeated by a quite uncommon philosophic spirit. He was an individualist and mixed little with his scientific colleagues; he was intolerant of officialdom in any of its aspects, and was wont to express

his contempt of bureaucracy with some vigour. His originality of thought, his outspokenness, and his unconventionality, indeed bohemianism, made him somewhat difficult of access, but in congenial society he was a delightful companion, full of knowledge of the world and sparkling with anecdote and caustic wit. He maintained his interest in science to the end, and, so late as April last, offered a money prize for the rediscovery of a microscopic green alga, found and lost by him, which had the power of converting atmospheric nitrogen into ammonia.

Le Bel was president of the French Chemical Society in 1892; he was a Commander of the Legion of Honour and a member of the Paris Academy of Sciences. He was elected an honorary fellow of the Chemical Society in 1908 and a foreign member of the Royal Society in 1911; in 1893 both he and van 't Hoff became Davy medallists of the Royal Society.

W. J. POPE.

News and Views.

PROF. F. O. BOWER, whose presidential address to the British Association is printed in our Supplement this week, is an outstanding figure in British botany. Following a brief period as lecturer in botany at the Imperial College of Science, South Kensington, he became Regius professor of botany in Glasgow in 1885, and there during his forty years of tenure of his chair devoted himself with boundless energy to the study of problems of plant morphology and affinity. His influence as a teacher, investigator, and administrator has been marked, and it may truly be said that he has done more than any other living botanist to form botanical opinion and stimulate research in his field of special inquiry. As a writer he has shown rare gifts of both analysis and synthesis. He is the author of many publications which have been widely read and constantly admired, both for their clarity of expression and constructive reasoning. Chief among these are "The Origin of a Land Flora", published in 1908, and his works on the "Ferns", published since 1923; but he has also devoted himself to more popular exposition in such works as "The Botany of the Living Plant" and "Plants and Man". He has held the presidential chair of the Royal Society of Edinburgh, has thrice been president of the Botanical Section of the British Association, and among the numerous other distinctions which have fallen to him in recognition of his work are a Royal Medal of the Royal Society, the Linnean Medal of the Linnean Society, and the Neill Prize of the Royal Society of Edinburgh.

To one so deeply interested as Prof. Bower in both the details of morphological study and broad philosophical discussion, the choice of subject for his presidential address to the British Association at Bristol may have been easy, and in choosing as his theme "Size and Form in Plants" he has presented a topic which has for long claimed his attention. Starting with Darwin's view of life that from simple beginnings creatures of endless form and beauty have been, and are being, evolved, he touches lightly on a probable common origin of the kingdoms of plants and animals, their early divergence in descent, their increasing size and complexity, and the attainment of those varied forms of colonial life which we call the higher creatures. If the offspring fail to separate, colonial life is begun and the surfaces of interaction with the outer world are restricted; growth of the dual partners proceeds to its limits, and division, without separation of the offspring, follows. Thus step by step the stature of the colony increases, the problems of life change for the individual components, and reflect themselves in the variously differentiated tissues which they come to compose. But though many of the units may die without dividing, and thus contribute in varied ways to the services of the colony as conductive and supporting tissues, in plants there is a residue of cells, mainly massed at the growing points of stem and root, which up to the limits of size and form of the colony may continue to grow, divide, and contribute still further to the stature of the colonial being. On the other hand, it would appear that the extreme stature mechanically possible for a tree-trunk thus evolved is about 300 feet, and that this coincides approximately with the limits of height of the canopy of a tropical forest; that the members of the plant kingdom range in size between the microbe and the forest tree, and that the varied forms of colonial plants which have won success in descent have been determined in large measure by the size factor.

IT is to the elaboration of this thesis that Prof. Bower's presidential address is largely devoted, and in its development the surfaces through which the physiological exchanges within the plant, and with the outer world, are maintained, are discussed. In brief, it is held that both in extent and arrangement a plan of external form and internal differentiation may be satisfactory up to a limit of colonial stature, that if the plan is maintained beyond this limit the creature fails, that throughout descent failures from this cause are manifold, and that Nature has not failed to seek and find escape from extinction for many of her creatures, as their size increased, in re-arrangement of the surfaces of physiological exchange, both internal and external. It is on this view that Prof. Bower has sought once more to direct attention to the wonders of form and structure which pass coldly to-day under the science of morphology, and to place them as reasonable and varied solutions which have been found to the problems of life in its higher forms. The address closes with a note of appeal to all who may assist in rendering the link of usefulness between pure research and application stronger, and a high appreciation of all that has within recent years been attempted and accomplished in this direction.

IF one may judge from the first days of the annual meeting of the British Association now in progress at Bristol, the gathering will rank as one of the most

successful in recent years. The organisation of the meeting is very complete, the reception-room being set in the commodious and beautiful Great Hall of the University and the sections all adequately housed near it. The figures of the attendance to date exceed 2500, many visitors being attracted no doubt as much by the interest of the city and its environs as by the scientific papers. As we go to press, Prof. Bower's presidential address is being delivered in the Colston Hall, which visitors to the previous meeting in 1898 may remember was dramatically burnt down two days before that meeting. The first of the citizens' lectures is being given on Sept. 4 by Sir Daniel Hall, on "Apples: the Effect of Research on Production". This subject has special local interest in view of the work of the University Agricultural Station, which was founded from the earlier Fruit and Cider Institute at Long Ashton. On the same evening the Lord Mayor is holding a reception in the Museum and Art Gallery, followed by a dance in the Victoria Rooms. Amongst other items of special interest in the programme for Thursday are the address by Prof. Abercrombie to the conference of delegates, on national parks, and also the inspection of the Henry Herbert Wills Physical Laboratory, with demonstrations to members of Section A. Visits to Messrs. Wills' tobacco factory and short tours of historic Bristol, which are taking place daily, are being well patronised. The handbook for the meeting is in magazine form, and includes articles on previous meetings of the Association at Bristol and on the development of the University, together with an illustrated account of the old and new city of Bristol.

BY the retirement on Sept. 1 of Mr. H. W. Dickinson, the senior keeper, the Science Museum, South Kensington, loses one of its best-known officers. Born at Ulverston, Lancashire, sixty years ago, Mr. Dickinson was educated at Manchester Grammar School and Owens College, and after gaining practical engineering experience in various works, in 1895 he joined the staff of the Science Museum, when it was still part of the South Kensington Museums. During his thirty-five years' service he has served under four directors, General G. R. Festing, Mr. W. I. Last, Sir Francis Ogilvie, and the present director, Sir Henry Lyons, and has been associated with all the modern developments of the Museum. As an assistant keeper and a keeper he has been responsible for the compilation of various catalogues; while as senior keeper of the engineering collections, the task fell to him of installing the important exhibits in the ground floor of the new galleries opened by the King in 1928. In addition to his ordinary duties, he has acted for sixteen years as secretary to the Advisory Council of the Science Museum, presided over by Sir Hugh Bell, and during the War was secretary to a panel of men of science set up by the Ministry of Munitions for the examination of inventions.

MR. DICKINSON'S travels have made him widely known in the United States and on the Continent. Since the formation in 1920 of the Newcomen Society, he has acted as honorary secretary, and recently he has accepted the honorary secretaryship of the Second International Congress of the History of Science and Technology, which will meet in London next June and July under the presidency of Dr. Charles Singer. He is the author of a life of Robert Fulton, and the joint author, with Mr. Rhys Jenkins, of the fine memorial volume on James Watt issued in 1919 in connexion with the Watt centenary celebrations. Though his retirement marks the end of Mr. Dickinson's official career, we are glad to know that it will not mark the cessation of his activities in furthering the study of engineering and technological history.

THE Canadian Supplement of the *British Medical Journal* of Aug. 30 contains the full text of Lord Moynihan's Lister oration delivered on the occasion of the annual meeting of the British Medical Association at Winnipeg on Aug. 29. Lord Moynihan described Lister as the greatest material benefactor the world has ever known, and as one who has saved more lives than all the wars of all the ages have thrown away. Lister created a new world for surgery by making it possible to prevent infection in new wounds and to deal more successfully than before with wound infection already established. This achievement was due to the recognition of a new principle, namely, that surgical infection was due to living microbes with their power of infinitely rapid propagation in wounds. In other words, Lister's success was due to the application to surgery of Pasteur's researches on putrefaction and fermentation, to which his attention was first directed in 1865 by Thomas Anderson, professor of chemistry at Glasgow. At first, as the result of Pasteur's influence, Lister regarded the air as the chief source of danger, and therefore made considerable use of the carbolic spray, which he afterwards discarded; but he afterwards convinced himself that the surgeon's fingers and instruments were more to be feared than the air. In spite of the scepticism, ridicule, and indifference of many eminent contemporary surgeons, Lister succeeded in reducing almost to zero the incidence of erysipelas, pyæmia, hospital gangrene, and tetanus, which had hitherto been rife in the Glasgow Infirmary as in other large hospitals, and in undertaking successfully operations which had hitherto been regarded as too dangerous. In conclusion, Lord Moynihan attributes Lister's ultimate triumph not so much to his supreme intellectual gifts as to his idealism, enthusiasm, earnestness, and courage.

DR. ALEŠ HRDLIČKA has recently returned to Washington from Alaska, where he has spent the spring and early summer in investigating the ethnology of the Eskimo of Kuskokwim River. According to a report circulated by Science Service of Washington, D.C., Dr. Hrdlička found that the Eskimo in this area now number about three thousand. They had not previously been studied on the spot, and he was fortunate enough to be able to measure a considerable number of them. He also unearthed a number of very ancient burials, and by measuring the skeletal remains was able to establish their physical characters over a considerable period, possibly some hundreds of years. The results show that the type has remained constant

for a long period of time, and Dr. Hrdlička concludes, it is stated, that it represents the old original type of Eskimo from which other types have developed. The distinctive feature in this type is that it lacks the extraordinary facial development and outstanding jaws characteristic of the Eskimo of Greenland and other Arctic regions. The differentiation is so marked, especially in the older specimens, as to warrant, in Dr. Hrdlička's view, the conclusion that the original type was Indian and to set definitely at rest any question that the Eskimo are of a different and distinct race. No doubt more will be heard of this matter at the International Congress of Americanists which meets at Hamburg on Sept. 7–13.

AN article by the special correspondent of the *Times* in the issue of Aug. 30 gives an account of some of the results obtained by Prof. Siegfried Loeschke on a site in Roman Trier on the Moselle. The site in question, which lies outside the original walls of the city founded by Augustus in the Altbachtal, was discovered by Prof. Loeschke in 1924. The excavations were begun in the following year and continued until Aug. 9 last, when they were closed down owing to economic difficulties. They have produced some remarkable results, especially in their bearing upon the religious beliefs and culture of the pagan Treveri, of whom little was known previously. In fact, these excavations have been pronounced by German authorities to be the most important for many years in the sphere of Romano-German cultural development and in the additions they have made to knowledge of theistic cults on Celtic soil. No less than twenty-four temples and twenty-nine chapels have been discovered in the course of these excavations. Among the more interesting finds during the current season is a life-sized marble statue of the goddess Arduinna, from whom the Ardennes takes its name; this statue is pronounced to be the finest marble found at Trier since 1845. Another is a representation in baked clay of the Celtic goddess of the woods and waters, Artio, in the form of a bull with forelegs arched over the figure of a youth. This is headless, but otherwise complete with pediment. A number of representations of other deities have been discovered, some of which are still unidentified; but in 1928 among a hundred clay statuettes found in a building adjoining a temple were a number unquestionably intended to represent the Germanic deities, Wodan, Ziu, and Donar, which were equated with the Roman deities, Jupiter, Mars, and Hercules. This find confirms, in Prof. Loeschke's view, the statement of Roman writers that the Germanic tribes worshipped Hercules, though the Gauls left no such tradition.

FROM the publication of some of the particulars of the will of the late Miss Sarah Priestley Wainwright, a great-granddaughter of the eminent natural philosopher Joseph Priestley, we learn that the diploma and seal in box sent to him by the Empress Catherine of Russia, together with his Copley Medal, have been bequeathed to the Royal Society. This medal was awarded to him in 1773 for his "Experiments on different kinds of Air", read to the Society two years before he announced the discovery of oxygen. But from an interesting letter from Franklin to Canton, reprinted in Weld's "History of the Royal Society", 1848, it will be seen that it had been proposed to award him the medal in 1767 for his experiments in electricity. When making the presentation in 1773, Sir John Pringle, the president, said to Priestley: "In the name and by the authority of the Royal Society of London, instituted for the improvement of Natural Knowledge, I present you with this medal, the palm and laurel of this community, as a faithful and unfading testimony of their regard, and of the just sense they have of your merit, and of the persevering industry with which you have promoted the views, and thereby the honour of the Society. And in their behalf, I must earnestly request you to continue those liberal and valuable inquiries, whether by prosecuting this subject, probably not yet exhausted, or by investigating the nature of other subtill fluids of the universe." Shortly after being awarded the medal, Priestley was elected one of the eight foreign associates of the Paris Academy of Sciences.

As broadcast receiving sets with outside aerials are much used in Great Britain, the following account of what happened when the aerial of a house in Doncaster was struck by lightning will be of interest. It is probable that some one had forgotten to earth the aerial after using the set. A report of the damage done (with a diagram) is given in the *Electrical Times* for Aug. 28. The house was on high ground, somewhat exposed, and was near the middle of a long row of houses. The horizontal aerial wire was attached to the top of a 38-foot pole through an insulator and to a short pole on a chimney-stack on the roof. It then went downwards to two iron brackets and insulators which kept it away from the building. Finally it entered a room on the ground floor through a leading-in tube and was attached to the receiving set. The lightning flash seems to have struck the horizontal part of the aerial and branched in each direction. The insulator at the pole end was smashed and the aerial fell. In the other direction, the lightning seems to have sideflashed down the outside of the chimney-stack, as the lead on the roof was pulled up some six inches round the base of the stack. The insulator on the top bracket was smashed, a charge sideflashing through it into a wall of lath and plaster separating two rooms, apparently bursting the wall and scattering plaster into each room. The insulator of the lower bracket was unbroken, a charge arcing to the bricks and scattering portions of them a distance of about thirty feet. The rest of the charge entered the receiving set and burst a condenser in it. On raising the lid, it looked as if everything had been sprayed over with pitch, doubtless from the condenser; but no damage was done to the valves or the transformers. The house fuses for the electric-lighting mains were blown and three electric lamps had their filaments broken, but the insulation of the mains was undamaged. Most sets with outside aerials have lightning protectors. It is advisable, therefore, to see that they are switched on during a thunderstorm.

"THE present centrifugal movement towards specialisation with its resultant divergency of interests and tendency to misunderstanding between workers" was deplored by Mr. C. E. Andrews, Government Geologist in New South Wales, in his recent presidential address to the Australian and New Zealand Association for the Advancement of Science. He commended the suggestion once made by Gilbert, the philosopher-geologist of America, who advocated "the extensive use of the 'Intellectual Excursion' amongst workers", meaning thereby that they should take an intelligent interest in work going on in other fields besides their own. Such excursions may prove a fruitful source of inspiration, an instance of which was given by Mr. Andrews in Darwin's utilisation in the "Origin of Species" of Mathew's work on "Naval Timber". He might also have added that perhaps Darwin's masterpiece would never have been written had not the author perused Malthus's "Essay on Population". But altogether apart from the stimulating effect of occasional excursions into other fields, there is the enlargement of the mind which accompanies the 'synoptic' point of view. Men of science have sometimes been charged with Philistinism, and specialism may easily tend in this direction. The best antidote would be that every student should work out some sort of a philosophical outlook for himself; but this he will scarcely do if he is blind to the importance of every subject except his own.

THE University of London Animal Welfare Society has sent us a letter appealing for information about the condition under which badgers and otters exist to-day in Britain. These are elusive animals and their secretive and nocturnal habits must make the collecting of accurate information about their distribution and numbers wellnigh impossible, but a present-day census, even if incomplete, would give a kind of standard by which fluctuations in future years might be tested. Helpers in this good work are requested to answer a series of questions with the view of elucidating: (a) The localities now inhabited by badgers and otters, their numbers and the years of special abundance or scarcity, the nature of their habitats, and natural causes of death; (b) their habits, especially in regard to their economic relations to the farm, game-preserving, and fishing; (c) methods of trapping and their desirability or otherwise from the point of view of cruelty involved, the nature of the 'sport' the creatures are subject to, and whether it is desirable as an effective means of destruction. Replies to the queries, which have been stated above in summary, should be sent to Miss Ada Hallett, 34 Acre Lane, London, S.W.2.

DR. JOHN WALTON, lecturer in botany in the University of Manchester, who has been appointed to the Regius professorship of botany in the University of Glasgow (NATURE, Aug. 30, p. 332), is well known as a distinguished authority upon fossil plants, particularly those of the Carboniferous system, and his appointment to the University of Glasgow seems particularly appropriate in view of the fact that the department of botany in that University houses the great Kidston collection of fossil plants with its accompanying library. The new professor may be expected to carry on the morphological traditions of the Glasgow school associated particularly with the name of Prof. F. O. Bower.

DR. J. A. CARROLL, assistant director of the Solar Physics Observatory, Cambridge, has been appointed professor of natural philosophy in the University of Aberdeen in succession to Prof. G. P. Thomson. Dr. Leslie J. Comrie, deputy superintendent since 1925 of the Nautical Almanac Office, has been appointed superintendent of the office in succession to Dr. P. H. Cowell, who has retired under the age limit after twenty years' service.

WE have received vol. 12 (1929) of Experimental Researches and Reports published by the Department of Glass Technology, University of Sheffield. This contains reprints of a number of papers published from the department in different journals covering various sides of the industry.

THE U.S. Coast and Geodetic Survey publication entitled "Directions for Magnetic Measurements", by Daniel L. Hazard, was reprinted in 1921, and a further (third) edition (serial number 166, price 30 cents) has now been issued. It gives the theory of magnetic instruments, and directions for their use on land and at sea. The principal instruments considered are the ordinary magnetometer, the dip circle, and the dip inductor; in further editions some account of electrical means of measuring the magnetic force may be hoped for. Brief instructions as to the operation of a magnetic observatory are included, but a separate detailed manual on that subject is in preparation. There is also a brief chapter on earthquakes and seismographs. The manual is a very valuable and inexpensive short treatise on practical magnetic work.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant road engineer in the Roads Department of Southern Rhodesia—The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2 (Sept. 7). An instructor in veterinary science under the Glamorgan Agricultural Committee—The Director of Agriculture, 17 Park Place, Cardiff (Sept. 8). A veterinary surgeon under the Municipal Commissioners of George Town, Penang—Peirce and Williams, 1 Victoria Street, S.W.1 (Sept. 9). A half-time assistant in the Geology Department of the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (Sept. 12). A demonstrator in chemical pathology in the University of Manchester—The Registrar, University, Manchester (Sept. 13). A junior lecturer and demonstrator in the chemical department of East London College—The Registrar, East London College, Mile End Road, E.1 (Sept. 13). A research officer for investigations of fisheries, Andaman Islands—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Sept. 17). A senior factory inspector under the Ministry of Labour of the Government of Northern Ireland—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (Sept.

20). An assistant lecturer in chemistry in the University of Birmingham—The Secretary, University, Edmund Street, Birmingham (Sept. 20). An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Office, Plymouth (Sept. 20). A lecturer in botany at the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (Sept. 22). Civilian education officers with a degree in engineering, in the R.A.F. Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1 (Sept. 22). An assistant lecturer in mathematics at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (Sept. 24). An agricultural mycologist at the Agricultural Institute and Experimental Station, Kirton, Lincs—The Principal, Agricultural Institute, Kirton, near Boston, Lincs (Sept. 27). A senior lecturer in education in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 30). A lecturer in chemistry in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Abbassia, Cairo (Oct. 14). A professor of pathology at the Medical College, Vizagapatam, Madras—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Nov. 3).

ERRATUM.—NATURE of Aug. 23, p. 272, col. 2, line 19, for "west to east" read "east to west".

Our Astronomical Column.

Meteoric Theory of the Lunar Craters.—*Scientia* for August contains a paper by A. C. Gifford in which he supports the meteoric origin of the lunar craters and walled plains, as against the volcanic theory. He refers to Meteor Crater in Arizona, and the gigantic Siberian meteor of June 30, 1908, as evidence that large meteoric masses still traverse the solar system; he assumes that they were much more numerous in the early days of the planetary system, since he adopts the planetesimal theory in preference to the gaseous filament theory proposed by Jeans and Jeffreys.

The objection that oblique impacts would not produce circular craters is answered by the assertion that the crater is not due to the impact itself, but to the explosion resulting from the violent heat produced by the sudden stoppage of the meteor. Mr. Gifford claims that the greater part of the matter scattered by the explosion would be driven out horizontally, forming the wall of the crater, while the matter that was thrown upwards would, on its descent, form the central peak or peaks. The explosion would reduce the material to fine powder, thus explaining the whiteness of many of the craters; it is noted that black glass appears white when finely powdered. Such matter as was reduced to a molten state by the impact would on solidification produce a dark surface, like that seen in the interior of Plato and other craters. The systems of radiating bright streaks surrounding Tycho, Copernicus, etc., are explained by supposing that in these cases the meteoric impact cracked the lunar crust, and molten matter was driven through the cracks from the interior, afterwards solidifying in a crystalline form.

Mr. Gifford compares his theory with that put forward in 1903 by Prof. N. S. Shaler. The latter also postulated the impact of large meteoric masses on the moon, but did not adopt the view that a great explosion would result from the sudden stoppage of the meteor and its reduction to a gaseous form; he supposed that the lunar surface would be liquefied and produce an extensive level region of a dark colour. In other words, he ascribed the *maria*, not the craters, to meteoric impact.

The Radcliffe Observatory and South Africa.—Mr. F. Robbins, the treasurer of the British Astronomical Association, has contributed two articles to the *Journal* of that body (vol. 40, Nos. 7 and 8) in which he describes the present general recognition of the value of South Africa as a centre for astronomical observation. This was pointed out by La Caille nearly two centuries ago; later on, Fallows and Sir John Herschel gave similar testimony. In the present century, Dr. Innes has spoken so enthusiastically of the climate of Johannesburg that astronomers from the United States, Leyden, and Berlin are establishing observatories in that region. The second article deals with the Radcliffe Observatory, the removal of which to Pretoria is now contemplated. John Radcliffe was a celebrated physician who died in 1714 at the age of sixty-one years. He left a large sum to be expended in Oxford. This is partly represented by the Library in the Radcliffe Camera. The remainder was devoted in 1770 to the building and endowment of the Radcliffe Observatory. The observations made by Dr. Hornsby, the first observer there, have not yet been fully reduced, but this is now being done by Dr. Knox Shaw. Mr. Robbins's article summarises the work done at the Observatory since its foundation, and includes eight reproductions of illustrations of the building and instruments.

Slitless Spectrograms of the Orion Nebula. In a recent communication to the Royal Astronomical Society (*Mon. Not.*, **90**, p. 580), Dr. W. J. S. Lockyer publishes some slitless spectrograms of the Orion nebula, extending from the green 'nebulium' lines to the pair at λ3727, obtained with much higher dispersion than has been previously used for this work. The results are discussed in relation to earlier work of the same kind by Pickering and Mitchell and to the researches of Keeler, Hartmann, and Reynolds, who photographed monochromatic images, using specially prepared light-filters. The results endorse in the main those of the investigators named, and show that the radiation from the central portion of the nebula—the so-called Huyghenian region—is almost entirely due to hydrogen, and the two 'nebulium' lines, N_{12}, now traced to O III. The 'Messierian' branch, to the east of the central portion, emits this radiation together with the λ3727 pair of O II, and the outlying regions radiate the λ3727 pair with practically nothing else. Numerical estimates are given, on an arbitrary scale, of the intensities of each of the several radiations in different regions. The relative faintness of the λ3727 images compared with those obtained by other workers—Reynolds, for example—is doubtless attributable to absorption in the lenses of the telescope; Reynolds, who obtained much stronger images, used a reflector. On p. 523 of the same volume of the *Monthly Notices* appears another communication from the Norman Lockyer Observatory—a further list of spectroscopic parallaxes and spectral types of *B*-type stars determined by Mr. D. L. Edwards. Data for 175 stars are tabulated and discussed in comparison with the results of other observers, with which they agree very well.

Research Items.

Medieval Indian Dress.—Mr. K. de B. Codrington contributes to the *Indian Antiquary* for August the first instalment of a study of medieval Indian culture as illustrated in the frescoes of the Ajanta Caves. The style of the frescoes, though mannered, is based on a minute observation of life; and there is no reason to doubt that the textiles, arms, and accoutrements are a faithful witness to vanished originals, except in the case of the frescoes of Buddha, of which the piled-up head-dresses and the jewelled necklaces never existed outside the tradition. With regard to chronology, four, or at most five, sequence styles can be detected, and the work is of the sixth and perhaps part of the seventh century, but certainly not later. Mr. Codrington here deals with costume and embroidery and textiles. It is usually said that cut and sewed garments were unknown in ancient India. Though this is borne out by the early sculpture at Bharhut and Sanchi, it does not apply to Ajanta. The indoor costume of the women consisted of a waist-cloth of varying length, usually supported by a beaded or jewelled belt. Occasionally a breast-cloth or scarf is worn. On other occasions a knee-length garment was worn, apparently slipped over the head, fitting tightly on the shoulders, and opening up on either side. With it was worn a long-sleeved waist-length bodice. The waist-cloth is the chief costume of the men, though the hunters and other forest people wear the small loin-cloth. A long-sleeved tunic to the knee is worn by soldiers and horsemen. Another type of jacket had short sleeves and ended at the waist. There are embroideries at the wrists, upper arm, and neck, and sometimes down the front. In some cases the dress seems to be a uniform. Here a waist-cloth is worn, but princes and heroes wear *paijamas* or tight-fitting 'jodhpurs'. With these one prince wears scarlet leather slippers.

Arterial System of Lemurs.—One of the most interesting results of the investigation of the anatomy of *Loris lyddekerianus* by Drs. A. Subba Rau and P. Krishna Rao (*Half-yearly Jour.*, Mysore University, vol. 4, p. 90, 1930) is the detailed description of a plexiform condition of the subclavian, external iliac, and middle sacral arteries. This leads to a general discussion of the purposes served by arterial plexuses, which, although most often found in aquatic air-breathing animals, are not confined to these and reveal no phylogenetic relationship or indeed at first sight any similarity of habit in their possessors. This is evident from their occurrence in creatures of such different modes of life as fishes, birds, and amongst mammals, ungulates, cetaceans, and lemurs. Various suggestions have been made as to the significance of the plexuses, such as that they merely represent a persistence of the embryonic phase of the arterial system, or that the minute branches diminished the velocity of the blood stream to the muscles, or that they served to maintain normal circulation during the period of contraction of the muscles. Judging from the structure and position of the plexuses in *Loris*, and from the association of venous with arterial plexuses, the authors "reaffirm the proposition already hinted at by Caralisle and add confirmative evidence in support of the view of Burne that these plexuses serve as storage tanks for arterial blood", and that they "regulate the supply of blood to the limbs in the same way as the spleen functions in regulating the blood supply to the viscera".

Aalborg Herring.—The Report of the Danish Biological Station to the Ministry of Shipping and Fisheries, **35**; 1929, by the Director, Dr. A. C. Johansen, contains some very interesting work. In the first part, "The Aalborg Herring and its Importance to the Danish Herring Fishery from the XVIth Century until the Present Day", Dr. Johansen deals with the history of the Limfjord herring fishery. In early years the Aalborg herring was the only one in the Limfjord, coming in from the Kattegat to spawn, but the breaking through of the Agger Isthmus in 1825 and the consequent inflow of salt water from the North Sea influenced the fishery profoundly. Not only was there an immigration of fish of different races from the west but also the altered conditions of salinity affected the spawning grounds of the original herring. There is distinct evidence to show that the eastern herring of the Limfjord of the present day is the descendant of the original Aalborg herring, having the same habits. Together with those of other races from different parts, it almost certainly spends part of its life in the Skagerrak feeding on the abundant and rich plankton to be found there, which fact accounts for its quality and its importance for centuries in the Danish fishery. The present day herring fishery, although proportionally not so large as in early years, is in a flourishing condition and the last decades show a decided increase, partly owing to the use made of the young, known as 'silding'.

Plankton of British Columbia.—Mr. G. H. Wailes has been occupying himself for some years with the marine plankton of British Columbia, publishing from time to time his very useful summaries of the various groups in the *Vancouver Museum and Art Notes*. The present paper, "Marine Zoo-Plankton of British Columbia" is reprinted from Vol. 4, 1929, of that publication, and embodies an address given to the Burrard Field Naturalists' Club on Oct. 25, 1929. The chief interest of this plankton lies in the fact that many forms are common to the Pacific and Atlantic and a plankton haul from Vancouver does not look very different from one from British seas. Some species are certainly different, but many may be closely related, such as *Calanus tonsus*, which to a large extent replaces *Calanus finmarchicus* in the Strait of Georgia. In the list of Copepoda are to be noted as abundant such common British species as *Calanus finmarchicus*, *Pseudocalanus elongatus*, *Metridia lucens*, and *Anomalocera pattersoni*, and similarly in other groups one meets many species which are familiar. A table is drawn up to show the food chains in the sea with special reference to *Clupea pallasi*, the Pacific herring, and the sock-eye salmon, *Oncorhynchus nerka*, including the various enemies of the latter fish.

Northern Echinoderms.—Two papers in *Bergens Museums Arbok* for 1929 deal with echinoderms. The first, by Mr. James A. Grieg, "Some Echinoderms from the South Shetlands" (Naturvidenskapelig rekke No. 3), describes some interesting collections from the Whaling Station in Admiralty Bay and from two of the whaling boats probably taken near the same locality. Among the sixteen species recorded there are some which are very little known and have only rarely been seen, and some which hitherto were only recorded from the Antarctic regions. In the second paper (No. 9) Mr. Sven Runnström describes a new spatangid larva from the west coast of Norway. These occurred between 50 and 100 metres, only four being found, representing a series of developing stages. The youngest larva still contained a good deal of yolk, showing that it must have come from a

yolk-laden egg. Red-gold yolky eggs were also collected which probably belonged to the same species. The author suggests that the eggs and larvæ are those of *Briaster fragilis*, the development of which was unknown but whose yolky eggs led Dr. Mortensen to predict direct development.

Mollusca from the Raised Beach at Portland Bill.—Collections have from time to time been made of the molluscan remains occurring in the raised beach at Portland Bill by such well-known observers as Pengelly, Prestwich, Damon, and Sykes, as well as by the Geological Survey, but so far no list has been given including the results of all their published observations. This has now been done by Mr. D. F. W. Baden-Powell (*Proc. Malac. Soc. Lond.*, Vol. 19), who has further added to the number of species found, which thus amounts to more than fifty, and supplied notes concerning each. With one possible exception, none of the forms is extinct, and the lower limit of age of the deposit may therefore be placed in the Pleistocene, and perhaps rather after the middle thereof, rather than in the Pliocene. The assemblage represents a more northern one than that now found at Portland, and the suggestion is that the sea at the time of the formation of this raised beach was colder than at present.

Temperature Gradients in the Permian of Texas.—W. B. Lang has discussed the depressed isogeothermal surfaces of the Permian Basin of Western Texas (*Jour. Wash. Acad. Sci.*, April 4, 1930). A well was recently drilled 4400 feet through Permian formations carrying anhydrite, into Carboniferous and Pre-Cambrian rocks. The subnormal gradient characteristic of the Basin was met with until the anhydrite beds were passed through, after which the gradient rapidly steepened. It therefore appears that internal heat is being conducted more rapidly by the anhydrite than by the underlying sediments. The thermal conductivities of anhydrite and rock salt are respectively 0·0123 and 0·0137, values twice as high as those characteristic of ordinary sediments. It is pointed out that our present data on the thermal conductivities of rocks as they exist under natural conditions are very meagre. The effects of compaction, porosity, bedding, mineral orientation, degree of cementation and water content have rarely been considered, although when cumulative they may be very great. There is urgent need for research on those lines, for until better data are forthcoming geothermal problems cannot be attacked with precision.

Copper Belt of Northern Rhodesia. The new copper field of Northern Rhodesia gives promise of becoming the greatest copper-mining centre of the world, for already the ore-reserves have been estimated at between 500 and 1000 million tons of copper. A detailed account by Alan M. Bateman of the deposits and their geological setting and origin appears in *Economic Geology*, June–July, 1930, pp. 365-418. The rocks of the area consist of an old basal complex overlain unconformably by the ore-containing Roan Series. The latter are continental sediments cut and metamorphosed by granite intrusions that represent the magmatic source of the copper. The areal distribution of the granite along the copper belt suggests a slightly eroded batholith with pendants of sediments projecting deeply into the granite. The pitchblende of Katanga has been shown by its lead ratio to be of late Pre-Cambrian age, and since the copper sulphides of Rhodesia and Katanga evidently belong to one metallogenic epoch, the Roan Series must therefore almost certainly be of Pre-Cambrian age. The sediments have been folded into open pitching folds with a north-westerly trend, giving V-shaped outcrops. The ore-beds are disseminations of minute specks of copper sulphides with sparse but deep oxidation in all the mines. The paragenesis is pyrite, linnæite, chalcopyrite, chalcopyrite and bornite, bornite, bornite and hypogene chalcocite, hypogene chalcocite, supergene chalcocite, and oxidation products. The latter probably formed at great depths during a former period of desert climate.

Wireless Echoes.—The address given by Prof. Carl Størmer to the Royal Society of Edinburgh on Feb. 17 has now been published in the Society's *Proceedings* (vol. 50, p. 187). He discusses the problem of whether the 'wireless echoes of long delay' come from space outside the moon's orbit or not. In a communication to NATURE of Jan. 5, 1929, he said: "the mathematical theory of the motion of electric corpuscles around a magnetised sphere shows that the chances of obtaining a well-defined toroidal space round the earth are good when the direction to the sun lies near the magnetic equatorial plane (perpendicular to the magnetic axis)." He predicted that it was very improbable that echoes would recur before the middle of February. This prediction was duly verified by several physicists. In particular, two observers in Indo-China observed two thousand echoes from a relatively small emitter station. The echoes came about 30 sec. after the signal and their amplitude was sometimes as great as one-third of the signal. Some of the experiments recorded prove conclusively that they were echoes. It seems as if the space outside the earth's orbit was traversed intermittently by very unstable streams of electrons. This may explain the great variety of echo times observed. It is also possible that multiple echoes may be caused by reflection between the inner walls of the toroidal space. The great variety of echoes is similar to the great variations in aurora phenomena and magnetic perturbations. If this explanation is correct, these wireless echoes give a striking proof of the corpuscular theory of aurora and a valuable method for exploring electron currents in cosmic space.

X-ray Wave-lengths and the Electronic Charge.—The determination of an X-ray wave-length by means of a ruled grating, in correlating quantities of atomic and of macroscopic dimensions, leads indirectly to an evaluation of the charge (e) on an electron, and, as is well known, the value of e obtained by this method is slightly larger than that found by the oil-drop method of Prof. Millikan. Further evidence for the reality of this discrepancy is furnished by some measurements of the wave-lengths of the L lines of molybdenum, of which an account is given by J. M. Cork in the second June issue of the *Physical Review*. The gratings used were of glass, ruled with either 30,000 or 14,400 lines to the inch, and were mounted in a vacuum spectrograph in direct connexion with a hot-filament X-ray tube. The values obtained for the wave-lengths of the $L\alpha_1$ and $L\beta_1$ lines were 5·4116 A. and 5·1832 A. respectively, whereas it was calculated on the basis of Prof. Siegbahn's measurements with a gypsum crystal that if calcite had been employed and corrections made for refraction, the two numbers would have been 5·3960 A. and 5·1674 A. The corresponding value for e is $4{\cdot}8162 \times 10^{-10}$ e.s.u., which is slightly larger than the number given by J. A. Bearden as a result of similar measurements with the K radiation of copper.

Cleavage Tests of Timber.—One of the tests made in connexion with the anisotropic properties of timber is a determination of its resistance to cleavage by the

application of equal and opposite loads, up to fracture, along the diameters of incomplete holes bored in flat specimens cut so that the stress is normal to the direction of the grain. An investigation by the photo-elastic method of the stresses which are set up, with the obvious limitation that the models used are isotropic, is described by Prof. E. G. Coker and G. P. Coleman in the *Proceedings of the Royal Society* for August. It has been found that the stresses are decidedly complex, and, moreover, that each form of test piece gives rise to a stress distribution peculiar to itself, which is doubtless further complicated in practice by the anisotropy, so that fairly comparable results in actual tests can only be expected when one form is adhered to. It is suggested, however, that it would probably be better to rely on a simple tension test to define cleavage property, with an arrangement so that load is applied uniformly and normally to the grain of the timber; such a test would, in a short length, exert normal tension across a large number of cells, and its selective action would ensure fracture at the weakest place.

Earthing Resistances.—The necessity of earthing electrical supply networks at one or more points has led engineers to study very carefully the best method of securing a good earthing electrode. In some cases a network of water pipes, the lead sheath of a large sized cable, or the steel structure of a building is available, but in many cases pipes, plates, and strips buried in the earth have to be used and it is advisable to know their relative merits. In a paper in the June number of the *Journal of the Institution of Electrical Engineers*, P. J. Higgs, of the National Physical Laboratory, gives a helpful account, both theoretical and experimental, of various kinds of earthing resistances. He begins by investigating the phenomena of polarisation and endosmose which happen when electric currents flow through damp earth and points out that their effects are very appreciable. Pipes, plates, and strips were installed in a plot of ground near the laboratory and periodic tests of their earth resistance were made for a year. The results obtained are of practical utility, but it is difficult to deduce general conclusions from them as the ground was probably far from being homogeneous. The seasonal variations in resistance during the year were found to depend on moisture and temperature, the former being the more important. The possible differences between measurements made with alternating and direct currents were also investigated. It was found that the resistances with direct current were greater than with alternating current, the maximum difference being about twenty per cent. The experiments indicate that pipes are the best to use. It was found that two pipes spaced about five feet apart and connected in parallel make a much more efficient earth than one pipe of diameter equal to the sum of the two.

Reactivity of Hot Coke.—It is known that the 'reactivity' or readiness with which a red-hot coke will reduce carbon dioxide is much increased by the presence of compounds of iron, and this 'reactivity' is liable to curious fluctuations with varying conditions. A study of this influence of iron compounds on the reactivity of coke forms the subject of a report by J. H. Jones, J. G. King, and F. S. Sinnatt (Fuel Research Technical Paper No. 25, H.M.S.O., 9*d*. net.) They show that the activating effect of metallic iron is large, of ferrous oxide small, and the fluctuations in activity are determined by the presence of iron in the reduced or reducible form. Should the iron be converted into non-reducible forms such as silicate or sulphide, the coke becomes relatively inert, although in the latter case reactivation may be brought about by exposure to air. Although other inorganic ingredients are known to increase the reactivity of cokes, it is concluded that in metallurgical cokes the preponderating catalytic effect is to be ascribed to the iron present.

Evolution of Heat by Polonium.—An interesting paper on this subject is published in the current issue of *Roczniki Chemji*, the organ of the Polish Chemical Society (**10**, 304-313; 1930), by Mlle. Alicja Dorabialska. The investigation was carried out in the Curie Radium Institute, Paris. The evolution of heat was measured by means of the adiabatic microcalorimeter constructed by Prof. Swietoslawski and Mlle. Dorabialska, made of different metals (copper, aluminium, zinc, nickel) and weighing only 2-3·5 gm. The experiments were made with three extremely small quantities of polonium, possessing an energy of about 3000 e.s.u. and weighing about 0·0005 gm., which were deposited one on a silver leaf, another on a nickel leaf, while a third was sealed in a copper tube filled with nitrogen. The rise of temperature amounted to 0·150°-0·250° per hour. The mean value obtained in the three series of experiments (nine in number) was $1·87 \times 10^{-5}$ ($\pm$ 0·9 p.c.) cal. per hour and per one electrostatic unit of polonium. From this number may be calculated the evolution of heat by one curie of polonium as 24·2 cal./hour. The number of α-particles calculated from this value would be equal to $3·4 \times 10^{10}$ per second either by one curie of polonium or by one gram of radium (Geiger and Werner find for this value $3·4 \times 10^{10}$). It is interesting to note that one gram of polonium would evolve $1·1 \times 10^{5}$ cal./hour, and one gram-atom of polonium would evolve during its life-time (197 days) $1·1 \times 10^{11}$ cal. (one hundred thousand million calories).

Sensitising and Desensitising Dyes of the Cyanine and Related Types.—A little more than two years ago (*Phot. Jour.*, 21; 1928) Mr. Olaf Bloch and Dr. Frances M. Hamer of the Research Laboratories of Ilford, Limited and of British Photographic Plates and Papers, Limited, published their first paper on the optical and photographic properties of these compounds, dealing with a complete series of typical, simple, cyanine dyes. They now (*Phot. Jour.*, 374; 1930) deal with 8 cyanine dyes, 12 styryl compounds, 2 cinnamylidene derivatives, and 10 anyls. Six of the cyanine dyes have recently been prepared for the first time by one of the authors. All were examined under the same conditions as described in the previous communication. Some of the compounds are sensitisers while others are desensitisers, but the change of structure which occasions this change of function is a comparatively slight one. The photographic action of dyes can show "enormous variations" with variations in the character and treatment of the emulsions employed in testing them, so that generalisations are at present impossible. The authors give the structural formulæ, names, spectrum absorption curves, sensitising curves, various physical properties, and certain analytical results of the dyes dealt with. During the discussion, Dr. Walter Clark suggested that it would be more reasonable to measure the absorption curve of the silver bromide dye complex rather than that of the dye itself, and Mr. Bloch said that it had been tried. He also asked if the authors had found any relation between the absorption spectrum of the desensitiser and the wave-length desensitisation due to it. Miss Hamer replied that there is no relation; there are numerous colourless desensitisers.

Denaturation of Proteins by Urea and Related Substances.*

By Sir F. GOWLAND HOPKINS, F.R.S.

UPON the facts enumerated the following simple method of determining the degree and rate of denaturation is based. A measured sample of the urea-protein mixture is diluted with ten times its bulk of water, and to secure complete precipitation of the denatured product a small quantity (say 1 gm. per 100 c.c.) of ammonium sulphate is added, and if precipitation is not immediate a small amount of acetic acid. When the precipitate has settled out it is filtered and washed, or better centrifuged and washed, until free from sulphate, when it will also be free from undenatured protein. The precipitate is then transferred to a tared basin, dried and weighed. The method is trustworthy and gives consistent results. If the protein left in solution after the precipitate has been removed be thrown out by saturation with ammonium sulphate, it will be found to be wholly soluble in water; that is to say, it is undenatured albumin.

The rate of denaturation increases with increasing concentration of urea. With respect to the influence of protein concentration but few determinations have been made, but it may be said that within a fairly wide range of concentration the percentage denatured in a given time by a particular concentration of urea remains of the same order.

The only quantitative results which will be given here are those which bear upon the effect of temperature upon the process. These have special interest. In the experiments carried out to determine the rate of change, solutions containing about 5 per cent of protein have been employed and the urea added to 60 per cent of full saturation (of saturation, that is, at 15° C.; 0·6 gm. added per c.c.). With such proportions, while denaturation is rapid, there is for relatively long periods no spontaneous separation of the product, either as precipitate or gel.

The following results of two experiments are fully representative of many. After the addition of urea the solutions stood at the temperatures mentioned, and the amount of denatured protein determined at the intervals stated. It is given in percentage of the whole protein present. The concentration of albumin mentioned in the first column is that of the original solution, not that present after the increase of volume due to the addition of urea.

Experiment.	Temperature. (° C.)	Amount of Denatured Protein at Intervals after Addition of Urea (per cent of whole Protein present).		
		15 Min.	1 Hour.	3 Hours.
Albumin solution 5 per cent	0	70·0	86·2	92·8
Urea, 0·6 gm. per c.c.	23	49·2	69·2	88·5
pH before dilution, 5·9	37	..	61·0	85·1
Albumin solution, 4·14 per cent	0	78·3	85·7	91·0
Urea, 0·6 gm. per c.c.	22	45·1	62·7	87·5
pH before dilution, 6·0	37	..	58·1	82·8

It is seen that denaturation by urea is a rapid process at each temperature investigated. While, however, heat denaturation was shown in the classical experiments of Chick and Martin[5] to be a process with an exceptionally high temperature coefficient, the above figures present the simulacrum of a negative coefficient. At the concentrations employed nearly 80 per cent of the albumin is denatured in 15 min. at 0° C. and less than 50 per cent at 22° C. Data such as the above have been repeatedly obtained. There is no reversal of the process on any lines with increase of temperature. Denaturation in any case ultimately proceeds nearly to completion. Only such temperatures are, of course, to be considered as are well below those at which heat denaturation itself begins.

The provisional hypothesis which perhaps most readily covers such facts is that denaturation occurs in a protein-urea compound which, save in the presence of large concentrations of urea, is highly dissociated, and of which the dissociation increases with rise of temperature sufficiently to account for the observed diminution in the rate of denaturation. The increased dissociation must then be assumed to outweigh other temperature effects. Proof or disproof of such a view must depend upon a study of various equilibrium relations. This offers technical difficulties and results are not yet available.

Certain substances, which can be shown to denaturate egg albumin, differ from urea in that their solutions exert little or no dispersive action upon the denatured product. Thus, whatever the relative concentrations, when such substances are present in amounts sufficient to denaturate actively, the product separates rapidly as a precipitate. Urethane presents a case of this kind.

If a concentrated solution of urethane be gradually added to an albumin solution, a point is reached at which precipitation begins immediately. If then the mixture be allowed to stand, denaturation and separation of the product proceed rapidly, and a large proportion of the protein will be denatured in the course of a few minutes. Thus to a 5 per cent albumin solution (pH 4·8) urethane in strong solution was added at 20° C. Precipitation began when the mixture contained 18 per cent urethane, and in ten minutes the precipitate (a typically denatured product) was centrifuged, washed, and weighed. It amounted to 59 per cent of the original protein. Like urea, concentrated urethane acts very rapidly at 0° C. It denaturates, though more slowly, when a solution contains 10 per cent or less.

Thiourea also denaturates while displaying little dispersive power. To separate samples of 4 per cent albumin solution at pH 4·86 thiourea was added to saturation (9 per cent). On standing at 17° C. precipitates separated and were weighed at successive intervals. After 15 minutes about 12 per cent, after 3 hours 25·5 per cent, 24 hours 62 per cent, and after 48 hours 80 per cent of the protein proved to be denatured.

Although the effective concentrations of the denaturants under discussion is high, it is scarcely likely that a 'lyotrope' action plays any dominant part in producing their effects. The phenomena differ of course in fundamental aspects from that of 'salting out' by electrolytes.

The simultaneous presence of electrolytes in solution, though, on the whole, tending to diminish its velocity, does not seem to exercise an important influence upon denaturation by urea, at least in the case of molar concentrations which alone have been tried. It is possible that a study of their effects in higher concentrations might throw some light upon the process.

One other circumstance associated with the phenomena under discussion should be mentioned. Using the green line of the mercury vapour lamp, the optical

* Continued from p. 380.

rotation of protein solutions was found to increase (after making due correction for the resultant change of volume) more than threefold when saturated with urea. In three separate experiments the rotation was increased to 3·25, 3·45, and 3·30 times its original value in water. I refer to this here merely as a fact empirically established.

SERUM PROTEINS.

Fewer observations have been made upon these and less space must be given to their description.

Attention must first be directed to the circumstance that blood proteins, unlike egg albumin, do not when denatured by any form of treatment yield a nitroprusside reaction direct. If, however, the denatured products are afterwards exposed to reducing agents, they then give a colour reaction which is intense. The most convenient method of demonstration is to add a small quantity of potassium cyanide to the solution of denatured protein, or to soak a precipitate or gel in a 1-2 per cent solution of cyanide before, in each case, dissolving a little solid nitroprusside in the fluid. A justifiable assumption is that the precursor of the active thiol group is a disulphide grouping not present in the native protein but established on denaturation. The effects of cyanide, etc., are exactly similar to those observed in the case of cystine and its conversion into cysteine.[6]

If native serum (horse or sheep) or solutions of separated albumin and paraglobulins be saturated with urea and the mixture allowed to stand for a few minutes in the presence of a little potassium cyanide, the addition of nitroprusside solution (plus ammonia if the solution be not sufficiently alkaline) will then produce an intense colour reaction.

Serum or its separated constituents (the behaviour of euglobulins has not been studied) on evaporation with denaturants on the lines described for egg albumin, whether the pH be that of native serum or reduced, say, to 5, behave similarly to the latter. Substances which denaturate the one protein act upon the other: those which fail in one case fail in all.

When, however, their behaviour is observed in solution, it becomes clear that the blood proteins are definitely more resistant to denaturation on these lines than in ovalbumin. It is noteworthy that the difference is more marked when the influence of urea, itself, is in question than in the case of, say, urethane with its smaller dispersive power.

Serum in its native condition or when brought to a pH of the order of 5, if saturated with urea, sets in a few hours at room temperature, and somewhat more rapidly at 37° C., to a jelly, and so in strong solutions do serum albumin and globulin. Such jellies treated as described above give an intense nitroprusside reaction, but only gradually after more prolonged standing do they show the resistance to redispersion into sols, which is characteristic of ovalbumin gels. Nevertheless, diluted serum or solutions of serum albumin or paraglobulin containing, say, 4-5 per cent protein, when mixed with such concentrations of urea as will rapidly denaturate ovalbumin, yield even after several hours' standing no precipitate on dilution or dialysis, and show no signs when dialysed free from urea of having assumed the characters of the suspensoid condition. This remains true if the pH of the solutions before or after adding the urea is brought to near the isoelectrical point of the proteins when denaturated by heat, 5·5·4. Observations giving these results have been made with the proteins of sheep's blood and with crystallised albumin from horse serum. Only after remaining many days in contact with urea do the blood proteins show evidence of more complete denaturation. On the other hand, their solutions when mixed with high concentrations of urea give at once after treatment with cyanide an intense nitroprusside reaction. It would seem as though these proteins undergo with readiness the chemical changes which in all cases are associated with denaturation, but the colloid particles of the product are more resistant than those of egg albumin to the dehydration which characterises the change from the lyophil to the lyophobe condition.

Easily to be demonstrated, however, is the denaturation of blood proteins under the influence of urethane, especially, but not only, when they are brought near to their isoelectric point. The following figures are illustrative. Dialysed and filtered sheep serum was brought to pH 4·86 and urethane (0·3 gm. per c.c.) added. After 1 hour at 20° C. 22·5 per cent of the total protein was denaturated; and after 3 hours 41·0 per cent. With thrice the concentration of urethane 43·5 per cent was denaturated in 1 hour. The process is clearly much slower than in the case of ovalbumin.

It is with intention that these notes have been confined to a simple description of observations which are themselves of a preliminary kind. Points of theoretical interest can scarcely fail to be noted, but at present they lack quantitative investigation. It has seemed worth while to give this indication that the phenomena in question are worthy of such investigation. Certain quantitative studies are being made in the Cambridge School of Biochemistry.

[5] *Jour. Physiol.*, **40**, 404; 1910.
[6] E. Walker, *Bioch. Jour.*, **19**, 1082; 1925.

Imperial Horticultural Conference.

AN Imperial Horticultural Conference, arranged by the Imperial Bureau of Fruit Production, met at the house of the Royal Society of Arts on Aug. 5-7.

The papers presented to the Conference were grouped according to the aspect of horticultural work discussed. In the group dealing with field experimentation, Mr. T. N. Hoblyn, of East Malling, stated that the failure of earlier research on fruit trees was due to (1) the inherent variability in the trees themselves, (2) variation due to outside causes. These causes of error can now be eliminated by the adaptation of statistical method to known material raised clonally. Prof. E. E. Cheesman, Imperial College of Tropical Agriculture, Trinidad, stated that the same inherent variability is markedly noticeable in tropical crops, which are largely cross fertilised and heterozygous. Here, too, in dicotyledons, clonal propagation seems to offer a solution; cacao is at present under investigation at the Imperial College at Trinidad. In the subsequent discussion, emphasis was laid on the desirability of close contact between the statistician and the horticultural worker, and on the importance of the close observation of individual trees in horticultural experiments.

Dealing with the application of the pure sciences to horticultural problems, Prof. B. T. P. Barker, Long Ashton Research Station, Bristol, remarked that chemistry can help the cider industry, particularly by determining the constituents of the apple; apples other than pure cider varieties can be used to supplement these. Investigations are in progress on the substitution of centrifuging for filtering. Prof. V. H. Blackman, Imperial College of Science and Technology, London, said that the physiological study

of the effect of external conditions on horticultural crops is complicated by the interrelationship of various factors. The solution of the stock-scion problem may possibly lie in some balance of processes, for example, enzymic action, or of ratio of assimilation to respiration.

The discussion of methods of fruit storage occupied the whole of the final session. Dr. Franklin Kidd, Low Temperature Research Station, Cambridge, divides the problems into two groups: (1) those concerned with reduction of wastage and improvement of quality, using present methods; (2) those connected with the evolution of new methods. Local testing of storage qualities is desirable, as is also investigations into trade practice in handling between producer and consumer. The effects of numerous volatile substances in the atmospheres of stores need further investigation. Dr. A. Horne, Imperial College of Science and Technology, London, dealt with the infection and invasion of the apple fruit by fungi and their effect on storage quality. The presence of high fungal numbers and many pathogenic forms in an orchard are in certain cases associated with considerable wastage under ordinary storage conditions, and low numbers and few pathogenic forms with little wastage. Resistance to invasion differs greatly. Miss H. K. Archbold, also of the Imperial College of Science and Technology, showed that prolonged storage life of the apple is generally associated with a slow rate of loss of oxidisable material in respiration. Time of picking greatly influences the chemical composition and hence the storage qualities of the apple. Mr. R. G. Tomkins, Low Temperature Research Station, Cambridge, discussed the biological effect of atmospheric humidity on fruit in storage, noting its possible success in checking certain rots, its value in prolonging storage life, and the practical difficulties met. Mr. Meirion Thomas, Armstrong College, Newcastle, described the condition known as 'aldehyde poisoning'; this condition can be distinguished from brown heart by chemical analysis. The problem is proving to be of considerable economic importance.

The papers presented to the Conference will be published in full by the Imperial Bureau of Fruit Production.

The Egyptian Lily.

IN *Ancient Egypt* for September 1929 (2nd ed.), recently issued, Sir Flinders Petrie publishes the result of a comparison of some two thousand dated and placed examples of the use of the lily in decorative art. The study was undertaken with the view of demonstrating that decoration being arbitrary, unlike objects of utility which may be invented and reinvented any number of times, in its resemblances it is of great value as an indicator of the movements of trade, of culture, of conquest, and of race. The comparative study of decoration thus gives an organised method of research into ages which are without a record.

The lily motive seems to have originated in Crete. It is used in Middle Minoan III. about 2300 B.C. on the great jars of Knossos and on fresco. It was here a natural group; but by about 1600 B.C. it was modified. It appears in late Helladic of about the same time, and with a less natural form about 1400 B.C. There is a form in Rhodes which suggests that the plant was not well known there. The Cretan form passed into being merely a flower; but in Egypt it became fixed in its botanical aspect of the parts, and this permanent type went through immense changes. The detail is much more precise than on the Egyptian paintings.

In various examples different types of simplification are shown. In Hauran the different parts are maintained, but they are wildly changed in an example from Cyprus. In Persia the tips of the spathe become a bunch of dates. An Italian form at Vulci brought in sprays, and such a form passed to India, where calyx and spathe survived. A curious bowl form, proved by examination of transition forms to be the Assyrian form borrowed from the Hittite, was borrowed by Cyprus, where again the old parts were put together differently on the top of an Ionic column of Assyrian origin. A bowl pattern was brought from Cyprus or North Syria into Italy, and two patterns which can scarcely be separated from this stage turn up at Athens and Mathura, India. An inverted form appears to be a Phœnician importation into southern Etruria.

When the form was used either way up, there was more licence in the employment of leafage. Of this type a derivation appears in northern pre-Roman France, which thus must be the result of trade. The Italian form passed back to Crete. In classical times various forms are found about Rome, and by trade passed to India, appearing in the caves of Ajunta. Later still it survived at Ravenna and was worn out finally in the eighth century at Rome and at Cividale. Thus the lily as a decorative motive originated in Crete before 2000 B.C.; coming thence to Egypt it passed by 1400 B.C. to the Hittites and on to Assyria as a tree pattern. Thence transformed by ignorance it reached Cyprus and so came by Phœnician trade to the Tiber, and spread northwards from Rome, naturalised in Italy as a foliage form and finally a group of relief.

Historic Natural Events.

Sept. 8, 1900. Galveston Hurricane.—The hurricane of Sept. 1-12, 1900, is described as the most severe storm which ever occurred in the United States. After travelling westward south of Haiti, it curved to the north across Cuba and nearly to Florida. There it turned again to the west-north-west, and growing in intensity, struck the coast of the United States near Galveston on Sept. 8, after which it passed inland and rapidly broke up. Galveston is built on a low sandy island about thirty miles in length and two to three miles in width, and the city was completely wrecked. The anemometer recorded a velocity of 100 miles an hour when it was blown away at 2 P.M., but the velocity increased steadily until 8 P.M., at which time the corrected barometer reading was 963 mb. (28·44 in.). The storm raised the level of the sea by 15-20 feet, and the whole island was flooded. Nearly half the houses were completely destroyed by wind and sea, more than 6000 people were killed, and property to the extent of 30 million dollars was lost. Enormous losses of life and property were also reported from the coast of the mainland, but owing to the Weather Bureau warnings, only two ships were lost.

Sept. 9, 1897. Typhoon in Sea of Japan.—A violent typhoon travelled along the east coast of Japan, causing enormous damage. At Tokyo the wind reached a velocity of 128 miles per hour in squalls from the south. Many ships were lost; on land many houses were blown down, but the greatest damage was done by the typhoon wave, which flooded large areas and more than 5000 houses.

Sept. 10-13, 1898. West Indian Hurricane.—A violent hurricane passed just south of Barbados on the evening of Sept. 10, crossed St. Vincent on the morning of Sept. 11, and continuing northwards,

passed east of Sombrero on Sept. 13. On Barbados 11,400 houses were swept away, about 115 lives lost, and 50,000 people rendered homeless. On St. Vincent, which experienced the full force of the storm, every exposed building or tree was blown down and 200 lives were lost. The rain was very heavy, amounting to 4·95 in. between 9 A.M. and noon on Sept. 11; probably as much fell between noon and 3 P.M., but the raingauge was destroyed. The rain filled the mountain torrents and whole villages were swept away. All shipping was destroyed. At St. Lucia an avalanche filled a valley for 3 miles, burying houses and estates. A curiosity of the storm was that at Kingstown, St. Vincent, the rain which fell was hot and stinking, and rotted clothes exposed to it; it may have come from the crater lake of Soufrière.

Sept. 10, 1899. Alaskan Earthquake.—This was one of the world's great earthquakes, for it disturbed an area of perhaps $1\frac{1}{2}$ million square miles. At the time little was known about the earthquake, for the central district was almost uninhabited. Six years later, however, the evidence of remarkable changes of elevation was still visible in raised beaches and in the bands of dead barnacles adhering to the cliffs. These showed that the coast was uplifted from a few feet to 47 ft. 4 in. Variations in the amount of elevation revealed the existence of a number of faults that divided the crust up into blocks, the tilting of which gave rise to the earthquake.

Sept. 10, 1902. Hailstorm near Maidstone.—Great damage was caused to the hop-crop in the districts around Maidstone by a violent hailstorm, accompanied by thunder. The hail in many places stripped the plants of all foliage, and the heavy rain even washed away the poles.

Sept. 10, 1903. Gale over British Isles.—During the evening and night of Sept. 10 a deep barometric depression passed rapidly across Ireland and northern England. In its front the barometer fell at the rate of nearly 5 mb. (1·4 in.) an hour, and pressure in the centre was so low as 975 mb. (28·8 in.). On the south coast of England the gale had a remarkable effect on the autumn vegetation, which was scorched brown, curled, and shrivelled up, even at places in the lee of the downs, several miles inland. This effect can scarcely have been caused by salt spray, as the storm was accompanied by very heavy rainfall.

Sept. 11, 1806. Hurricane in Porto Rico.—One of the severest hurricanes on record in the southern part of the island of Porto Rico occurred on this date. Many churches and a large portion of the houses were damaged, fruit trees were destroyed, and rivers overflowed their banks, destroying much property. At San Juan shipping suffered much loss.

Sept. 12, 1717. Triolet Glacier Outbreak.—A great moraine at the end of the glacier of Triolet, at the bottom of Val Ferret, broke up in the night, and an immense amount of débris, mixed with water and enormous blocks of ice, covered all the ground surrounding two châlets. Since then the fertile plain on which these châlets were situated has been covered by ice.

Sept. 13, 1922. Highest Recorded Temperature.—At Azizia in the semi-desert plain of Jefara, in northern Africa, between the coast of Tripolitania and the interior plateau, a maximum temperature of 136·4° F. was recorded on Sept. 13, 1922. This is the highest shade temperature ever recorded by a tested thermometer exposed under standard conditions, and is 2·3° F. higher than the previous record at Death Valley, California on July 13, 1910. The site of the station is in a shallow basin which becomes highly heated by the sun's rays.

Societies and Academies.

PARIS.

Academy of Sciences, July 16.—The president announced the death of A. T. Schlœsing, member of the Section of Rural Economy.—**Ch. Maurain, Mlle. G. Homery, and G. Gibault**: The vertical atmospheric current. At the Val-Joyeux Observatory the electric field is measured continuously and the conductivities corresponding to the positive and negative ions measured three times daily. Tables are given showing the values of the vertical currents deduced from these data.—**J. Courrègelongue and H. Maugein**: Some experiments on auto-oscillation and autorotation of immersed plates.—**Edgar Pierre Tawil**: Stationary ultra-sonorous waves made visible in gases by the method of striæ. A description of an apparatus capable of rendering visible the stationary waves produced in air by a piezo-electric crystal. Photographs are given.—**Herculano de Carvalho**: The presence of uranium in mineral waters. The uranium-radium ratio. Uranium determinations have been made in waters from five springs, the amount found being of the order of 10^{-6} gm. per litre. There was no constant ratio between radium and uranium.—**F. Bourion and Mlle O. Hun**: The determination by the boiling method of the affinity relative to the formation of the complex ammonium iodide-cadmium iodide.—**Auméras and Tamisier**: The spectrophotometric study of the cupripyridine ion in aqueous solution.—**Mme. Ramart-Lucas and J. Hoch**: The configuration of molecules in space. The absorption in the ultra-violet of the acids $C_6H_5(CH_2)_n.CO.OH$, $C_6H_5(CH_2)_n.(CO.OH)_2$ and the hydrocarbons $C_6H_5(CH_2)_nC_6H_5$.—**Sébastien Sabetay and Jean Bleger**: The chromic oxidation of the cyclanepolyols. By the oxidation of quinite in acetic anhydride solution by chromic anhydride, cyclohexandione is obtained in good yield (56 per cent theoretical yield): its physical properties and chemical reactions are given.—**Charles Dufraisse and Marius Badoche**: Researches on the dissociable organic oxides: the transformation of oxyrubrene into a non-dissociable isomer, iso-oxyrubrene. A probable formula is assigned to this oxide, but it is still difficult to suggest a formula for oxyrubrene which explains its property of dissociation with liberation of oxygen.—**Marcel Solignac**: The mineralogical characters of the oolitic iron mineral of Djebel el Ank, southern Tunis.—**Jean Lugeon**: Measurements of the ionisation, of the electric field, and of atmospherics on Mt. Blanc.

CRACOW.

Polish Academy of Science and Letters, June 2.—**C. Zakrzewski and D. Doborzynski**: Some remarks on the dielectric polarisation of the elements. The dielectric polarisation of elements not belonging to the seventh group of the periodic system is independent of the temperature, and the molecules of these elements do not possess electric dipoles. The polarisation of elements belonging to the seventh periodic group depends on the temperature, and this polarisation can be expressed by the well-known Debye formula.—**Wlad. Gorczyński**: The maximum values of the intensity of the solar radiation observed on oceans and in other regions of the earth. Whilst the ocean values do not exceed 1·4 cal. at normal incidence, 1·4–1·5 cal. is obtained on the plains and 1·7 cal. in an oasis of the Sahara. Still higher maxima are observed at high altitudes.—**H. Lachs and J. Biczyk**: The determination of the electrokinetic potential with the aid of the method of the e.m.f. of filtration.—**E. Chrobaczek**: The phenomena of correlation in

wheat and the theory of associations in chromosomes. —**A. Oszacki**: The oxygen in the venous blood of human sarcoma.

SYDNEY.

Linnean Society of New South Wales, June 25.—**J. R. Malloch**: Notes on Australian Diptera (24). This paper completes the notes on Tachinidæ. Species belonging to the tribes Actiini, Linnæmyiini, Cylindromyiini, and Tachinini are dealt with. Twelve genera, one subgenus, and forty-six species are described as new, and a new name is suggested for *Phorocerosoma*, preoccupied.—**G. H. Hardy**: Fifth contribution towards a new classification of Australian Asilidæ. This paper revises the tribes Saropogonini and Stichopogonini, contrasting the Australian forms with many of the world's genera. One new genus and two new species are proposed; a table of chætotaxy, and a key to the genera are included.—**H. N. Dixon** and **W. Greenwood**: The mosses of Fiji. The mosses known from Fiji now total 205 species, about half of these having been added to the list since 1917 by the collections made by one of the authors (W. G.). This paper contains record of all the known species in Fiji, with notes of the localities from which the species have been collected. A key is given to the genera found; twenty-seven species and five varieties are described as new.

ROME.

Royal National Academy of the Lincei, April 6.—**V. Volterra**: Hereditary mechanics. The energetics of hereditary mechanics, limited to the case of linear hereditary actions, was recently considered. The case of non-linear actions for a system with only one degree of freedom is now treated.—**T. Levi-Civita**: Further consideration of the motion of a body of variable mass.—**G. Hagen**: Photographed oscillations of the free pendulum.—**F. Vercelli**: General method for the analysis of the periodicities in statistical and experimental diagrams.—**G. Silva**: The formula of normal gravity.—**G. Tizzoni** and **G. De Angelis**: Immunity against the adeno-carcinoma of the mouse conferred by the pulp of the tumour itself with addition of formol. The phenolated vaccine previously tried causes mainly an anti-neoplastic immunity, whereas the formolated vaccine results principally in anti-toxic immunity.—**A. M. Bedarida**: The infinity of prime numbers in quadratic forms. **G. Barba**: The functional equation $f(x)f^1(x)=f[f(x)]$ connected with a geometrical problem. The form of the intrinsic equation of a curve in order that this may be similar to its evolute, is considered.—**P. Cattaneo**: A class of cyclic varieties.—**I. J. Schwatt**: The development of $\sec^p x$ in Maclaurin's series.—**A. Belluigi**: The topographical corrections in Eötvös remainders. **E. Segrè**: Statistical calculation of the spectrum of an ionised atom. The statistical method is applicable to the construction of the spectrum of an ionised atom from the atomic number and the degree of ionisation. Even with highly ionised atoms the method furnishes satisfactory results.—**G. Bargellini** and **A. Grippa**: 2 : 5 Dibromoanisidine. This compound and several of its derivatives are described.—**G. Bargellini** and **F. Madesani**: 3 : 5- and 2 : 6-Dibromoanisidines. Bromination of acetyl-*p*-anisidine yields the acetyl derivative, not of 3 : 5-, but of 2 : 5-dibromoanisidine.
G. Natta: Crystalline structures of hydrogen sulphide and hydrogen selenide (1). X-ray investigation indicates that hydrogen sulphide and hydrogen selenide crystallise in the cubic system. For the former, the side of the unit cell is $5 \cdot 778 \pm 0 \cdot 003$ A. and its volume $192 \cdot 9 \times 10^{-24}$ c.c. On the assumption that the unit cell contains four molecules and that the weight of the hydrogen atom is $1 \cdot 65 \times 10^{-24}$ gm., the density of solid hydrogen sulphide at $-170°$ is calculated to be $1 \cdot 166$.—**G. A. Barbieri**: Reduction of silver ferricyanide by means of ferrous sulphate. Under suitable conditions, ferrous ions may reduce ferricyanogen ions, even in acid solution. This reaction is applicable to the determination of ferricyanides.—**S. Visco**: Action of the latex of *Ficus carica* on proteins. The action of this latex on the proteins constituting the albumen of hens' eggs does not proceed beyond the formation of products of the character of secondary proteoses.—**S. Sorrentino**: The older formations of Monte S. Calogero and of Nadure near Sciacca.—**L. Maddalena**: Study of a phenomenon exhibited by the Aurisina stone used for covering walls. When this stone is used for outside constructional work, yellowish rusty spots, often zoned, gradually develop on it, and, after increasing in diameter to 15-20 cm., slowly fade and finally almost disappear. This phenomenon is due to the formation of colloidal iron hydroxide (hydrosol) by the oxidation of the pyrites present to ferrous sulphate and interaction of this with the lime of the mortar in presence of slightly alkaline water. Moisture easily transports the colloid to the outer surface of the porous stone, where it is first fixed as hydrogel by evaporation of the water and later washed away by the mechanical action of rain.—**C. Artom**: Origin and evolution of parthogenesis in *Artemia salina diploide* of Cette. **P. Pasquini** and **G. Meldolesi**: Investigations on radio-sensitivity in the development of the eggs of amphibia (2). Specific alterations and secondary malformations from differential radio-susceptibility in *Rana esculenta*.—**N. A. Barbieri**: Improvement in the metabolism of plants by physiological culture without alteration of the soil. Experiments with *Cattleya*, maize, beans, potatoes, sugar-beet, etc., confirm the advantages of the author's method of homogeneous mineral culture, which consists of localised application of a mixture of the soluble and insoluble salts existing preformed in the plants in the amount required by the whole of the crop.—**V. Rivera**: Radiation and growth in plants—development under a leaden screen.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 5, May 15).—**A. E. Navez**: On the distribution of tabular roots in *Ceiba* (Bombacaceæ). In Cuba, the so-called buttress or tabular roots of these trees grow principally on the sides struck by the dominant winds, the largest generally in the N.E.-E.N.E. direction. The roots are 'resistance cables' rather than 'buttresses'.—**Ernest Glen Wever** and **Charles W. Bray**: Action currents in the auditory nerve in response to acoustical stimulation. A decerebrated cat was used and electrodes placed on the exposed auditory nerve. Sound stimuli applied to the animal's ear set up action currents which, when amplified, produced sounds in a telephone apparently identical with the original stimulus. Speech was transmitted with great fidelity; response was obtained with frequencies between 125 and 4100 ~ per second. Frequency of response is correlated with frequency of stimulation. —**Robert K. Nabours**: Mutations and allelomorphism in the grouse locusts (Tettigidæ, Orthoptera). —**F. H. Murray**: The electromagnetic field exterior to a system of perfectly reflecting surfaces. A mathematical discussion.—**Louis S. Kassel**: The rates of second-order gas reactions. A theoretical discussion based on the assumption that the chance of reaction at a collision increases with energy of collision.—**Ernest W. Brown**: On the prediction of trans-Neptunian planets from the perturbations of Uranus. —**Edwin H. Hall**: The 'reaction-isochore' equation

for ionisation within metals.—**Sinclair Smith**: The effect of low temperatures on the sensitivity of radiometers. Radiometers in hydrogen, helium, and air in a specially designed chamber at $-180°$ C. were exposed to light from a controlled source. Maximum sensitivity increases at low temperature and shifts towards lower pressures.

Official Publications Received.

BRITISH.

Mines Department. Eighth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1929. Pp. 62. (London: H.M. Stationery Office.) 1s. net.

Astrographic Catalogue 1900·0. Sydney Section, Dec. $-51°$ to $-65°$, from Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 11: R.A. 12^h to 18^h, Dec. $-53°$ to $-55°$, Plate Centres Dec. $-54°$. Pp. 86. Vol. 12: R.A. 18^h to 24^h, Dec. $-53°$ to $-55°$, Plate Centres Dec. $-54°$. Pp. 43. (Sydney, N.S.W.: Alfred James Kent.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 38: A Study of the Polysaccharides. Part 2: Note on the Purification of the Natural Products. By J. Reilly and Declan T. McSweeney. Pp. 451-453. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

The North of Scotland College of Agriculture. Calendar, Session 1930-1931. Pp. viii+120. (Aberdeen.)

Proceedings of the Royal Society. Series A, Vol. 128, No. A808. Pp. 361-666. (London: Harrison and Sons, Ltd.)

The Journal of the Ipswich and District Natural History Society. Edited by Henry Ogle. Vol. 1, Part 2. Pp. ii+71-140. (Ipswich.)

Imperial Agricultural Bureau. Bulletin No. 1: Miscellaneous Information relating to Breeding of Herbage Plants. Pp. 22. Plant Genetics: Herbage Plants. Catalogue of Journals and Periodicals in the various Libraries in Aberystwyth to which the Bureau has Access. Supplement to Bulletin No. 1, 1930. Pp. 10. (Aberystwyth.)

The Rowett Research Institute. Collected Papers, Vol. 2. Edited by Dr. John Boyd Orr. Pp. xv+588. (Aberdeen.) 21s.

Forestry Commission. Tenth Annual Report of the Forestry Commissioners, Year ending September 30th, 1929. Pp. 69. (London: H.M. Stationery Office.) 1s. 3*d*. net.

FOREIGN.

Proceedings of the Imperial Academy. Vol. 6, No. 6. Pp. xix-xxi+217-242. (Tokyo.)

The Science Reports of the Tohoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 14, No. 1. Pp. 96+28 plates. Fourth Series (Biology), Vol. 5, No. 2. Pp. 215-422+plates 9-14. (Tokyo and Sendai: Maruzen Co., Ltd.)

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning. År 1929. Pp. 45. (Göteborg: Elanders Boktryckeri A.-B.)

Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 7, No. 1. Pp. 99. (Tokyo: National Research Council of Japan.)

Annales de l'Observatoire de Paris: Section d'Astrophysique à Meudon. Tome 8, Fascicule 2: Recherches sur la structure de la chromosphere solaire. Par L. D'Azambuja. Pp. iii+120+10 planches. (Paris: Gauthier-Villars et Cie.)

Proceedings of the American Philosophical Society. Vol. 69, No. 5. Pp. 257-294. (Philadelphia.)

Division of Fish and Game of California. Fish Bulletin No. 22: A Bibliography of the Tunas. By Genevieve Corwin. (Contribution No. 87 from the California State Fisheries Laboratory.) Pp. 108. (Terminal, Calif.: California State Fisheries Laboratory.)

Bulletin of the Vanderbilt Marine Museum. Vol. 1, Art. 2: Scientific Results of the Yacht *Ara* Expedition during the Years 1926 to 1930, while in Command of William K. Vanderbilt. Fishes (collected in 1929). By N. A. Borodin. Pp. 39-64+2 plates. (Cambridge, Mass.: The Cosmos Press, Inc.)

Ministry of Public Works, Egypt: Physical Department. Physical Department Paper No. 27: Upper Winds at Cairo and Khartoum. By L. J. Sutton. Pp. 52+6 plates. (Cairo: Government Press.) 10 P.T.

CATALOGUES.

Photography Simplified: Printing and Toning. Pp. 12. (London: Burroughs Wellcome and Co.)

A Catalogue of Important Scientific Books containing Standard and Rare Works on Ornithology, Zoology, Ecology, Entomology, Botany, Forestry, Mathematical and Physical Sciences, Natural History in General. Pp. 80. (London: W. and G. Foyle, Ltd.)

The Nickel Bulletin. Vol. 8, No. 8, August. Pp. 241-280. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

CONGRESSES.

SEPTEMBER 3 TO 10.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Bristol). (*For particulars see* NATURE *of Aug. 30.*)

Change of Programme.—(B) *Sept.* 9, at 11 A.M.—Prof. C. S. Gibson and Prof. J. L. Simonsen: Some Recent Investigations of Organic Compounds of Gold; instead of Prof. Semenoff: The Initiation of Combustion.

SEPTEMBER 4 TO 14.

INTERNATIONAL ZOOLOGICAL CONGRESS (at Padua).

SEPTEMBER 7 TO 13.

INTERNATIONAL CONGRESS OF AMERICANISTS (at Hamburg).—Papers on The Aboriginal Peoples of America and their Ethnic Relations, The Prehistory of America, Manners and Customs of the Various Groups of Indians and their Distribution in the Old and New World, The Aboriginal Languages, The Discovery and Colonisation of America, The Geography and Geology of America, with Special Reference to Human Activities, and a Discussion on The Civilisation of the Indians at the time of their first contact with Europeans and to-day.

SEPTEMBER 8 TO 12.

INTERNATIONAL CONFERENCE OF THE APIS CLUB.

Monday, Sept. 8 (at Apothecaries' Hall, Water Lane, E.C.), at 3.30.—Miss Annie D. Betts: The National Importance of Apiculture (Presidential Address).

Wednesday, Sept. 10 (at Crystal Palace).—Dr. G. Morison: Notes on Acarine Disease.

Thursday, Sept. 11 (at Crystal Palace), at 11 A.M.—Dr. H. W. de Boer: Behaviour of Diastatic Ferments in Honey when Heated.

At 12 noon.—C. H. Hooper: Fruit Pollination and the Importance of Insect Visitors in Fruit Production.

At 2.30.—D. Morland: Frosting.

At 5.30.—Dr. F. Kretschy: Our Bee as Doctor.

At 6.30.—L. M. Bertholf: The Distribution of Stimulative Efficiency in the Ultra-Violet for the Honey Bee.

Friday, Sept. 12 (at Crystal Palace), at 11 A.M.—M. le Chanoine A. Delaigues: Transformism.

At 12 noon.—Dr. J. Stitz: Ultra-Violet Absorption of Honey.

SEPTEMBER 9 TO 12.

INSTITUTE OF METALS (at Southampton).

Tuesday, Sept. 9 (in Chantry Hall), at 8 P.M.—Prof. D. Hanson: The Use of Non-Ferrous Metals in the Aeronautical Industry (Autumn Lecture).

Wednesday, Sept. 10 (in Chantry Hall), at 10 A.M.—E. A. Smith: Rolled Gold: Its Origin and Development.

Dr. W. Rosenhain, J. D. Grogan, and T. H. Schofield: Gas Removal and Grain Refinement of Aluminium Alloys.

J. D. Grogan: Pressure Die-Cast Aluminium Alloy Test-Pieces.

N. W. Ageew and Olga I. Vher: The Diffusion of Aluminium into Iron.

Dr. K. L. Meissner: The Artificial Ageing of Duralumin and Super-Duralumin.

Dr. W. L. Fink and Dr. K. R. Von Horn: Lattice Distortion as a Factor in the Hardening of Metals.

Dr. Marie L. Gayler: A Study of the Relation between Macro- and Microstructure in Some Non-Ferrous Alloys.

Thursday, Sept. 11 (in Chantry Hall), at 10 A.M.—Dr. J. C. Hudson: The Effect of Two Years' Atmospheric Exposure on the Breaking Load of Hard-Drawn Non-Ferrous Wires.

Dr. W. H. J. Vernon and L. Whitby: The Open-Air Corrosion of Copper. Part II. The Mineralogical Relationships of Corrosion Products.

Dr. E. Voce: Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys.

E. Vaders: A New Silicon-Zinc-Copper Alloy.

H. C. Dews: The Effects of Phosphorus on the Strength of Admiralty Gun-Metal.

Dr. D. Stockdale: A Note on the Constitution of the Cadmium-Zinc Alloys.

Prof. G. Tammann: On the Determination of Crystallite Orientation.

D. A. N. Sandifer: Pendulum Hardness Tests of Commercially Pure Metals.

F. Hargreaves: Heat-Treatment, Ball-Hardness, and Allotropy of Lead.

SEPTEMBER 11 TO 14.

SWISS SOCIETY OF NATURAL SCIENCES (at St. Gallen).—In sixteen sections covering Pure and Applied Science and Medicine. Addresses by Prof. E. Abderhalden, on The Significance and Mechanism of Ferments in Nature; Prof. P. Niggli, on Ten Years' Work of a Mineralogical and Petrographic Institute; Prof. R. Chodat, on The Symbiosis of Lichens and the Problem of Specificity; and Prof. C. Wegelin, on Endemic Cretinism.

SEPTEMBER 13 TO 20.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Liverpool).

SEPTEMBER 15 TO 20.

IRON AND STEEL INSTITUTE (in Czechoslovakia).

Monday, Sept. 15, at 10 A.M.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.

J. Šárek: What Reasons Compelled the Prague Ironworks to Introduce Thin-Walled Blast-Furnaces.

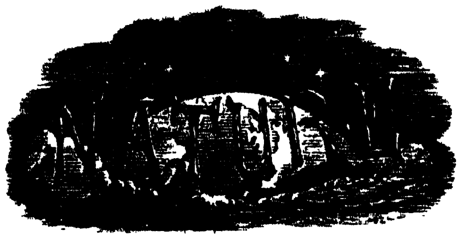
W. H. Hatfield: Permanence of Dimensions under Stress at Elevated Temperatures.

Tuesday, Sept. 16, at 10 A.M.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

H. C. Wood: Open-Hearth Furnace Steelworks. A Comparison of British and Continental Installations and Practice.

D. F. Campbell: High-Frequency Steel Furnaces.

L. W. Schuster: The Effect of Contamination by Nitrogen on the Structure of Electric Welds.



SATURDAY, SEPTEMBER 13, 1930.

CONTENTS.

Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Fertilisers and Soil Fertility.

THE extent to which the phosphatic fertilisers have dominated the outlook of farmers all the world over is well seen by the fact that when a country first embarks upon anything approaching a large scale use of artificial manures, it is the phosphatic fertilisers that are almost invariably employed, to the practical exclusion of all others. This is understandable, and within certain limits entirely reasonable: for when rainfall and sunshine are adequate, and where leguminous plants can thrive abundantly, a deficiency in phosphates is often the sole limiting factor to greatly increased production, and under these conditions phosphates frequently occasion results of such a pleasing magnitude that the farmer is, perhaps naturally, not in a hurry to look for methods of still further increasing his productivity—although, of course, it seldom happens that the addition of phosphates is all that is necessary to produce the highest yields obtainable.

Thus, for example, in a pastoral country like New Zealand, in the main with abundant rainfall and conditions potentially favourable for the spread of leguminous plants, the benefits from phosphatic manures have been enormous, and the increase in their use during the last decade very remarkable; while in the case of those areas in the wheat belts of Australia where the methods of fallow practices have been perfected and water conserved to the maximum, it has been found remunerative to increase the dressing of superphosphate very appreciably above the amounts that were originally considered adequate.

The position of South Africa (the Union and Southern Rhodesia) is perhaps unique, and agriculturists—not only of that continent, but also of the world at large—should derive inspiration from Sir Frederick Keeble's critical survey* of the fertiliser position, part of which appears elsewhere in this issue (p. 417), and more particularly from the penetrating suggestions he makes as to the problems which South Africa sets the scientific investigator for solution.

Sir Frederick has had the advantage of studying extreme conditions. In South Africa, as he tells us, not only are enormous tracts subject to slight precipitation, but also mineral deficiency is universa —and, we might add, leguminous plants are not abundant, for there, unlike New Zealand, wild white clover has not run riot, and, unlike large

* "Agricultural Problems in South Africa." Paper read before Section M (Agriculture) of the British Association at Bristol on Sept. 5

areas in Australia, a host of little European annual clovers have not become tantamount to wild plants. What are the limiting factors to a satisfactory scale of production in South Africa? This is the question Sir Frederick has set himself, if not to answer, at least to explore; not, he thinks, by any means necessarily the scant precipitation, but rather the inherent deficiency in plant foods—first and foremost an acute deficiency in phosphates and in lime, and secondly, a deficiency in nitrogen.

From the point of view of grassland, the effects of drought are no doubt greatly accentuated by the prevailing mineral deficiency, which must tend to stunt even the native vegetation and render colonisation by a more desirable and nutritious flora impossible, and in this connexion it is probable that a scarcity of available nitrogen must rank with a scarcity of phosphates as a contributing factor of no mean importance. That this is indeed the case is rendered the more likely from the results of experiments recently conducted in Great Britain, which have shown that in dry seasons it is the pastures manured with a complete and well-balanced combination of fertilisers that not only maintain the highest productivity, but also suffer the least damage. It is significant, too, and corroboratory, so far as it goes, of Sir Frederick's far-reaching thesis, that it is scarcity of plant food rather than of water that is the outstanding cause of low productivity in South Africa; that experiments with which we have been concerned on soils of very low fertility have shown that the difference between success and failure in the establishment of new sward-forming plants, through the intermediary of seeds, may turn upon the application of a complete and well-balanced manurial dressing at or a little before sowing. Sir Frederick adduces cogent reasons in support of his view that the South African grasslands are not only on the face of it likely to be, but also in fact are, nitrogen-starved; and by reference to small-scale experiments conducted by Mr. T. D. Hall, shows that these grasslands, despite the inherent deficiency in phosphates, none the less show a remarkable response to ammonium sulphate when applied by itself—the response, however, being greater when the added nitrogen (in sufficient quantity) is supported by phosphates, and greater still when supported by phosphates and lime.

The position that clovers may possibly be made to take in the improvement of South African grasslands, in our view, therefore, deserves greater emphasis. White clover, for example, is by no means unknown in the Union, and it is more than probable that by sowing the seed in conjunction with heavy phosphating this all-valuable pasture plant, or for that matter some kindred legume, might be established on a telling scale, and consequently we should like to see added to the experiments and researches that Sir Frederick suggests, trials with a large number of species and strains of leguminous plants; but further than this, such trials should in all cases be supported by inoculation, for it is more than probable that the organism appropriate to the several legumes is but sparingly present, or totally absent, in these mineral-deficient soils. On the evidence placed before us, there would seem to be little doubt that the careful balancing of manurial ingredients will have to play a more than usually important rôle in the improvement of South African grasslands, but the economic prospects will be greatly enhanced if by proper manuring it is thus rendered possible to introduce better species of plants, and especially if these can be made to include legumes, the successful introduction of which would not only add to the nitrogen-calcium content of the ration offering to the grazing animal, but also react economically on the nitrogen-phosphate balance that the scheme of manuring adopted should aim to maintain.

With regard to the grasses, no preconceived reservation should be made as to what species might prove valuable: thus for certain difficult situations in New South Wales such an unlikely grass as tor grass (*Brachypodium pinnatum*), which is nothing but an objectionable weed in Britain, has been shown to be of possible value and worthy of more serious trial; while on soils as deficient in minerals as those of South Africa, creeping soft-grass (*Holcus mollis*), perhaps the least desirable of grasses in British pastures, might prove to have a certain, though probably very limited, application.

The extreme poverty of South African soils in organic matter must tend to create an unsatisfactory soil condition from the bacteriological point of view, and this leads Sir Frederick to the opinion that the chief chemical rôle of organic matter is perhaps to supply carbon for the soil bacteria, and that a substance rich in organic carbon should contribute to complete fertilisers. To make good, so far as possible, the humus deficiency of these soils is obviously of the first importance, not only to maintain soil fertility, but also, perhaps almost equally, as a means of ameliorating the influence of drought, and consequently the farmer needs to adopt a system of management which will so far as possible augment the plant residues returned to, or retained in, the soil.

Thus in this connexion the time of application of nitrogenous fertilisers in support of phosphatic manures is perhaps as important as its presumable effect on the plant's ability both to collect and utilise water to the best advantage, since the root system (the development of which is favoured by phosphatic manures) of an arable crop must bear a close relation to humus formation in the soil. Consequently, investigations designed to establish 'the most water-economising' scheme of manuring applicable to different crops should go beyond merely an exploration of the factors which influence the economic use of water by the plant in the production of dry matter of the part or parts of the plant constituting a particular crop.

The insistence on the significance of humus deficiency adds emphasis, we think, to the importance of a crop like lucerne in the economy of South African husbandry, and the more so if, as Sir Frederick considers probable, the nitrogen-fixing organism associated with the wattle (another leguminous plant) is also capable of bringing the phosphates of the soil into organic combination. The growing of lucerne does not, however, represent the only cultural means of increasing the humus content of arable soils; the same end could be achieved by maintaining leys consisting of other plants, or by encouraging, in the first instance by the purposeful sowing of seeds and the generous application of manures, a volunteer flora of annual grasses and clovers such as undoubtedly contributes to the fertility of the Australian wheat belts.

On the balance, there would seem to be evidence to suggest that the evolution of high farming in Australia and in South Africa presents something in the nature of an antithetical parallel. In Australia, it was when the husbanding of water by improved fallow methods became well understood that the need of artificial manures (still chiefly phosphates) was fully appreciated and the potential usefulness of the alien annual flora realised; in South Africa, perhaps it will be when the deficiencies in plant foods have been artificially rectified that an impetus will be given to further endeavour in the direction of conserving moisture, and to the introduction of valuable sward-forming and humus-creating plants.

The problems of the two countries are in many respects very similar, and Sir Frederick's final suggestions, though made to the geneticists of South Africa, are equally applicable to those of Australia, as indeed they are in their broad implications to the whole body of economic plant breeders. In laying emphasis on the desirability of discovering races of maize with male inflorescences which will continue to produce pollen over a long period, he in fact directs attention to the need of the fertilisation affinities of our cultivated races of plants being in accord with the restrictions imposed by the conditions under which we expect them to grow. It is probable that the chances of successfully inducing the spread of a plant like white clover through some of the grasslands of South Africa would be increased in proportion as early and abundant seeding races could be selected for introduction, while it is equally probable that the most successful pioneer plants in regions of low rainfall are self-fertile annuals with the maximum ability for setting and ripening seed quickly. The plant breeder who seeks to take up Sir Frederick's challenge and to breed varieties of crops designed to utilise manures to the most economic advantage may take heart from the fact that it is undoubtedly true that different strains of grasses of one and the same species, at all events, react to fertilisers, both qualitatively and quantitatively, in an appreciably different manner.

Future of Australian Aborigines.

FOR some time past certain sections of the public in Australia have been much exercised by the present conditions and the future of the aborigines. The question was brought into special prominence some five or six years ago by Dr. Basedow, the anthropologist, on his return from one of his expeditions to Central Australia. As a result of his observation of conditions among the aborigines on that occasion, he organised a number of public meetings in Adelaide and elsewhere and aroused a public feeling sufficiently strong to secure the setting aside by the South Australian and Western Australian Governments of a reservation for the aborigines of 62,000 square miles lying across the boundary of the two territories.

There is, however, reason to believe that the hopes for the amelioration in the condition of the aborigines then entertained by the promoters of the movement have not been fulfilled, and it has been stated categorically by Prof. Wood Jones, in an address to the Australian Association for the Advancement of Science, that the provision forbidding the granting of concessions for the exploitation of minerals within the reserved area has been deliberately ignored by one of the governments concerned. At present the aborigines come under the respective State governments, each of which has its own Protector of the Aborigines, with

a subordinate staff; but there has been a strong expression of opinion that the care of the aborigines should be under the Commonwealth Government.

Recently the Commonwealth Government has had under consideration certain recommendations made by Mr. J. W. Bleakley, Chief Protector of the Aborigines for the State of Queensland, dealing with the aborigines and half-castes of North Australia and Central Australia. Mr. Arthur Blakeley, Minister for Home Affairs, has now made known the decision of the Commonwealth Government on the proposals, after taking into account recommendations which had been put forward by the Melbourne Conference of Missionary Societies and other bodies interested in the aborigines, as well as the administrations of North Australia and Central Australia and the Department of Home Affairs.

Certain recommendations as to wages are to be adopted, though not that which urges the payment of wages in goods instead of money—a point upon which a strong opinion has been expressed at one time and another in view of wasteful expenditure of the money wage. Accommodation for workers is to be improved under the supervision of the Protectors; and though the co-operation of employers is to be invited in securing an improved moral atmosphere, no extension of the existing law against soliciting and procuring is proposed, nor are employers to be required to employ only the married. The administration of the existing law, however, is to be tightened up. A recommendation for an aboriginal hospital contiguous to the general hospital is set aside, on financial grounds, for later consideration. It is not considered necessary that the existing reservations lying contiguously in the three States of Central, South, and Western Australia should be extended, as they are only sparsely populated by aborigines at present; but the Commonwealth Government is in communication with the State governments in connexion with the suggestion that the whole of the area in the three reserves should be placed under Commonwealth control. The most important decision, however, is that the whole of Arnheim Land is set aside as a reservation for aboriginals.

The decisions of the Commonwealth Government, excepting for the creation of a reserve in Arnheim Land, may seem relatively unimportant. Actually they mark an advance in dealing with the aboriginal question upon which all who are concerned with the interests of the aborigines may well feel cause for congratulation. In a recently published book, "The Australian Aboriginal as a Human Being", by Mr. M. M. Bennett, the case for the aboriginal is temperately set out. In that book, those who will may read the grave indictment of the treatment of the black fellow by the white—all the more serious because the greater part of the evidence is drawn from official documents.

There can be little doubt that, unless measures are taken without delay, in a few years the aboriginal will become extinct. On humanitarian grounds this is, to use a mild term, discreditable; on scientific grounds it is to be deplored. From the scientific point of view, the disappearance of the aboriginal, even as he exists to-day, would be a calamity. Spencer and Gillen saved from oblivion a vast amount of material which demonstrated the value of the Australian evidence in its bearing upon the early history of society and culture. Even now much further study is needed, for which the data still exist, especially among the remoter and less known tribes. A few years more and it will be too late; the evidence will have vanished for ever.

Scientific Bibliography.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Edited by Ernest R. Pitt. Pp. xxiv + 1208. (Melbourne: H. J. Green, 1930.) 10*s*.

THE problem of rendering available to scientific workers the torrent of information now being poured out by the Press is in urgent need of thorough investigation. Obviously, the task comprises five processes—(1) it is necessary to ascertain exactly and immediately all that is published, so that no information may be overlooked; (2) means must be provided for collecting all the material, in order that it may (3) be thoroughly indexed, so that (4) complete bibliographies on special subjects may be supplied to research workers on demand and (5) they may be able to obtain the volumes containing the desired information for study. Merely to state these requirements is to realise that not a single one of them is adequately met. Yet the cost of an organisation to deal completely with the task would not be much greater than that of the upkeep of one of the large public libraries, certainly much less than of some in America, and, until a practical solution to the problem, as a whole, has been found, scientific workers must continue to waste their energy in useless repetition. It is time that the question was taken in hand.

Although, however, librarians generally appear scarcely to have realised the existence of the problem, they are at least beginning to appreciate the need for attempting to make lists of published literature, hence what may be called the union catalogue movement.

Union catalogues are confined mainly to periodical literature. The earliest known example of such a catalogue appears to have been one of 14 pages published in Milan in 1864. The German "Gesamtverzeichnis der ausländischen Zeitschriften" issued in 1914 to 1924 contains about 14,000 periodicals filed in about 1400 libraries. A French union catalogue "Inventaire des périodiques des bibliothèques de Paris" was issued by the Academy of Sciences in 1924–25. This catalogue represents 115 libraries and contains 16,000 periodicals. The Swiss catalogue is entitled "Verzeichnis ausländischer Zeitschriften"; the third edition, published in 1925, contains nearly 9000 periodicals from 387 libraries. A Norwegian union catalogue, "Utenlandske Tidskrifter", appeared in the same year, containing 4200 periodicals from 96 libraries. The British catalogue known as the World List of Scientific Periodicals was completed in 1927. It is a list of upwards of 24,000 periodicals contained in about 150 libraries. The union list in America is even larger, containing about 75,000 periodicals representing 225 libraries, but includes other than scientific periodicals. A new edition of the "List of Serial Publications in the Union of South Africa" was completed in 1927 and contained about 3000 periodicals from 44 libraries.

The figures quoted serve to show the inadequacy of the provision for scientific reference in different countries. Great Britain is fortunate in having one of the largest collections of scientific periodicals. But many of these are not available for loan to any research worker who may require them, and numbers of periodicals are not represented at all.

The present work contains about 10,000 periodicals filed in 132 libraries in the Commonwealth of Australia, is clearly printed, and shows evidence of very careful compilation. The editor is to be congratulated particularly on having resisted the popular clamour for a catalogue prepared without rules, "as reason panders will". The preface states: "The main object of the catalogue is to enable the research worker to ascertain readily where a reference met with in the course of his studies may be consulted. A subsidiary, but nevertheless important, purpose is to serve as a guide for Australian librarians to the latest methods of cataloguing periodicals." It would be an enormous simplification of the task of listing scientific literature if all catalogues could be prepared on a uniform system, so that entries prepared in different libraries could be brought together readily into one alphabet. As has already been pointed out for indexing information, so in cataloguing also, there is need for the adoption of a standard system. It is encouraging to see that in Australia this need is recognised.

Unfortunately, this cannot be said of some of the countries in which larger union catalogues have been prepared. The public may be excused for asking that periodicals should be entered where they may expect to find them. The librarian knows that the first essential of a good catalogue is a rigid system of rules, which shall provide one place, and one place only, for a given publication. Nevertheless, some members of the profession appear still to be in sympathy with Mr. J. G. Cochrane, who, when asked before the Royal Commission on the Management of the British Museum, in 1850, "Do you object to rules in any compilation of catalogues?" said, "Yes, very much". Thus a number of important union catalogues of periodicals attempt merely to list periodicals under their titles, with the result that entries are collected in masses under general headings such as 'Bulletin', 'Journal' and 'Report', and, owing to the great variety of small changes possible in the titles, it becomes exceedingly difficult to find the periodicals at all.

In the present work Mr. Pitt has eliminated a great deal of confusion by recognising that publications are characterised more particularly by the name of the issuing body than by their titles, and has entered them accordingly. Still further difficulties would have been avoided if the British Museum rule had been followed exactly.

S. C. BRADFORD.

Landscape for the People.

National Parks: and the Heritage of Scenery. By Dr. Vaughan Cornish. Pp. xi + 139. (London: Sifton Praed and Co., Ltd., 1930.) 5s. net.

THE appointment by the Prime Minister of a Departmental Committee to inquire as to the desirability and the feasibility of establishing one or more national parks in Britain has stimulated interest in the claims of different areas to be regarded amongst the elect. Often the claims are backed by local sentiment and little more, small

attention being given to the minimum requirements which any national park must possess if it is to meet the needs of the people. The ideal park must be spacious; it must be varied in aspect, representing many types of unspoiled Nature, mountain and valley, moorland and forest, stream and lake; its fauna and flora also must be varied and rich; it must be peaceful, accessible, and yet remote from the bustle of traffic; and, if the project is to make headway in the near future, it must be land the value of which is not exorbitant.

Dr. Vaughan Cornish examines with the eye of the practised geographer the areas in Britain which he regards as suitable for national parks. They are not very many: in Scotland, the wild regions of Glen Affric, the Cairngorms, and the Cuillin Hills of Skye; in Wales, Snowdonia; and in England a variety of aspects, from the moorlands of Tynedale, adjacent to the Roman Wall, and the wilder scenery of Lakeland, to areas of special and restricted character, such as the Norfolk Broads, Dartmoor, the South Downs, the New Forest and the Forest of Dean, and the sea-cliffs of Pembroke and North Cornwall.

In enumerating the characteristics and merits of each of these regions, Dr. Cornish restricts consideration to the scenic aspects, on the ground that he is dealing with "sanctuaries of scenery for the preservation of the sense of communion with Nature on the part of our people". It is an unfortunate restriction, for it ignores the fact that to many the sense of communion with Nature is bound up with observation of the plants and animals of the country; natural history and natural scenery march side by side. How can one assess the value of the Cairngorms as a national park, without discussing the interests of the unique primeval pine-woods of Rothiemurchus and Glen More (simply mentioned as 'forests'), or the outstanding members of its fauna, red deer and roe and Arctic hares, its golden eagles, ptarmigan, dotterel, greenshanks, and snow-buntings? It was for good reason that the terms of reference of the National Parks Committee included "fauna and flora", and the omission of this aspect of the question limits the value of the analysis presented in this volume.

We know that specialists in botany and natural history have declared that preservation of fauna and flora is incompatible with the full play of a national park, and the author concedes this point. But from our knowledge of the expert egg-collecting which now takes place, without let or hindrance, in that area, we are convinced that the rare birds would be safer under the watchful eyes of the park wardens; so also would it be with the wild beasts. As for the people, they themselves, recognising their heritage and the danger it would run from selfish molestation, will become the best protectors of flowers and animals.

A strong plea is made for the preservation from the spread of the seaside bungalow, so encouraged by modern ease of transport, of goodly strips of sea-cliff. That is a southern problem, for Scotland will always have its cliffs and islands, haunts of innumerable sea birds, which need no protection other than their remoteness, and the areas suggested in Pembroke and Cornwall have the great advantage that their climate favours winter as well as summer visitors.

The second part of the volume analyses the qualities and combinations of natural and artificial features which make for pictorial grouping in agricultural and urban landscape, at home and in various parts of the world. It shows the dangers of hasty and unconsidered building, and ought to suggest to local authorities and architects ways in which the needs of civilisation may be served without grievously interfering with Nature's majesty and beauty. J. R.

The Historical Approach to Science.

Pour l'histoire de la science Hellène. Par Paul Tannery. *De Thalès à Empédocles.* Deuxième édition, par Prof. A. Diès. Pp. xxiv + 435. (Paris: Gauthier-Villars et Cie, 1930.) 80 francs.

THE new second edition of this standard book is to be warmly welcomed for several reasons. It first appeared in 1887, and has been long out-of-print. It is now reissued with some additional matter (a letter and essay on Melissus by Tannery and some notes by the editor, M. A. Diès). Above all, it has an admirable preface by M. Federico Enriques, putting the case for the study of the history of science and giving an estimate of Tannery's work as a whole. Hence it will be understood that this is a book to be possessed by all who make the history of thought the main line of their study of the past, but it should be accompanied by Tannery's two other books, "La Géométrie grecque" (1887) and "Pour l'histoire de l'astronomie ancienne" (1893).

There can be no question of the unique importance of the evolution of thought which these three works cover; it is nothing less than the establishment of the framework of science in which the human mind has worked ever since, which it has

continually elaborated and is elaborating to this hour. It is therefore of perennial interest, for mankind will always be thinking it over and refashioning it in the light of new discoveries and fresh points of view. As it stands at present, there are still abundant lacunæ, frequent issues on which doubt remains and on which more than one opinion may be legitimately held. On the other hand, certain conclusions now stand out above all question. It may be interesting to set down a few of these as they appear from this latest edition of Paul Tannery's book.

In the first place, we know for certain that Greek science arose from the intercourse of Greek minds with Egyptian and Babylonian, especially the former. It can first be dated in the sixth century B.C., and was always connected in Greek tradition with the name of Thales of Miletus, the leading name among the seven Sages. What we do not know is how much to attribute to Thales personally and how much to the Egyptians, how far the Egyptians had gone in geometry, arithmetic, or astronomy, or whether these sciences are due, as sciences, entirely to Thales and his successors. On these questions Tannery is pro-Greek, but not pro-Thales. Thales himself he treats as a somewhat mythical figure, but has no doubt that it was Greeks of about that time who built up the first geometrical and rational cosmological conception of the world. There is probably much more to be discovered about the early thought and achievement of the Egyptians, and those who have seen the marvellous architecture lately uncovered by Mr. Firth at the foot of the Step-Pyramid at Saqqara, and attributed to the fourth millennium B.C., will hold their judgment as to the presence or absence of any particular geometrical conception in the minds of Egyptians of that age. It is hard to believe that the men who erected these things, or the Great Pyramids, had no notion of angular measurement—much easier to think that the Rhind papyrus, on which so much has been based, is a careless or ill-informed production of inferior minds.

In the volume before us, Tannery was discussing the exact import and affiliation of the cosmological ideas of the pre-Socratics—Nous, the infinite, the elements, etc. Here, it must be confessed, the importance of the speculation is much less evident than in the thinking which led to the foundation of mathematics. There is no doubt as to the affiliation of modern mathematics to that of the Greeks; Descartes goes back to Pappus, and Copernicus improves on the Ptolemaic system. But can one say the same of modern physics and chemistry? Are the atoms of Dalton in the direct descent from Anaximenes or Democritus? These physical speculations of the early Ionians often strike one as the clear but quite crude ideas of children, and, by themselves, would not justify the high esteem of the Greeks as scientific founders. This is why the three aspects of Tannery's studies —the geometrical and astronomical as well as the cosmological—should go together.

M. Federico Enriques' preface is the best defence of the study of the history of science, within that compass, that we have ever seen. It should be printed as a pamphlet and broadcast. He sees in the historical approach to science the best, perhaps the only, means of preventing science becoming a mass of detached specialisms with less and less of a spirit of synthesis or any obvious place in the general history of social progress. In the study of history man preserves his continuity with the past and consciously builds up the future; it is his special prerogative. As science, that is, orderly thinking, is more clearly recognised as the central thread in this process, it must take a corresponding place in the record which each age makes afresh for itself of its own past.

F. S. MARVIN.

Our Bookshelf.

(1) *Elementary Inorganic Chemistry.* By Dr. J. W. Mellor. Pp. x + 229. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 3*s*. 6*d*.

(2) *Intermediate Inorganic Chemistry.* By Dr. J. W. Mellor. (New edition of "Introduction to Modern Inorganic Chemistry".) Pp. xx + 690. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 7*s*. 6*d*.

DR. MELLOR has divided his well-known "Introduction to Modern Inorganic Chemistry" into two separate volumes in order to meet more adequately the needs of schools. The more elementary volume is written about the properties of air, water, and the common non-metals, with a simple discussion of some of the fundamental principles of chemistry, together with biographical notes of some of the founders of the science. Most of the text has been incorporated into the "Intermediate Inorganic Chemistry", which includes also some chapters on organic compounds and on the common metals. Both volumes are admirably illustrated and the subject matter is presented in an attractive fashion. The "Intermediate" volume contains questions at the end of each chapter, and here and there one comes unexpectedly across delightful quotations from such works as "Alice in Wonderland" and Shelley's poems. It also contains a fair amount of physical chemistry.

In the chapter on energy and matter a series of illustrations of the kinetic theory is given with the

view of enabling the imagination to grasp some idea of the "scale of magnitudes in the world of molecules". This is followed by a discussion of the bearing upon the theory of the study of ultra-microscopic particles. No mention is made of electrons, nor are the modern views of atomic structure dealt with. This is rather surprising, since an elementary discussion of the subject would probably make a stronger appeal to the young student's imagination than Planck's conception of energy quanta and Einstein's extension of his ideas, which are introduced into the section on specific heats. The chapter on classification is perhaps the weakest part of the book. It opens with a highly condensed scheme of qualitative analysis which seems to serve no useful purpose. Both the scheme and the doggerel verses which precede it might well be banished from the modern text-book. Classification of the elements is discussed up to the work of Mendeleéff, with the addition of elements discovered since then. No explanation is given of the atomic numbers which are to be found in the table on p. 289.

Telegraphy and Telephony, including Wireless: an Introductory Textbook to the Science and Art of the Electrical Communication of Intelligence. By Dr. E. Mallett. Pp. ix + 413. (London: Chapman and Hall, Ltd., 1929.) 21*s.* net.

ELECTRIC communication whether by wires or by radio is now an art of great commercial importance. It is not surprising, therefore, that there are many text-books written on the subject. Many of these deal with highly specialised applications and several are written for the telegraphist or the telephone linesman, but there are very few which attempt to give an outline exposition of the scientific principles on which the whole art is based.

In the book under notice, Dr. Mallett successfully gives such an exposition. It is designed to meet the needs of the university or technical college student who has studied electricity and magnetism up to the second year standard. It should prove useful for students preparing for the final examinations in telegraphy and telephony for the B.Sc. (Eng.) of the University of London. From the student's point of view it would have been desirable to include a few examination questions with complete solutions in various parts of the book. The explanation of the so-called skin effect is perhaps too brief, and in several places not sufficient stress is laid on the fact that sine assumptions have been made. We can commend this book to the student who intends to take up electric communication as a career.

Human Biology and Racial Welfare. Edited by Prof. Edmund V. Cowdry. Pp. xviii + 612. (London: H. K. Lewis and Co., Ltd., 1930.) 28*s.* net.

THIS book is addressed to the student about to specialise and to the general reader. It consists of twenty-five essays by eminent authorities in their own fields, and is divided into five parts leading from the origin of man to a consideration of his destiny. The contributions maintain a high scientific level and nevertheless are so written as to be easily understood by those not acquainted with technical terms. This is a somewhat remarkable achievement. But it may be asked whether the editor has not set himself an impossible task. Though care has been exercised in arrangement, the effect cannot be other than to give the impression of a collection of scraps. The field is vast and those parts of it which are touched upon are briefly, sometimes very briefly, treated. There seems to be no reason why some problems are included and others omitted. The reader finds himself setting off on a number of journeys, and before he has got accustomed to the scenery he is off again in a new direction. Integration, which is presumably one of the objects of the book, is not achieved. Those to whom the book is addressed require a guiding thread, which perhaps could be given if the book was the work of one hand; but no one with a reputation to lose would attempt the task single-handed. A worthy attempt has been made to fill a gap which undoubtedly exists by the alternative method, but with a degree of success that is necessarily limited by the defects of that method.

Fütterung der Haustiere: ihre theoretischen Grundlagen und ihre wirtschaftliche Durchführung. Von Prof. Nils Hansson. Deutsch von Dr. Franz von Meissner. Zweite, umgearbeitete und erweiterte Auflage. Pp. xv + 274. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 10 gold marks.

THE first edition of this work appeared in 1926. In the present edition, Prof. Hansson has reviewed the subject matter of the former edition in the light of the progress which has been made in animal nutrition research during the last decade. A chapter on vitamins, their distribution and significance, has been inserted. The question of the biological value of the constituents of feeding stuffs is also dealt with. Other new features of the present edition include: accounts of feeding stuffs which have been introduced recently into feeding practice; the scientific aspects of poultry nutrition; the regulation of bulk in the feeding of farm animals; the mineral requirements of different classes of farm stock. The tabular matter in the final section has been augmented by the inclusion of data showing the reactions of the ash constituent of the common feeding stuffs.

The Material Culture and Social Institutions of the Simpler Peoples: an Essay in Correlation. By L. T. Hobhouse, G. C. Wheeler, and M. Ginsberg. (The London School of Economics and Political Science: Series of Studies in Economics and Political Science, No. 3 of the Monographs on Sociology.) Pp. v + 299. (London: Chapman and Hall, Ltd., 1930.) 10*s.* 6*d.* net.

THIS is a photographic reproduction of a book first published in 1916, though there is no intimation to that effect and the title-page bears the date 1930. It was, and still is, a monograph of great value for the study of primitive peoples, but so much work has been done since it was compiled that it requires considerable additions and some revision.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Fine Structure of α-Rays.

IT is usually assumed that the long range α-particles observed in C'-products of radioactive series correspond to different quantum levels of the α-particle in the nucleus. If after the preceding β-disintegration the nucleus is left in an excited state with the α-particle in one of the levels of higher energy, one of the two following processes can take place: either the α-particle will cross the potential barrier surrounding the nucleus and will fly away with the total energy of the excited level (long range α-particle), or it will fall down to the lowest level, emitting the rest of its energy in the form of electromagnetic radiation (γ-rays), and will later fly away as an ordinary α-particle of the element in question. Thus there must exist a correspondence between the different long range α-particles and the γ-rays of the preceding radioactive body. If p is the relative number of nuclei in the excited state, λ the corresponding decay constant, and θ the probability of transition of the nucleus from the excited state to one of the states of lower energy with emission of energy (in form of quanta or an electron from the electronic shells of the atom), the relative number of long range α-particles must be $N = p\frac{\lambda}{\theta}$. Knowing the number of α-particles in each long range group and calculating, from the wave mechanical theory of radioactive disintegration, the corresponding values of λ, we can estimate for each group the value θ/p, giving a lower limit for the probability of γ-emission. For example, for thorium-C' possessing besides the ordinary α-particles also two groups of long range α-particles, we have for transition probabilities from two excited states to the normal state $\theta_1 < 0{\cdot}4 \times 10^{12}$ sec.$^{-1}$ and $\theta_2 < 2 \times 10^{12}$ sec.$^{-1}$, which is the right order of magnitude for the emission of light quanta of these energies. With decreasing energy λ decreases much more rapidly (exponentially) than θ, so that the number of long range α-particles from the lower excited levels will be very small. (From this point of view we can also easily understand why the long range α-particles were observed only for C'-products for which the energy of normal α-particles is already much greater than for any other known radioactive element.)

A difficulty arises with the recent experiments of Rosenblum (*C.R.*, p. 1549; 1929; p. 1124; 1930), who found that the α-rays of thorium-C consist of five different groups lying very close together. The energy differences and intensities of the different groups relative to the strongest one (α_0) are, according to Rosenblum:

$$
\begin{array}{ll}
E\alpha_1 - E\alpha_0 = +\ 40{\cdot}6 \text{ kv.} & I\alpha_1 = 0{\cdot}3 \\
E\alpha_2 - E\alpha_0 = -287 & \\
E\alpha_3 - E\alpha_0 = -442 & \\
E\alpha_4 - E\alpha_0 = -421 & I\alpha_4 = 0{\cdot}005
\end{array}
$$

If we suppose that these groups are due to α-particles escaping from different excited quantum levels in the nucleus, we meet with very serious difficulties. The decay constant λ for the energy of thorium-C fine structure particles is very small ($\lambda \sim 10^{-3}$ sec.$^{-1}$), and in order to explain the relatively great number of particles in different groups we must assume also very small transition probabilities. We must assume that thorium-C nucleus can stay in an excited state without emission of energy for a period of half an hour!

We can, however, obtain the explanation of these groups by assuming that we have here a process quite different from the emission of long range α-particles. Suppose that two (or more) α-particles stay on the normal level of the thorium-C nucleus. It can happen that after one of the α-particles has escaped the nucleus will remain in an excited state with the other particle on a certain level of higher energy. (In this case the energy of the escaping α-particle will be smaller than the normal level and obviously will not correspond to any quantum level inside the nucleus.) From the excited state the nucleus (thorium-C'' now) can afterwards jump down

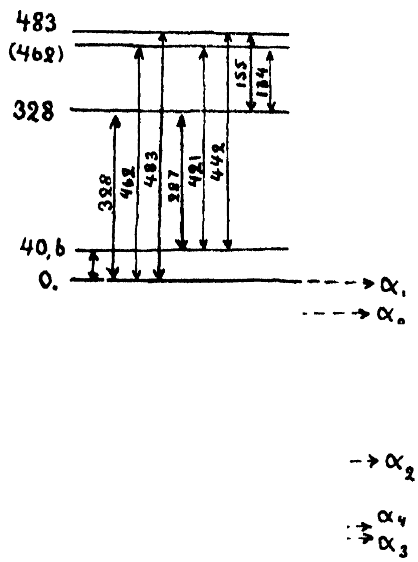


FIG. 1.

to the normal level, emitting the energy difference in form of a γ-quantum.

Thus the relative number of different groups will not depend on the probability of γ-emission but only on the transition integral:

$$W = \iint f(r_{1,2})\psi_{E_0}(a_1)\psi_{E_0}(a_2)\bar{\psi}_{E_n}(a_1)\bar{\psi}_{E\alpha_n}(a_2)\,dv_1 dv_2$$

where $f(r)$ is the interaction energy of two α-particles at a distance r apart, ψ_{E_0} and ψ_{E_n} the eigenfunctions of an α-particle in the normal and n^{th} excited states, and $\psi_{E\alpha}$ the eigenfunction of an escaping α-particle with the energy: $E\alpha_n = E_0 - (E_n - E_0)$.

According to this scheme, the γ-rays corresponding to different fine structure groups of thorium-C must be observed as γ-rays of thorium-C (ejecting electrons from K, L, M, . . . shells of the thorium-C''-atom) and not as the rays of thorium-B, as we would expect in the case of long range particle explanation. The level scheme of the thorium-C''-nucleus as given by fine structure energies is represented in Fig. 1.

In the observed γ-ray spectra of thorium-$C + C''$ (Black, *Proc. Roy. Soc.*, pp. 109-166; 1925) we can find lines with the energies: 40·8; 163·3; 279·4; 345·8; 439·0; 478·8; 144·6 kv. fitting nicely with the energy differences in Fig. 1.

Thus we see that the fine structure group of highest energy corresponds to the normal level of the nucleus, while the other groups are due to the ordinary α-particles which have lost part of their energy, leaving the nucleus in an excited state.

I am glad to express my thanks to Dr. R. Peierls and Dr. L. Rosenfeld for the opportunity to work here.

G. GAMOW.

Piz da Daint,
Switzerland, July 25.

Vitamin Content of Marine Plankton.

THE synthesis of vitamin A in *Nitzschia* and other organisms grown in cultures of artificial sea-water (Jameson, Drummond, and Coward, *Biochem. J.*, **16**; 1922, and subsequent workers) has constituted the main evidence for assuming that marine organisms rely upon phytoplankton for their supplies of vitamins. A search for vitamin D in the same diatom (Leigh-Clare, *Biochem. J.*, **21**; 1927) proved unsuccessful; and little further attention has been given either to the possible presence and rôle of vitamins A and D in planktonic organisms or to the origin of the exceptionally rich stores found in the cod's liver.

To determine what may be, in the natural habitat of the plankton, the possible source and supply of vitamins A and D, plankton was collected and extracted by one of us (E. R. G.). Collections of diatoms and of zooplankton were made from Port Erin in the spring and summer of 1928, and through the kindness of Sir F. G. Hopkins the work of extraction was carried out at the Biochemical Laboratory, Cambridge. The dried plankton was treated in soxhlets with light petroleum and precautions were taken to ensure against overheating and against oxidation through access of air.

Vitamin tests have been conducted both at the Department of Biochemistry, University College, London, and, through the courtesy of The British Drug Houses, Ltd., by Dr. S. W. F. Underhill in their Physiological Laboratory. The feeding tests for vitamin A were supplemented by observations upon the colour reaction with antimony trichloride and by spectroscopic examination. In testing for vitamin D the degree of healing was determined both by histological (line test) and by X-ray examinations.

The following is a summary of the results hitherto obtained:

Nature of Test.	Result from Phytoplankton.	Result from Zooplankton.
VITAMIN A.		
(1) Growth tests .	Positive (in 20 mgm. doses)	Negative
(2) Antimony trichloride	Strong blue colour obtained	Negative
(3) Absorption spectrum	..	No band at 310–330 $\mu\mu$
VITAMIN D.		
(1) Line test . .	Doubtfully positive (much less than 100 Coward antirachitic units per c.c. in 0·02 c.c. doses)	Positive (less than 100 Coward antirachitic units per c.c. in 0·02 c.c. doses)
(2) X-ray . . .	Negative (in 50 mgm. doses)	Negative (in 20 mgm. doses)

The extracts of both animal- and phyto-plankton were strongly pigmented and with antimony trichloride produced red and yellow colours which in some samples were so intense as to render the determination of the blue colour almost impossible. When the antimony trichloride reaction was applied to the unsaponifiable fractions prepared from some of the oils the response was much more definite. A clear blue colour was given by the material isolated from the phytoplankton oil. How far this was due to carotene was not determined by spectroscopic examination, as the quantity of material available was insufficient, but that pigment was undoubtedly present. The unsaponifiable fraction examined from two zooplankton oils did not give a blue coloration with the antimony trichloride.

The probable absence of vitamin D in the phytoplankton is in agreement with the result obtained by Leigh-Clare for *Nitzschia*, which showed no antirachitic activity. It has not been possible to test the amount that would be required to show an order of activity much lower than 100 units per c.c.; therefore the possibility of its having a strength comparable to that of butter (2 units per c.c.) remains an open question. Small doses of the animal plankton, on the other hand, seemed to show fairly definite signs of antirachitic activity, and the possible discrepancy arising in the X-ray examination may be due to the greater delicacy of the line test. The tests suggest that the small amount of vitamin D which appears to be present in these animals results from their irradiation while in surface waters, rather than from a prolonged diet of phytoplankton.

J. C. DRUMMOND.
E. R. GUNTHER.

London.

Scattering of X-Rays by Bound Electrons.

IN two letters to NATURE (May 17 and June 7), Dr. B. B. Ray announces an interesting experimental observation on what he calls "Scattering of X-rays by Bound Electrons". He allowed $K\alpha$ radiation of copper to pass through soot and air, and found that the photograph of the transmitted beam showed, besides the primary $K\alpha$ beam, lines of lesser frequency, namely, $\nu - \nu'$, where ν is the characteristic K-frequency of carbon, oxygen, and nitrogen (matter traversed). The nickel $K\alpha$ radiation also shows a similar modification, the quantum being deprived of a part of its energy corresponding to the K-radiation of the substance traversed.

The object of the present note is to point out that the phenomenon observed has nothing to do with scattering as Dr. Ray seems to think, but is a case of photoelectric ionisation. When a beam of frequency ν traverses matter, it may hit an electron in the K-shell, and will thereby be deprived of a part of its energy equal to $h\nu_K$ where ν_K is frequency of the characteristic K-radiation of the substance traversed. The modified beam will have, according to energy principles, the energy $h(\nu - \nu_K)$, and this may pass on as such, or be absorbed by the electron, which will be ejected with an equivalent velocity. This method has been utilised by De Broglie and Robinson in determining the energy levels of different atoms (from an analysis of the photoelectrons emitted), and by Ellis, L. Meitner, and others in determining the wave-length of nuclear γ-rays. This last application is very interesting, because as the γ-rays from the nucleus of a radioactive substance, say radium-actinium, pass through the nucleus, they release β-rays having the energies $h(\nu - \nu_K)$, $h(\nu - \nu_L)$, etc., and when the β-ray spectrum is analysed, it reveals the characteristic difference $(\nu_{K_1} - \nu_{L_{11}})$, etc., of the atom traversed.

Dr. Ray has, however, gone a step further, and has been the first to analyse the modified (by absorption) beam of primary quanta by a spectroscopic method, and supplemented the work of De Broglie and Black. It is therefore a remarkable experimental verification of photo-ionisation, and hence it easily explains why no modified beam is observed in any other than the forward direction.

The diffuseness of the modified lines is due to the fact that the characteristic $K\alpha$ radiation of the light elements from neon downwards is very diffuse, as observed by Söderman (*Zeit. f. Physik*, **52**), and the diffuseness increases the lighter the element. It appears to me that it affords probably a far more accurate and less troublesome method for determining wave-lengths of the softer radiation from light

elements, and also of such radiation as originates from the outer levels of compound and other aggregate formations. SALIGRAM BHARGAVA.

Physics Department,
University of Allahabad,
July 10.

IN continuation of my previous notes in NATURE (May 17 and June 7, 1930), I have further observed the following lines :

Incident Radiation.	Scattering Substance.	Modified Lines.	Origin.
Ni$K\beta_1$	C	1552 X.U. (587·0)	Ni$K\beta_1$ – C$K\alpha$
ν/R = 608·7	N	1573 X.U. (579·0)	Ni$K\beta_1$ - N$K\alpha$
	O	1602 X.U. (569·0)	Ni$K\beta_1$ O$K\alpha$
Fe$K\beta_1$	C	1825 X.U. (499·0)	Fe$K\beta_1$ - C$K\alpha$
ν/R = 519·9	N	1859 X.U. (490·0)	Fe$K\beta_1$ - N$K\alpha$

The figures in the bracket denote the values of ν/R.

The values of the $K\alpha$ radiations (in ν/R) of carbon, nitrogen, and oxygen are 20·4, 28·7, and 38·3 respectively (Söderman, *Zeit. f. Phys.*, **52**). These modified lines are broad, diffuse, and weak, and as such they were only measured by a glass scale. The error in the measurement may be so great as 4 X.U.

Though Coster, Ehrenberg, and Kast (as mentioned in my previous notes), following Bergen Davis and his collaborators, who were the first to report the detection of such modified lines in the scattered rays, have failed to detect any line on the photographic plate, through the scattering of X-rays by an atom in a direction at right angles to the direction of propagation, where the Raman effect is usually observed, this experiment clearly shows that the modified lines produced by the "scattering of X-rays by bound electrons" are observed in the direction of transmission of the incident radiation. It further follows that to be consistent with the current definition of scattering and absorption, the effect observed by me, which was described in my previous notes to NATURE as "modified lines due to the scattering of X-rays by bound electrons", would be more correctly described as modification due to part-absorption of the incident radiation by atoms. B. B. RAY.

University College of Science
and Technology,
92 Upper Circular Road,
Calcutta, July 10.

Optical Investigations on the Formation of the Latent Photographic Image.

THE effect of colouring of the alkali halides, such as rock salt, with X-rays, radium radiation, or far ultra-violet radiation, is due in the light of modern knowledge to the transference of the valency electron from the chlorine to the sodium. The latter is suspected to be deposited in the lattice in the state of neutral atoms. The new absorption band, causing, for example, the yellow colour of rock salt, can be made to disappear by exposing the coloured salt to the rays it absorbs, that is, the blue-violet ones, or by heating it. A plausible theory is that in this case the backward transference of a valency electron takes place. In both cases the liberated electrons must cause the photo-conductivity effect, and this was indeed observed for the decolorising effect and studied by Pohl and Gudden and their collaborators.

On the other hand, the photo-conductivity effect was found in silver bromide and was investigated by Dr. Toy and his collaborators and also by Kirilov (*Zs. f. wiss. Photographie*, 1928); as Dr. Toy shows, it is closely correlated with the primary photographic process, and both are due to the same primary separation of the electron from the bromide ion.

This analogy between the processes taking place during the illumination of rock salt and silver bromide suggested some optical investigations on the absorption spectra of unexposed and exposed silver bromide, in the hope that they may contribute to the theory of formation of the latent photographical image. The silver bromide was used in the form of layers of fused salt or in large crystals, obtained by the Kyropoulos method. The following results were obtained :

(1) The silver bromide layers and crystals, when not illuminated, are lemon coloured; their absorption band lies in the blue-violet and the near ultra-violet region of the spectrum, and can be regarded as analogous to the far ultra-violet absorption band of sodium chloride (near 1800 A.).

(2) Illumination with rays it absorbs or with X-rays makes the layer quickly change its colour from yellow to emerald-green. The absorption band of this phase lies in the red and infra-red parts of the spectrum; it was measured by us as far as 2000 $m\mu$ and found to consist of a maximum at 610 $m\mu$ and a continuous absorption in the infra-red. It seems to be analogous to the absorption band of the yellow rock salt and can be regarded as the "absorption spectrum of the latent image" (A. Smakula, *Zs. f. Phys.*, **59**, p. 604; 1930).

(3) This view is supported by the observed disappearance of this 'latent image' on heating and by the action of red and infra-red radiations, which is analogous to the decolorising of the yellow salt (Herschel's phenomenon).

(4) Przibram and his collaborators have found that radiations of a given intensity cannot cause colouring of rock salt exceeding a certain maximum limit. The same is observed for the silver bromide layers. The increase of exposure does not completely compensate the decrease in the intensity (analogous to the Schwarzschild law).

(5) My investigations on the coloured rock salt, which are to appear shortly in the *Zeitschrift für Physik*, have led me to conclude that under some conditions (simultaneous illumination and heating) the neutral sodium atoms can aggregate into larger colloidal clumps; the absorption spectrum of such a colloidal system can be evaluated on the basis of the known theories of Maxwell-Garnett and G. Mie. The application of this evaluation to the system sodium–sodium chloride gave results which are in good agreement with the observed red, violet, and blue colour of the rock salt samples.

On the other hand, silver bromide layers, when exposed to the simultaneous action of the active and decolorising radiations, become brown or, when slightly heated, reddish brown (visual blackening); different samples may have a slightly different colour. The analogy with the change of colour of the blue rock salt by heating and other considerations leads me to assume that the brown colour is due to colloidally-distributed silver particles; the application of Mie's theory to the system silver-silver bromide seems to support this view. M. SAVOSTIANOVA.

Physico-mathematical Institute,
Academy of Science,
Leningrad, July 29.

The Splitting of Spectral Lines at Scattering of Light by Liquids.

As was pointed out in my previous communication (see NATURE, Aug. 9, p. 201), when light is scattered by liquids or crystals, there can be observed a splitting of spectral lines which may be ascribed to the influence of elastic heat waves. In the case of strongly scattering liquids, the change of the frequency is given by the following equation:

$$\nu = \nu_0\left(1 \pm 2n\frac{v}{c}\sin\frac{\theta}{2}\right) \quad n = 0,\ 1,\ 2,\ 3,$$

where ν_0 is frequency of the incident light, v and c are velocities of sound and light in the medium, θ is the angle between the incident and scattered rays. It is interesting to note that the length of sound waves to which this splitting may be ascribed is of the same order of magnitude as the wave-length of light.

I wish to give here some details regarding this phenomenon and also to describe some new experiments.

The observed displacement of components does not strictly follow the above equation. In all cases, with the exception of aniline, the observed values are somewhat greater than the calculated ones. In these calculations, the experimental values for the velocity of sound obtained chiefly by the Kundt method were used. However, the velocities of sound calculated from the coefficient of compressibility and density of liquids also do not give values which are in full agreement with experiment.

The intensities of 'red' and 'blue' components are, as it seems, nearly equal. The intensities of inner components (that is, corresponding to $n = 1$ in the above equation) are greater than those of the outer ones (corresponding to $n = 2, 3, \ldots$), and the intensity of the undisplaced line is still greater but perhaps is not greater than twice the intensity of the nearest displaced components. The greatest relative intensity of the undisplaced line was observed in benzene and water. Perhaps the increased value of the intensity of this line is due, at least partly, to dust and contamination of the liquids, which did not in these experiments undergo a special purification (this refers particularly to water, for which the intensity of scattered light is small). It must be remembered that it is very difficult to judge the relative intensity of lines from spectrograms obtained with the echelon grating.

The width of displaced as well as of undisplaced components is not the same for different liquids. It is less in benzene, which gives the displaced lines most distinctly; on the other hand, ethyl alcohol and ethyl ether give diffuse, barely distinguishable lines. In benzene the width of components may be estimated at 0·025 A. Between all the components there is a continuous spectrum.

Some experiments on polarisation of scattered light were made with benzene. When the incident light is not polarised, the undisplaced and the two neighbouring displaced components, that is, lines corresponding to $n = 0$ and $n = 1$ in the above equation, are strongly polarised, the electric vector being perpendicular to the direction of the incident beam. On the contrary, the other components, that is, corresponding to $n = 2, 3, \ldots$, are, as it seems, almost quite unpolarised.

I wish to return to the question of the maximum possible value of n, or the maximum possible displacement of components. If the appearance of these displaced components is due to the diffraction by 'heat wave gratings' of harmonics, the value of n will be limited by the fact that in liquids as well as in solids it is possible to assume a limiting maximum frequency of Debye's 'acoustic spectrum' which corresponds to a wave-length equal to twice the mean distance between molecules. If this distance is of the order of 3–4 A., the limiting frequency will be of the order of $2\text{–}2{\cdot}5 \times 10^{12}$ sec.$^{-1}$ and will produce a displacement of about 15 A. Maybe this is the cause of the broadening of the scattered lines in both directions extending nearly to the above distance which was noticed in liquids (for example in benzene) by many observers (Cabannes et Daure, *C.R.*, **186**, p. 1533; 1928; Raman, *Ind. Jour. of Phys.*, 4, p. 399; 1928; Gerlach, *Ann. d. Phys.*, **5**, p. 301; 1929). Experiments which are now in progress seem to support this view.

E. GROSS.

Optical Institute,
Leningrad.

The Atomic Diameters of Hydrogen and the Inert Gases with respect to Electrons of Very Low Velocity.

THE wave-mechanical treatment of the problem of the scattering of α-particles by neutral atoms has been given by Sommerfeld ("Wave-Mechanics", pp. 192-199). To simplify the calculations he assumes that all the electrons in the atom under consideration are concentrated in the K-shell and have no influence on one another. With similar assumptions, but by a somewhat different procedure, we have made an approximate calculation of the scattering of very slow *electrons* by neutral atoms. This has enabled us to calculate the atomic diameters of hydrogen, helium, neon, and argon with respect to electrons of vanishingly small velocity (0-volt electrons). We obtain the surprising result that the atomic diameters of these gases should vary *inversely* with respect to their atomic numbers. It is obvious that this result should come out most correctly by experiment in the relative magnitudes of the atomic diameters of hydrogen and helium, as only the K-shell exists in their case, and that the error introduced by the above assumptions as applied to the present problem will become much greater as we pass to the higher atomic numbers owing to the greater number of electrons far outside the K-shell.

Actual experimental values of these atomic diameters with respect to 0-volt electrons have not yet been obtained. The best available data for comparison are those obtained from experiments by Townsend and Bailey. In Fig. 10, p. 28, of Townsend's "Motion of Electrons in Gases" (Oxford) curves are given which exhibit the relationship between the mean free paths of electrons of varying velocity in hydrogen, helium, neon, and argon. The velocity of the electrons ranges from 2 volts to 1/9 volt in this diagram for the case of hydrogen and helium, but only from 2 volts to slightly below 1 volt in the case of argon and neon. At an electronic velocity of 1 volt the mean free paths are in the ratios 3 : 8 : 40 : 140 for hydrogen, helium, neon, and argon respectively, of which the atomic numbers are 1, 2, 10, 18. All the curves are divergent towards lower velocities, so that these ratios would become correspondingly larger below 1 volt.

Townsend and Bailey showed in 1921 that the mean free path in argon reaches a maximum at 0·39 volt (as has recently been verified by Ramsauer and Kollath: see NATURE, Mar. 15, 1930, p. 427), and, as there is reason for believing that a maximum occurs in the case of all gases, extrapolation of these curves towards lower velocities is impossible. Since we may take the mean free paths as inversely proportional to the atomic cross-section or the square of the atomic

diameter, the above ratios show that the wave-mechanical treatment of the problem gives the correct experimental result qualitatively for hydrogen, helium, neon, and argon; in the case of hydrogen and helium there is even fair quantitative agreement.

We wish to emphasise that our calculation can be regarded only as a first approximation, because we are dealing with slow electrons, which will be considerably influenced by the extra-nuclear electrons beyond the K-shell, whereas in the case of the scattering of α-particles the effect of the electrons outside the nucleus is only of secondary importance. The way in which this fact modifies the results above mentioned will be given in our detailed paper which will be published shortly.

HENRY L. BROSE.
E. H. SAAYMAN.

Physics Department, University College,
Nottingham, Aug. 25.

Noise Associated with Lightning.

SOME years ago I directed attention in NATURE to a swishing sound that is sometimes heard when a flash of lightning is very close to the observer. I had at that time never heard the sound myself. I heard it, however, very distinctly on the night of Aug. 29–30. I had been expecting a flash to come close, as a very active storm centre had been moving directly towards this spot, with steadily decreasing intervals between the cloud to earth flashes and the thunder. I did not see the actual flash, only the illumination of the garden through the open window; it was very brilliant and was followed instantly by a noise as though a shower of large water drops had been thrown on to a hot metal plate; this was followed almost instantly by the thunder. I think there was a slight interval between the swish and the thunder, but it must have been only a fraction of a second; I had been counting seconds after previous flashes, but with this one I had not time to begin to count before the thunder came. The flash must have struck a point well within a hundred yards of my room, and I suspect that it struck the lightning conductor on the house. The noise was heard by my daughter and by two other people in the house. It was also heard by two people in a cottage about 50 yards from the house; one of them likened it to a red-hot poker being plunged into cold water, the other to the sound of the arc when two electric cables are short circuited.

The origin of the noise is obscure. I feel inclined to think that it is caused by some of the branches into which the main discharge often divides before reaching the ground; it may well happen that a number of these may be nearer to the observer than the main discharge and so be heard first. The noise is not unlike the crackle of a brush discharge on a large scale. The chief argument against this explanation is that a correspondent in NATURE described the sound as occurring not after but before the flash. But it seems possible that on some occasions brush discharges may occur just before a flash. At any rate, this sometimes occurs with a highly charged Wimshurst machine.

Another point that I noticed (not for the first time) in the recent storm was that there seemed to be definite active centres. When I first observed the storm about 9 P.M., summer time, there were two centres where most of the brightest flashes were occurring, one on a line through Chichester, the other on a line just north of Portsmouth, though both centres were probably at a good distance farther than either town; almost all the flashes at this time were connected with one or other of these centres, though many of the cloud to cloud flashes travelled long distances in the sky. The 'Portsmouth centre' moved nearer, taking a course that brought it within about five to six miles to the north-west of us. Meanwhile, another centre of activity had moved a little south of us; this produced some very good flashes a mile or two to the south-east and east, and finally moved away in the direction of London. It could be followed for a long time, the flashes appearing, owing to increasing distance, to become shorter and fainter. Finally, I noticed another centre on a line a little to the south of the direction of Portsmouth, and this centre it was that was responsible for the flash described above; it also produced three other flashes quite close by, and one of these made the peculiar noise, though I did not hear it myself, probably because I was going round the house to see if any damage had been done by the first flash and happened to be in a passage where there was not an open window.

C. J. P. CAVE.

Stoner Hill, Petersfield, Sept. 1.

Sunspots and Pressure Distribution.

THE issue by the Meteorological Office of the daily charts of the weather in the northern hemisphere has enabled me to ascertain the barometric changes which take place from day to day in high latitudes. As a rule, the cyclones and anticyclones are large as compared with the polar uncharted area, and it proved possible to extend the isobars of the surrounding areas over the Arctic Sea. However, east Siberia could not, in the absence of the Japanese daily charts, which reach England about six months late, be dealt with.

From the partially completed charts the mean pressures were calculated for each day along latitudes 30°, 40°, 50°, 60°, 70°, and 80° north. When plotted they showed irregular periodic variations, some of which had a swing of something more than 25 days. As this is about the apparent period of rotation of the sun and pointed to our chief luminary as the cause of the variability of pressure from day to day, I decided to consider the sunspot question carefully.

By the courtesy of the Astronomer Royal, I have been supplied with bromide prints for each day for January, February, March, and April, and been allowed to see some of the later negatives of the solar disc. Also, by the courtesy of the director of the Meteorological Office, I have obtained the pressure charts—issued to the public, since March—for January and February.

The sunspots have been plotted upon a diagram, the abscissæ of which are days and the ordinates degrees on the sun's surface measured from the apparent centre of the disc. They clearly show the movements of each spot or group of spots, as they approach or recede from the centre of the disc, owing to the sun's rotation.

An examination of this diagram demonstrates the fact that the pressure is low over the Arctic regions when there are sunspots near the sun's centre, and that there are high pressures over the Arctic regions when there are no spots near the centre of the disc. Such low pressures due to sunspots occur in the long Arctic winter quite as markedly as they do during the summer. When the sun's disc was clear in the centre on April 24, the mean pressure north of 60° was 1025 millibars. On Mar. 8 the mean pressure was 1001 millibars and there were spots near the sun's centre.

I hope to be in a position to publish full details concerning the matter soon after the receipt of the Japanese weather charts of the North Pacific area for June.

R. M. DEELEY.

Arden, The Grove,
Isleworth, Middlesex.

Theories of Terrestrial Magnetism.*

By Dr. F. E. SMITH, C.B., C.B.E., Sec.R.S.

EARTH'S MAGNETIC FIELD AND SECULAR VARIATION.

VERY valuable criteria have been given by Gauss and by Schuster, the former showing that the main origin of the earth's magnetic field is within the earth, and the latter that the cause of the daily variations is external to the earth's surface. Any predominant magnetic effect due to external causes need not, therefore, be looked for.

What do we know of the so-called permanent field ? Examination of the available data leads to the conclusion that the magnetic field may be regarded as moving westwards along a parallel of latitude at the rate of a few seconds of angle per day, the rate of movement being such that, if continued for some hundreds of years, the field would make a complete revolution round the earth, the motion being in the opposite direction to that of the earth's rotation. The secular variation may therefore be regarded as caused by change in direction of the axis of magnetisation. If outer space is a conducting medium, there will be relative motion between the magnetic field of the earth and it, and the moving field will induce currents in the outer conducting medium, and these currents in turn will react and induce other currents and associated magnetic phenomena. There will also be mechanical reactions, and Schuster showed how these reactions can be calculated. It is certain that the induced currents must tend to destroy the motion of the inducing field, and that one effect must be to reduce the period of rotation. Such a reduction in the period of rotation would result even if the magnetic axis coincided with the axis of rotation, but when the two axes do not coincide there is another retarding couple acting on the magnetic field.

A circular movement of the magnetic pole about the axis of rotation may be regarded as produced by two radial movements at right angles operating from that axis. Such motions of the magnetic field will induce currents in the conducting layer, and the reacting forces will tend to destroy the movements which produce them, that is, the tendency will be to make the two axes coincide. The total result is, therefore, to slow down and eventually destroy the rotation of the magnetic axis and to reduce the angle of separation of the two axes and eventually cause them to coincide. A bird's-eye view of the magnetic and geographical poles taken over a long period of time would reveal a spiral path for the magnetic pole, the latter drawing nearer and nearer to the geographical pole.

It is, of course, not necessary to assume a large volume of outer space to have uniform conductivity to produce such effects. An outer layer will suffice, and the conductivity may be uniform or patchy, but the reactions will be of the sign indicated. It is certain that the movements of the magnetic field are not simple as outlined above but are very complex, and that unexpected reversals occur, so that it is not possible to predict the conditions even twenty years ahead. The theory advanced is, however, still capable of explaining the variations, for any conducting layer may not only vary greatly over considerable areas, but there may be relative motion between the earth and portions of the layer which also varies.

ELECTRIC CURRENTS CIRCULATING ROUND THE EARTH.

The next simplest theory to that of a magnetic core is that the magnetic field is due to electric currents circulating round the earth, and this naturally gives rise to the question of the seat of origin of the electromotive forces necessary to maintain such currents. If the currents are uniform in density throughout the volume of the earth, the magnitude of this density would be about 10^{-8} amp. to produce the necessary intensity of magnetisation. If we suppose that there was once a source of electromotive force but it has long ceased to operate, the currents produced would take a very long time to die down owing to self-induction. But it is much more profitable to look for a possible electromotive force not only to produce but also permanently to maintain a current system.

Such a possible source was indicated by Larmor at a meeting of the British Association in 1919. Larmor pointed out that in the case of the sun, surface phenomena indicate the existence of a residual internal circulation mainly in meridian planes. If this circulating conducting material cuts a magnetic field which in direction is the same as that of the earth, circulating currents will be set up in such a direction as to augment the magnetic field, and eventually a condition of equilibrium will be set up between the producing electromotive force and the attenuation effects. The system is, in fact, that of a self-exciting dynamo, and the energy of the system is obtained at the expense of the energy of the circulating conducting material.

While in the case of the earth any internal circulation of matter in meridian planes or near thereto is entirely conjectural, the theory does provide not only for the main field but also for the secular variation by changing the paths of the circulating currents.

Ross Gunn has recently put forward a theory attributing the magnetic field to electrical currents set up inside the earth in the high temperature regions where the thermal motions are considerable. Gunn suggests that the temperature of the inner earth is of the order of 10,000°, and as a consequence the material will be highly ionised and the conductivity correspondingly great. In the case of the upper atmosphere, Gunn has analysed the motions of ions and electrons of long free path spiralling about the magnetic lines of force, and in such a case a diamagnetic effect and drift currents are produced.

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Bristol on Sept. 8.

An extension of the calculation to the inner earth where the free paths are short is made, and it is considered that the primary current system of the earth results from the motions imposed upon ions having a mean free path of the order 10^{-7} cm., the motion being imposed by the internal gravitational electric field at right angles to the magnetic field. The currents produced augment the original field in a regenerative manner.

MAGNETIC EFFECTS ASSOCIATED WITH EARTH'S ROTATION.

Let us consider the possible ways in which a body may by virtue of its rotation act like a magnet. First consider the earth as a body carrying a positive or negative electric charge. If the surface density of the charge be ρ, the magnetic force at the equator parallel to the surface is

$$H_e = \frac{4}{3}\pi\rho r\omega$$

where ω is the angular velocity and r the radius of the earth. If Q is the total charge on the surface, the horizontal magnetic force may be written

$$H_e = Q\omega/3r = \frac{V\omega}{3}$$

where V is the potential. In this case it is obvious that any small sphere charged at the same potential and rotating at the same angular velocity would produce the same surface field, since the radius of the sphere is not involved.

If, however, the charge be distributed uniformly throughout the earth—and this is necessary for uniform intensity of magnetisation—the value of the horizontal field at the equator is $Q\omega/5r$. If the charge on the earth be negative, the resultant field is such that there would be an upward vertical component at the north pole, and a south to north horizontal field at the equator. A field of this type does not exist in practice, the field of the earth being such that its direction is south to north at the equator and vertically downwards at the north pole. Moreover, it is not possible to produce by means of a single rotating charge, fields of the correct sign both at the pole and the equator, for if we change the sign of the charge the resultant fields at pole and equator are also changed in sign.

To overcome the difficulties of a surface charge, Sutherland suggested an equal but opposite charge concentrated at the centre of the earth, thus neutralising the electrostatic field due to the surface charge but not the magnetic effect of the charges in motion. Later he suggested that an inequality in the distribution of the earth's atomic charges might be a cause. There are a number of variants of this idea of separated charges. One is that the rotation of the earth brings about an electric polarisation in the atoms perpendicular to the axis of rotation, such polarisation producing a magnetic and also an electrostatic field. The direction of magnetisation of the field is not, however, that actually observed on the earth, the same difficulty presenting itself as that already considered with the charged sphere.

In 1891, and on several occasions since, Schuster has raised the question whether every large rotating mass is not a magnet, and so far back as 1891 he put forward the suggestion that the sun has a magnetic field associated with it.

The observed similarities between the magnetic fields of the earth and the sun, especially as the physical conditions are so different, naturally lend support to the theory that the magnetisation is brought about by rotation, and the fact that the axes of rotation and magnetisation do not coincide, while disturbing, may possibly be explained by reasonable assumptions.

If rotation of matter is necessary to produce the magnetic fields of the earth and the sun, the angular velocity, the radius, and the density must be important factors. If the magnetic effect is proportional to $D\omega r^2$, where D is the density, the calculated intensity of the sun's field agrees with that observed, taking the earth's field as the standard. Unfortunately, owing to the square of the radius being involved in the expression for the field, an effect proportional to $D\omega r^2$ cannot be tested by experiments in the laboratory, as a value of ω necessary to produce a measurable effect could not be obtained. A magnetic effect proportional to $D\omega r$ can be and has been tested in the laboratory, but the effect is far too small to account for the earth's magnetism.

A theory which has been tested by laboratory experiments is one depending on gyroscopic action. If the magnetic condition of iron arises from the rotation of the electrons in the constituent atoms, the axes of rotation should tend to become parallel to the earth's axis of rotation. The net result so far as the magnetic effect is concerned is to cause each molecule to contribute a minute magnetic moment parallel to the earth's axis of rotation. The effect will be proportional to the angular velocity and not the radius, so that the effect can easily be tested in the laboratory. Barnett first succeeded by laboratory experiments in showing that magnetisation was produced in this way and that the intensity of the field observed was proportional to the angular velocity. The direction and general shape of the magnetic field of the earth could be accounted for by this gyromagnetic theory, but the intensity of magnetisation produced is far too small. The estimated value is about 10^{-11} times that of the earth.

POSSIBLE MODIFICATION OF LAWS OF ELECTRODYNAMICS.

The difficulties confronting such theories as an electrically charged earth and the smallness of the gyromagnetic effect, have led to suggestions that the field may be due to some departure from the commonly accepted laws of electrodynamics.

In 1894 J. J. Thomson pointed out that if atoms exerted slightly different attractions on positive and negative electricity, then a large rotating body could produce a magnetic field. In such case the intensity would be proportional to ωr^2, so that no laboratory experiments could confirm or refute the theory.

Swann, who has put forward a theory based on a slight modification of the laws of electrodynamics, points out that the ratio of the magnetic fields for the earth and sun would be obtained also for an expression of the form $D\omega^4r^4$, since the ratio of the values of ω^4r^4 differs inappreciably from that of ωr^2. According to this theory, spheres of such size that they may be used in laboratory experiments should give effects which are just measurable, and Swann and Longacre have made experiments with a copper sphere 10 centimetres in radius rotating at 200 revolutions per second, but the results obtained differ very appreciably from those calculated on the theory, that is, an effect proportional to ω^4r^4.

VERTICAL ELECTRIC CURRENTS.

There is, however, a possibility that a small portion of the earth's magnetic field may be due to vertical electric earth-air currents, which can easily be distinguished from currents circulating in the upper atmosphere or in regions beyond.

Rücker chose areas in Great Britain where the magnetic forces were well known, and failed to find any evidence of such vertical currents. Dyson and Furner made an examination of data available in 1922, and conclude that although there is some evidence, such currents are not indicated with any certainty. On the other hand, Bauer has made many calculations, and on all occasions has been forced to conclude that such vertical currents do exist.

The probable error, however, associated with the measurements is considerable; but sufficiently precise measurements could be made over a carefully chosen area which would enable a definite decision to be reached with respect to such vertical currents.

DAILY VARIATIONS.

Schuster's analysis shows that the daily variation is probably due to electric currents in the upper atmosphere, but in addition to the magnetic effects of these currents there is an effect due to currents induced in the earth by them. These induced currents are naturally in the opposite direction to the inducing ones, and hence the magnetic effects for the horizontal intensity are additive, while those for the vertical force are opposed.

Chapman's analysis shows the system in the sunlit hemisphere to consist of two closed circuits which (at the equinoxes) may be taken as symmetrical with respect to the equator, their foci lying very nearly on the 11 A.M. meridian. As the electric currents are supposed to be induced by the movement of conducting layers of air in the magnetic field, such currents must also be produced near the ground, but the conductivity of the air near the ground is so low that their effect may be neglected. In the upper regions the movements, while larger, cannot be regarded as immeasurably greater than near the earth's surface, and the increase in current intensity can only be attributed to an increase in the conductivity, a view which Balfour Stewart was forced to adopt, although at the time there was little evidence to support it.

The magnitude of the dynamo effect is dependent on three factors—(1) the horizontal movement of the air, (2) the conductivity of the air, (3) the intensity of the vertical magnetic field. All these factors vary with latitude, and hence it is to be anticipated that the magnitude of the variations will also vary with latitude, which is the case. The intensity of the field can be calculated with considerable accuracy but the conductivity and movements of the upper air are not known, although such movements are attributed to thermal effects and hence will be a maximum in the daytime.

As a first and crude approximation we may imagine a spherical conducting layer to surround the earth, and in addition a conducting hemispherical cap over the hemisphere facing the sun, the height of this cap being a few hundred kilometres. Neither the complete spherical conducting shell nor the hemispherical cap are of uniform conductivity, and the matter constituting these layers moves with the earth, so that ionisation and recombination are always taking place.

While we have from wireless measurements fairly good evidence of the height of the lower conducting layers, our knowledge of the extent of the ionisation is not sufficiently good to enable us to do more than speculate on the merits of the theories advanced, for in addition to the dynamo theory there is due to Ross Gunn known as the diamagnetic layer theory, and a third called the drift current theory. The differences between the theories are best brought out by considering the ionisation effects in the hemispherical conducting cap facing the sun. Pederson has calculated the number of electrons and ions per cubic centimetre at various heights and he and Ross Gunn have considered the nature and magnitude of the conductivity of the upper ionised regions. They have shown that the conductivity varies with the direction of the magnetic field, the conductivity at right angles to the fie being at times very small, and under certain conditions it approaches zero, while the conductivity in the direction of the field is unaffected by the field's intensity. Hence in layers where the conductivity transverse to the magnetic field is very small, such large circulating currents as are necessary for the dynamo effect cannot flow, and where there is an appreciable vertical magnetic field there can be but negligible horizontal electric currents. In the case considered by Gunn, where a charge in its spiral path can execute many revolutions between successive collisions, the spiral motion of the charge has the same effect as a small magnet opposed to the field, so that the whole hemispherical cap is equivalent to a diamagnetic layer, and to this diamagnetism Gunn attributes the diurnal variation. There appears to be no doubt that such a diamagnetic effect does exist, and that it contributes to the diurnal variations, but its magnitude is much too small to explain the whole of the diur variation.

Chapman has shown how the ionisation in the diamagnetic layer contributes far more effectively to the diurnal variation. He shows that the les the contribution made by a charged particle to the

ansverse conductivity (relative to the magnetic ld) the greater is the mean drift velocity which experiences, and in the case of the earth's mag- tic field such drift currents are eastward in direc- on. There is, in fact, a steady drift of electrons nd ions in a direction perpendicular to the lines f magnetic force and the gravitational field.

With regard to the relative merits of the three eories, an effect of the diamagnetic layer appears rtain, but with it is associated the drift current ffect which is much larger. The diamagnetic layer ffect must therefore be regarded as secondary in nportance. The dynamo theory involves motions f the air as well as ionisation, and while on the hole the drift current theory appears to be superior, ore information is needed of the number and istribution of ions and electrons in the upper tmosphere before coming to a final decision.

SUNSPOTS AND MAGNETIC STORMS.

Any unevenness in the radiation from the sun s it rotates must also affect the conductivity and ence produce variations. Examination of magnetic ecords shows that many variations are related to he sun's period and also to sunspot periods, and it ppears not improbable that there is overlapping f several periods probably intimately connected. results obtained show that with rise and fall f sunspot frequency there are corresponding hanges in the diurnal variation. Moreover, the mplitude of the daily changes rises and falls with he intensity of the magnetic disturbance. It lows, therefore, that change in amplitude of the iurnal variation in years of many sunspots is due the same ultimate cause, namely, solar radia- on, as that causing magnetic disturbance.

Magnetic storms are marked disturbances of ar origin, and to explain these many theories ve been advanced, but the facts are not easy of planation. One of the first theories put forward tributed magnetic storms to the magnetic fields duced by streams of charged particles from the n acting like an electric current and producing direct magnetic effect. Schuster showed that ch a stream moving between the sun and the h would move in a magnetic field of constantly creasing intensity, and would be subject to a tarding force also continually increasing. Linde- ann has overcome this difficulty by suggesting lar streams which are ionised but on the whole utral. The groups of particles are assumed to projected from the solar prominences, and the ises in these are of such high velocity, 10^8 cm. r sec., that the journey from the sun to the earth ould be possible in less than two days, without rious recombination taking place. Moreover, ing to its neutrality such a stream will not tend spread outwards by the mutual repulsion of its nstituent particles.

Maris and Hulbert attribute the increase in nsation to the action of ultra-violet light. They nclude that at heights of 300-400 kilometres mperatures of 1000° K. are reasonable, and at ights exceeding 400 kilometres the free paths the particles are very long, the motions due to formal impact considerable, and the ionisation entirely due to the action of ultra-violet light. When the activity of the sun increases it is assumed that there is a tremendous increase of ultra-violet light; thus Maris and Hulbert estimate that if one ten-thousandth part of the solar surface (temperature 6000°) were removed and there were exposed regions of black body temperature 30,000°, the total ultra-violet energy would be increased 10^5 times, whereas the solar constant would be increased by only 1 per cent.

Recently Chapman and Ferraro have suggested that magnetic storms are essentially connected with the approach of a neutral ionised stream towards the earth, the more important changes in the stream taking place in the direction of the sun at a distance equal to a few times the radius of the earth. Retardation of the stream results, and this retardation is naturally greatest at that part of the front of the stream in direct line with the centre of the earth. On either side the stream will advance and partly enclose the earth, and along the sides of the enclosure there will be charged layers due to the polarisation of the stream by the magnetic field. Across the space on the dark side of the earth it is assumed that a westerly current is set up due to charges passing over the space between the charged layers.

NEED FOR MORE PRECISE DATA.

This very hasty sketch of some theories relating to terrestrial magnetism reminds me of Dr. Chree's remarks that the deductions from such theories are just as hypothetical as the theories themselves, and I am very sensible that this rapid survey is not only incomplete, but also that no theory considered is completely satisfactory. Moreover, while fully realising that they are vital links in any chain of evidence, I have avoided the companion subjects of auroræ, atmospheric electricity, and earth currents, because to have considered them would have taken far too long. I do, however, wish to emphasise that data of a precise kind are much needed to modify existing theories and to produce new ones, and I cannot do better than conclude with a remark of Rücker's in Bristol thirty-two years ago. Rücker said: "If there be any who are inclined to ask whether the careful study of terrestrial magnetism has led, or is leading, to any definite results, or whether we are not merely adding to the lumber of the world by piling up observations from which no deductions are drawn, we may answer that, though the fundamental secret of terrestrial magnetism is still undiscovered, the science is progressing. . . . But there are special and cogent reasons why the science of terrestrial magnetism should be cosmopolitan. For those who would unravel the causes of the magnetic movements of the compass needle concerted action is essential. They cannot, indeed, dispense with individual initiation or with the leadership of genius, but I think that all would agree that there is urgent need for more perfect organisation, for an authority which can decide not only what to do but what to leave undone."

The Fifth International Botanical Congress.

NEVER has there been such a large and representative gathering of botanists as was assembled in Cambridge on Aug. 16–23 for the Fifth International Botanical Congress. Of the twelve hundred members who registered, nearly one thousand attended. As was to be expected, Great Britain supplied most members, but the United States of America sent a large contingent, and, including the overseas portions of the British Empire, about fifty-five peoples were represented. The original intention had been to hold the Congress in London, but it was decided that Cambridge would be a more convenient centre.

London, however, shared in the programme. The Linnean Society generously supplied a reception room at Burlington House for the two days preceding the meeting at Cambridge, and threw open its rooms to members of the Congress. In addition, a selection from the Linnean collections was exhibited and members were presented with a descriptive catalogue, which also included an account of the foundation and history of the Society. The story of the efforts of the younger Linnæus to prevent the sale of his father's collections and to preserve them from deterioration; of their offer by his mother to Sir Joseph Banks after her son's death, in order to provide suitable marriage portions for her daughters; of their purchase at Banks's suggestion by James Edward Smith; of the foundation of the Linnean Society and its early meetings at Smith's house in Great Marlborough Street, where the collections were for a time housed; of their subsequent homes, including for many years Sir Joseph's house in Soho Square, until their arrival at Burlington House in 1857; and of their purchase from Smith's executors at a price ruinously increased beyond the original cost, is well told in the pamphlet, which overseas members will value as an interesting memorial.

On the Friday evening a reception was held at the Imperial Institute, where the members were received on behalf of His Majesty's Government by the Right Hon. Christopher Addison, H.M. Minister of Agriculture and Fisheries.

At Cambridge many of the members were accommodated in the colleges, a privilege which was evidently much appreciated, especially by American visitors. The sunny weather which lasted through most of the week showed Cambridge at its best.

The business of the Congress opened with a plenary meeting in the large Examination Hall at Cambridge, where the members were welcomed, in a Latin speech, by the Vice-Chancellor of the University, in state, and by the president of the Congress, Prof. A. C. Seward. At a second plenary meeting on the following Wednesday, two hundred delegates conveying greetings from governments, departments of state, universities, societies, and institutions were presented to the president. At this meeting also Prof. F. A. F. C. Went, of Utrecht, presented an invitation to Holland for the next Congress, to be held in 1935. The invitation was unanimously accepted. Morning and afternoon throughout the week were devoted to sectional meetings, the business closing with a plenary meeting at noon on Saturday.

Apart from the value of the papers and discussions in the sectional meetings, which were well attended, the Congress afforded ample opportunity for intercourse among fellow-workers from all parts of the world. Old friendships were renewed and colleagues known only by correspondence or exchange of papers took human shape, and the reception room (always a centre of activity), social meetings, excursions, and meals in common in the old college halls were media for conversation, discussion, and exchange of ideas.

Serious work was distributed among eight sections—bacteriology, phytogeography and ecology, genetics and cytology, morphology and anatomy, mycology and plant pathology, plant physiology, palæobotany, and taxonomy and nomenclature. A volume of abstracts of the communications, a copy of which was given to every member, facilitated the work of the sections.

An important duty of the Congress was to review the rules of botanical nomenclature. The code of rules formulated at the previous Congresses at Vienna (1905) and Brussels (1910) had been re-examined by an international committee appointed for the purpose at the previous Congress held in America in 1926. The function of the committee was to receive and report on suggestions and resolutions submitted by botanists generally, and the results of its deliberations in the form of a Synopsis prepared by the Rapporteur-général, Dr. John Briquet of Geneva, formed the basis of discussion by the Sub-Section on Nomenclature. It was hoped that certain differences in practice, and more especially the fundamental differences between the majority of workers on one hand and a school representing an important section of American botanists on the other, might be amicably settled, and that the 1930 Congress might witness the achievement of a system to which workers generally would be willing to conform. Pleasing features of the discussions were the evident wish to arrive at a common agreement and the absence of that somewhat polemic atmosphere which was noticeable at Vienna in 1905. Dr. E. D. Merrill, Director of the New York Botanic Garden, presided over the meetings, and, guided by the Rapporteur-général and other experts, the sub-section was able to formulate a revision of the Vienna and Brussels "Rules" which was adopted at the final plenary meeting of the Congress and left to an editorial committee to prepare for press. Especially helpful in securing this revision were the suggestions contained in a code drawn up by the British sub-committee appointed at the Imperial Botanical Conference in 1924, and a series of amendments to the international rules presented by Mr. Rehder, of the Arnold Arboretum.

An important outcome of the discussions on nomenclature was the appointment of a representative International Advisory Committee, to hold

office until the next Congress, which would adjudicate on debatable points in the interpretation of the rules. In the course of the debates the starting-point for the various groups evoked some discussion. While 1753, the date of the first edition of Linnæus's "Species Plantarum", was generally accepted for flowering plants and ferns (excepting fossil plants), later dates were suggested for some groups of cellular plants. To avoid upsetting well established names of genera by the strict application of the law of priority, the principle of lists of *nomina conservanda* was accepted for all groups. The scrutiny of these lists was to be a function of the Advisory Committee. The principle of similar lists of conserved names of species was rejected by a large majority.

Battle was joined afresh on the question of a compulsory Latin diagnosis when describing a new genus or species. The original alternative of the three best-known European languages is no longer tenable with the increasing spread of the study of taxonomy, and the only alternative to Latin was obviously the use of any tongue, a practice which would add to the difficulties of taxonomic work. It was also pointed out that the embodiment in a short diagnosis of the salient points of a genus or species would be helpful both to the author and other workers. The vote on the question indicated an almost complete disappearance of the opposition to Latin; an appeal from bacteriology and palæobotany to be excepted owing to inherent difficulties was, however, allowed. In order to legitimise names already published in a vulgar tongue, the rule will not come into force until January 1932. Another decision was the recognition of standard-species in fixing the identity of genera.

A discussion on methods of furthering the advance of taxonomy emphasised the importance of a broader training for the taxonomist and especially the value of a phylogenetic view-point. The formation of an International Taxonomic Bureau to assist and correlate systematic work and to relieve individual institutions of certain extraneous duties was also adumbrated. The question of finance was a serious factor. The species-concept was the *motif* of joint discussions, with the geneticists in relation to cytogenetics, and with the ecologists in relation to geographical distribution. The ecologists also considered standardisation in description and terminology in the study of vegetation-areas and plant-communities. The morphologists returned to two favourite subjects of discussion, the shoot-unit and the origin of the leaf, and floral organisation with special reference to the carpel. The mycology and plant-pathology section discussed the effect of environment on disease, plant-viruses (with the bacteriology section), and the dissemination of cereal rusts; in connexion with the last-named a resolution was formulated asking the co-operation of overseas governments in the study of these pests of cereal crops. The plant physiology section dealt with protoplasmic organisation and the cell, and problems of growth and nutrition; and the palæobotany section, the antiquity and origin of angiosperms, early terrestrial vegetation, and plants as stratigraphical indices. Life-cycles of bacteria and criteria for differentiation were subjects of debate by the bacteriologists.

In connexion with the various sections, exhibits and demonstrations germane to the discussions were arranged. Evening lectures, including a topical one by Mr. G. F. Hickson on the University of Cambridge and its Colleges, and other subjects of general interest, provided a change from the more specialised work of the sections, which with their differing technicalities of language recalled, as Prof. von Goebel remarked, the Tower of Babel.

The honorary degree of doctor of science was conferred by the University of Cambridge on Dr. John Briquet, Director of the Geneva Conservatoire and Botanic Garden; Prof. Ludwig Diels, Director of the Botanic Garden and Museums at Berlin; Prof. T. G. Halle, Keeper of Palæobotany in the Swedish Natural History Museum; Prof. L. R. Jones, of the University of Wisconsin; Prof. C. J. Schröter, a pioneer in ecology, and Prof. F. A. F. C. Went, Director of the Botanic Garden and Laboratory at Utrecht; and (in absence) Prof. P. A. Dangeard, of the Paris Museum.

Social functions included a garden party by the president and Mrs. Seward in the grounds of Downing College, a reception by the Master and fellows of St. John's, and a dinner in the hall of Trinity College, where overseas delegates were entertained by their British *confrères*. Among the excursions were a whole-day visit to Wicken Fen. A select party visited Halesworth, Suffolk, where a memorial tablet to William and Joseph Hooker was unveiled by Sir David Prain (see NATURE, Aug. 23, p. 287).

Though the business of the Congress finished on Aug. 23, many members availed themselves of excursions and visits arranged from London in the following week. These included visits to Darwin's House at Down, Kent; the Rothamsted Experimental Station; the Royal Horticultural Society's Gardens, Wisley; the John Innes Horticultural Institute, Merton; and the nurseries of Messrs. Sutton and Carter. The Director and members of the staff of the Royal Botanic Gardens, Kew, received the visitors on Monday; and a special exhibit was arranged at the Department of Botany, British Museum, where the keeper and his assistants were in attendance on two afternoons. In connexion with the visit to the Museum a booklet had been prepared explanatory of the exhibits and giving an account of the origin and growth of the botanical collections since the foundation of the Museum as the result of the bequest of Sir Hans Sloane's collections in 1753. Of special interest to overseas visitors were volumes from the Sloane Herbarium containing the early collections from Jamaica and other parts of the New World, and the original specimens which were the basis of Linnæus's first great systematic work, the "Hortus Cliffortianus", and of his "Flora Zeylanica" (1747).

For the success of the Congress and the smooth working of the arrangements in Cambridge and London, special thanks are due to the secretaries, Mr. F. T. Brooks and Dr. T. F. Chipp, and their willing helpers.

The British Association and a Centenary Fund.

IN 1931 the British Association for the Advancement of Science will hold its centenary meeting in London. No more appropriate place of meeting could have been selected. The Association may justly claim to be fully representative of science as a whole within the British Isles; by its overseas meetings it has stimulated scientific activities and focused the aims and interests of scientific workers in the dominions and dependencies. This dual function makes it inevitable that so momentous an occasion in its history should be endowed with a significance which can most fittingly find expression only in the capital city of the Empire.

The imperial character of the meeting and the place in which it is to be held will make serious demands on the organisation and resources of the Association. On normal occasions the annual meeting is a heavy burden, financial and otherwise, on the locality in which it is held. In London expenditure will be altogether on a higher scale. The cost of entertainment of foreign guests and visitors from the dominions and dependencies, if it is to be such as will be regarded as commensurate to the occasion, will be far beyond anything the Association has been able to contemplate hitherto. Without entering into detail, it is abundantly clear that the financial resources of the Association, derived as they are largely from subscriptions which are liable to fluctuation and on ordinary occasions provide no very large margin over the expenses incurred, cannot be relied upon to produce the sum which will be required.

The British Association, having this in view, proposes to raise a fund for its centenary which will be sufficient to meet necessary and desirable expenditure for the meeting. But, in addition, it asks for a sum which will place its finances on a basis adequate for the future development of the Association's approved activities. The appeal was launched at the opening of the recent meeting at Bristol. Everyone connected with scientific work in Great Britain would surely wish that the centenary of the Association should be celebrated with the dignity and circumstance befitting the occasion; but it is perhaps only those who have been intimately in touch with the inner working of the Association who will appreciate fully all that is implied in the reference to the future development of its work.

During the hundred years of its existence, the Association has striven for the advancement of science primarily by promoting intercourse between scientific workers through its annual meetings. By encouraging the attendance of those not specifically engaged in scientific work or even not specially trained in any one branch of science, the Association has endeavoured to extend the interest in science among the public, especially when occasion offers in regard to its practical application to the affairs of everyday life. While a larger public has been made aware of this side of the Association's work through the good offices of the daily press in reporting the proceedings in the sections and at general meetings, it has had little opportunity to appreciate the valuable support given to research by the money grants administered through research committees. These grants, made year by year on the nomination of the sectional committees representative of the various sciences comprised within the Association, constitute one of the greatest, if not the greatest, of its services in the advancement of science. Many of the committees have produced results of national and even international importance. Even though the sources outside the Association from which grants for research are available have increased in recent years, the assistance of the Association is still in demand, especially in the initial stages of research. At the present moment, indeed, the Association maintains some seventy research committees distributed among the various sciences. For some years the Association has disbursed an average annual amount of £1100 on the work of its committees—a sum expended entirely in the actual cost of research, the members of the committees receiving no remuneration for their work. The amount available for these grants is to a great degree dependent upon the amount of the subscriptions received, and in the past has frequently been inadequate to the demands.

It is probable that the public is not aware that the activities of the Association are not confined to the duration of each annual meeting. In the interval between sessions the organisation of the Association is not even solely engaged in preparing for its next meeting, heavy as is the work entailed thereby. The Council is also occupied in giving effect to the resolutions passed at the preceding annual meeting, which are usually of considerable moment and, as they frequently affect public interests or policy, involve the submission of the resolutions to Government departments, administrative bodies, and kindred societies. Further, the Council may be said to hold a watching brief for science throughout the year. It is prepared to take action, if need arises, in all matters in which science may be directly or indirectly affected.

While other aspects of the Association's work must here be passed over, reference may be made to the Association's custody of Down House, the home of Darwin, which will in future entail no inconsiderable expense.

The annual income of the Association at the moment is about £5600, of which nearly a half is derived from the fluctuating annual subscriptions. The amount at which the Association aims for its fund has been put at £40,000. If from the sum raised part is added to endowment, the Association will be placed in a position to assure its activities and extend them in directions which cannot fail to be of advantage to science. In particular, the amount available for research will be increased; the burden of the annual meetings, now so heavy on the place of meeting, may be somewhat lightened, and the imperial obligations of the Association,

which have come increasingly into prominence of late years, may be more adequately met.

It should be scarcely necessary to press the claim of the Association in further detail. The position which it has won by its work during the past hundred years is a sufficient warranty of its deserts and of its fitness to administer wisely any funds committed to its charge. On the ground of its services to science and to the community, the Association has well earned the right to expect the support for which it asks.

The greater part of the Bristol meeting of the British Association was favoured by fine weather, of which full advantage was taken by all the sections. Owing to the easy access of many points of special interest, these purely sectional excursions were more fully organised than is usually the case. The Norman Lockyer Observatory at Sidmouth was visited by a party of physicists and astronomers, while Wookey Hole and the Mendips attracted geographers, zoologists, geologists, and anthropologists. The Forest of Dean was included with other excursions by botanists. In the sections themselves, apart from the presidential address, physicists listened with great interest to a summary of the present state of the theory of cohesion by Prof. Lennard-Jones, who showed that through the new mechanics a most promising theory is at last in the process of development. The subject of the present position of the British dyestuff industry provoked an important discussion in Section B, to which many well-known academic and industrial chemists contributed. The memorial lecture to Dr. Beddoe by Sir Arthur Keith emphasised the important anthropological work which has been and is still being done in Bristol, which Sir Arthur pleaded should be recognised by the foundation of a chair in that subject in the University. Airships, both British and German, naturally attracted engineers in Section G; while members had an opportunity of seeing the gyroplane in action at the new Bristol airport. The largest available theatre was filled for a joint discussion between geology, geography, and anthropology, on the relation between past pluvial and glacial periods, under the chairmanship of Prof. Fleure.

The following were included amongst the foreign guests present at the meeting: *Section A* (Mathematical and Physical Sciences): Prof. R. S. Mulliken (Chicago), M. R. Bureau (Paris), Prof. M. Siegbahn (Uppsala), Prof. Van Vleck (Wisconsin); *Section B* (Chemistry): Prof. J. H. Hildebrand (Berkeley, California); *Section C* (Geology): Prof. G. Delépine (Lille); *Section D* (Zoology): Prof. D. de Lange (Utrecht); *Section E* (Geography): Prof. A. E. Douglass (Tucson, Arizona); *Section G* (Engineering): Prof. A. E. Kennelly (Cambridge, Massachusetts); *Section H* (Anthropology): Prof. E. Fischer (Berlin-Dahlem), Dr. M. Vassitz (Belgrade); *Section K* (Botany): Prof. T. H. Goodspeed (Berkeley, California), Prof. D. H. Campbell (Stanford, California), Prof. W. J. V. Osterhout (New York), Prof. F. A. F. Went (Utrecht).

The total membership for the Bristol meeting was 2650.

The General Committee of the Association has approved the arrangements made by the Council for the centenary meeting to be held in London next year. The president will be the Right Hon. J. C. Smuts, and a long list of vice-presidents prepared by the Council, together with a representative London Committee, was also accepted by the General Committee.

As the Albert Hall will not be available for the inaugural meeting in London, the Council booked the Wesleyan Central Hall and annexes for this meeting. The General Committee approved of this and also of the proposal that the inaugural meeting should be devoted mainly to receiving addresses and other messages, the president-elect finally addressing the meeting. His presidential address will, however, be delivered on a separate occasion, namely, the final evening of the meeting, Tuesday, Sept. 29. The reception room, sectional meeting rooms, etc., will be in and near Exhibition Road, South Kensington, at such institutions as the University of London, Imperial College of Science, Imperial Institute Science Museum, Victoria and Albert Museum, Royal College of Music, and the Royal Geographical Society.

The new members of Council elected by the General Committee are: Prof. H. Clay, Prof. W. T. Gordon, Dr. C. W. Kimmins, Sir Peter Chalmers Mitchell, and Dr. H. T. Tizard.

The meeting of the Association in 1932 will be held at York, and in 1933 at Leicester. The Lord Provost of Aberdeen and the Principal of the University, Sir George Adam Smith, attended the meeting of the General Committee on Sept. 5 to invite the Association to meet at Aberdeen in 1934, and the invitation was unanimously accepted.

News and Views.

THE fact that definitely anti-social actions have been committed under the cloak of rationalisation is responsible for many of the misgivings with which labour regards the rationalisation of industry. Moreover, the displacement of workers by machinery has led to some distrust of science by labour. Labour-saving machinery is too often labour-displacing machinery, and although mechanical science is gradually eliminating from industry many of the most unhealthy and exacting conditions of labour, notably in the mining and metallurgical industries, science is often held responsible for creating unemployment. Labour frequently fails to realise that originative discoveries of science create new demands and open fresh avenues of employment in which displaced labour is absorbed. Such discoveries are, of course, those with which science is most closely associated. In this connexion, addresses such as that given by Sir Richard Gregory on Sept. 7, in connexion with the Bristol meeting of the British Association, before the Bristol Branch of the

Independent Labour Party on "Science and Labour", are particularly valuable at the present time as tending to bridge a gulf which, since the days of Darwin, Huxley, and Kingsley, has gradually developed between science and labour.

SIR RICHARD GREGORY referred in his address to the development from fundamental scientific discoveries, such as those of Faraday and Cavendish, many of which were regarded as of no practical value when made, of a wide range of new industries—electrical engineering, the fixation of atmospheric nitrogen, automobiles, aviation, metallic filament lamps, the gramophone, and the many branches of wireless telephony. In every one of these cases the application of scientific discovery has resulted in increased employment and frequently has been accompanied by an increase in the pleasures of life. It may well be that the future of civilisation largely depends on the ability of science once again to co-operate with labour. Unsatisfactory social conditions are often a consequence of incapacity to use aright the results of scientific advances. Such incapacity is frequently due to the political impotency of scientific workers and their failure to co-operate, and the re-establishment of harmony between science and labour would do much to remove that political weakness. Such co-operation and harmony can, however, only be achieved by scientific workers demonstrating, as Sir Richard Gregory does in his address, that science is not merely mechanical invention but rather creative knowledge which enables man to control his environment, and by their participation in social movements as citizens whose motives are above suspicion and whose knowledge is at the service of the community for the promotion of the greatest good.

PROF. T. E. GREGORY's presidential address to Section F (Economic Science and Statistics) of the British Association, on "Rationalisation and Technological Unemployment", which was read in his absence on Sept. 8, is welcome indication that the Association recognises not only a duty to inform the general public on all scientific advances but also a corresponding obligation to assist in the control and solution of some of the problems created by such discoveries and their applications. The international character of the rationalisation movement and its undoubted effect in most cases in reducing the cost per unit of output make it impossible for any single country engaged in international trade under competitive conditions to contract out of its consequences except at the expense of its international trade. Since rationalisation effects a lowering of real costs, given a desire for a rising standard of life, Prof. Gregory believes there is no reason to suppose that the volume of unemployment will not again fall. The most optimistic view of the situation, however, must recognise that a grave transfer is involved and the difficulties may be accentuated by monetary and other independent circumstances. Scientific workers have no right to delude themselves into thinking that a new era of orderliness will come automatically, and must concern themselves much more seriously about the use or misuse of the new knowledge they have acquired and the social consequences of the improved methods of production which mechanical invention has developed. Increased productivity may tend to enhance the problem of unemployment, even if only temporarily, but it provides society with the margin of lower prices and increased leisure out of which unemployment can be relieved. The better use of the arts of production made possible by scientific methods and investigations is unlikely to endanger the organisation of society unless the process is applied with a wanton disregard of the injury which may be inflicted upon other industries or upon the workers rendered superfluous.

SIR ARTHUR KEITH's Beddoe Memorial Lecture, which was delivered in the course of the meeting of the British Association at Bristol, and of which we print a summary elsewhere in this issue, was an eloquent affirmation of the enduring value of the work of this great pioneer. Beddoe's originality and vision, as well as his patience in inquiry, place him in a rank apart among the greatest of the anthropologists of the nineteenth century. It was only fitting that Sir Arthur should couple his appreciation of Beddoe with a strong plea for the institution of a chair of anthropology in the University of Bristol. The work of the Spelæological Society has shown that enthusiasm for the subject and the true spirit of inquiry are there among the members of the University. Bristol presents opportunities for anthropological investigation that are unrivalled. As a gateway of Britain from the earliest times to the present day it holds a key position. The caves of the Mendips; the lake-villages of Glastonbury and Meare; the traditions of early contact with Ireland, hostile and otherwise; the ethnology, archæology, and folklore of the border counties of Wales—these are some only of the fields in which we should look to the University for enlightenment. Of the practical considerations in relation to civic affairs upon which Sir Arthur touched it is unnecessary to enlarge. To a public-spirited business community such as the City of Bristol, they should carry conviction without further emphasis.

THE report submitted at the Bristol meeting of the British Association to Section D (Zoology) by the subcommittee appointed to inquire into the position of animal biology in the school curriculum is, on the whole, encouraging: for there is evidence that biology is receiving wider recognition as a subject of educational value. It is a hopeful sign that a committee of the Economic Advisory Council has been appointed "to consider the obstacles which stand in the way of the education and supply of biologists for work in this country and overseas, and to submit recommendations for the removal of such obstacles". The British Social Hygiene Council, too, is pressing the claims of biology, and the Colonial Office is awake to the importance of the subject. All the examining bodies, with the exception of the Oxford and Cambridge Schools Examination Board, which is understood to have the matter under consideration, now provide syllabuses in biology for the school certificate examination. The percentage of candidates offering biology in this examination has been steadily

rising for the last seven years, and that of those offering botany as steadily falling. But unsatisfactory features in this report are the statements that the great majority of the biological candidates are girls, very few boys' schools taking biology in the school certificate examination; and that the shortage of men teachers with biological training persists. The vicious circle has not yet been broken down. The report suggests remedially the institution of general honours degrees, which four of our universities do already confer, by all universities as alternatives to the existing special honours courses. To this may be added the recommendation that all colleges in the residential universities should accept biology as a subject in their entrance examination. The refusal of some colleges to do so is a serious obstacle to the supply of biologists.

ON Sept. 5, Section B (Chemistry) of the British Association devoted the whole morning session to a discussion on the present position of the British dyestuff industry. Prof. A. G. Green, formerly director of research of the British Dyestuff Corporation, who opened the discussion, surveyed the position of the industry up to the time of the Dyestuffs (Import Regulation) Act, which came into force in January 1921 for a period of ten years. Since that date, the dyestuffs industry in Great Britain has made great strides; it now supplies 25,000 tons of dyestuffs annually, or about 11 per cent of the world's requirements. While the proportion supplied by Germany, Switzerland, and the United States has remained constant in the past few years, the British contribution has increased from 8·9 per cent in 1925 to 11·7 per cent in 1928. Prof. Green is of opinion that a further period of State assistance is both justified by past progress and by the present world position. Prof. J. F. Thorpe emphasised the need for the production of new dyes for new fibres coming into use, and referred in particular to the inevitable interdependence of flourishing schools of research in organic chemistry and a stable and vigorous dye-making industry. Sir William Pope also discussed the effect the Dyestuffs Act has had in promoting the training of chemists for all branches of industry. The industrial side was dealt with by Mr. J. Morton, of Scottish Dyes, who pleaded that the industry has justified the continuation of the Dyestuffs Act; but Sir Joseph Turner, managing director of the British Dyestuffs Corporation, urged that the Act has served its purpose and should be allowed to lapse.

THE third triennial conference of the Pathological and Bacteriological Laboratory Assistants' Association was held in the Medical School of the University of Manchester on Aug. 25–29. It was opened by Prof. W. H. Lang, pro-vice-chancellor of the University, who expressed appreciation of the skilled assistance rendered by the laboratory assistants in scientific work. Workers often do express their indebtedness to their assistants when contributing to the medical and scientific journals. Prof. Lang hoped that the time was close at hand when the laboratory assistants of other sciences would attach themselves to the Association. The following papers were read at the conference: H. R. Hardie (London), the development of chemistry, from alchemy to biochemistry; P. H. Osmond (Liverpool), the pathogen selective culture method; S. G. Laws (Uganda), a simple flocculation test for the diagnosis of syphilis; R. J. Bromfield (London), equipping a biochemical laboratory and selecting biochemical methods; D. B. Colquhoun (Glasgow), a new method of isolating the typhoid and paratyphoid group from fæces; A. H. Walters (London), the examination of rats for plague in the Port of London; F. Dale (Manchester), Vincent bacilli and spirilli in cervical smears. The subject for general discussion was the training of juniors, opened by Mr. J. McLean (London). Prof. W. Blair Bell welcomed the conference to Liverpool on Wednesday, Aug. 27, and also spoke on laboratory research in cancer investigations. At the conference dinner, Sims Woodhead memorial medals were presented to Prof. A. E. Boycott and to W. A. Mitchell (Cambridge) for conspicuous services to the Association. The attendance at the conference was representative of the widespread organisation, members attending from Uganda, north and western Ireland, as well as all parts of England, Scotland, and Wales.

THE hurricane that reached Santo Domingo on Sept. 3 last is said to have caused many thousands of deaths, to have practically obliterated the capital of the Dominican Republic, and to have given rise to wind speeds so great as 160 miles an hour. Accurate measurements of wind speeds so high as this are not likely to have been obtained, but the material damage done supports the view that speeds of exceptional magnitude even for a tropical cyclone occurred. The large death-roll was evidently due in part to the unfortunate chance whereby a populous city felt the full force of the storm at its height. According to Fassig, the mean path of West Indian hurricanes in September lies to the north of the Leeward Islands and near to the north coast of Haiti. The particulars received so far suggest that the recent storm, at least in its earlier stages, followed a path slightly to the south of the normal track, for Dominica (Leeward Islands) was mentioned as the first island to be affected, and suffered some loss of life, while most of the islands immediately to the north of Dominica were unaffected. It is to be hoped that the full figures for loss of life will not be found to be so great as for the Galveston hurricane that occurred on Sept. 8, 1900, when 3000 people were killed in that town alone, but they evidently do not fall far short of those for the earlier disaster. Even if the storm reaches the mainland with reduced intensity, as predicted, it will rank as one of the very worst in a record that goes back to the fifteenth century.

THE Russian Soviet Union Society for Cultural Relations with Foreign Countries has issued the first number (Jan.–Feb. 1930, pp. 120) of *V.O.K.S.*, an illustrated literary and scientific publication in English. The object of this journal is to acquaint readers abroad with current affairs and cultural development in Russia, and the first issue contains more than

thirty contributions. Most of these are signed articles of general interest, such as, "Women of the U.S.S.R.", by Sophia R. Farman; "Building a New State", by A. Gurowitsch; "Excavations in the Crimea" and "Culture over the Ether", by "E. L." There are also descriptive travel articles on Samarkand, Tadjikistan and Turkmenistan, but the present issue does not devote much attention to scientific matters, although Prof. B. Arendt describes the Soviet archæological expeditions in 1929 and an account is given of the Leningrad Institute of Experimental Medicine and of the work conducted at the laboratory for experimental biology in the Moscow Zoological Gardens.

THE Leningrad Institute of Experimental Biology has undoubtedly performed most valuable work for the Russian people during the last decade. Side by side with the investigations of Profs. Kravkov, Omelyansky, Pavlov, and Vinogradsky, much urgently needed routine work has been performed in connexion with hygiene and sanitation and the preparation and application of curative and preventive serums. Prof. Daniel Zabolotny, president of the Ukrainian Academy of Science and former Commissar for Public Health, was also connected with the Institute of Experimental Medicine until he died recently. An obituary notice of him appears next to an account of the medical research work in progress at Leningrad. Prof. Zabolotny will be remembered for his studies of plague epidemics and the rôle of rodents as carriers of disease. Attempts have been made in several of the contributions to emphasise the progress being made under the *P'atiletka* or five-year plan of economic reconstruction and industrialisation. This is exemplified by "The Non-Stop Week", an article illustrated by the new Russian calendar for January and February, in which there are eleven weeks of five days each—a scheme which, it is claimed, has added sixty working days to the year. It is announced that twenty issues of *V.O.K.S.* will appear annually, the subscription being six roubles, or 12*s*.

THE eleventh International Conference of the Apis Club was opened on Monday, Sept. 8, at 3.30 P.M., in the Apothecaries' Hall, kindly lent for the occasion by the Society of Apothecaries, by Lord Ebbisham, who laid stress on the desirability of promoting apiculture among small-holders and other land workers, and referred to the increasing appreciation in other lands of the work of the Club. Miss A. D. Betts, in her presidential address, recapitulated the history of beekeeping, showing how it appears to have attained its maximum of national importance among the worshippers of the mother-goddess in neolithic or bronze age times. It has gradually fallen to its low status of a century ago through the loss of its religious standing, and by the economic difficulties caused by the substitution of other beverages for mead, the diminution of the wax market at the Reformation, and especially through the effects of the use of sugar upon the demand for honey. She pointed out that modern apiculture is built up upon science and must remain allied with science if it is to prosper, and indicated some of the directions in which apiculture is, or could become, of national importance. The Conference continued throughout the week, Sept. 8–13, and included the reading of papers (at the Crystal Palace, in conjunction with the National Show of Bees and Honey) and an excursion to view the apiaries of Messrs. Sturges and Soden at East Dean, Sussex.

WE have lately received the first three Reports of the National Research Council of Japan. The first number is a reprint of one published in March 1922. The manuscript of the second number, and all the other materials, together with the office of the Council, were destroyed by the great earthquake and fire of Sept. 1, 1923. The issue of the later numbers has been delayed on this and various accounts, and the Council has now decided to bring out four double numbers in quick succession to cover the eight years, 1922–30, after which a single number will be published every year. The work of the Council is divided into eight sections, dealing respectively with astronomy, geophysics, chemistry, physics, geology and geography, biology and agriculture, medical sciences, and engineering, and each section issues its own *Japanese Journal*, except that astronomy and geophysics are combined in one, while that of biology produces separate journals of botany and zoology. The ideal that the Council has set before itself is that all original memoirs on one branch of science shall be published in the same periodical. Also, since papers written in the Japanese language are closed to western readers, authors are pressed to write either in English, French, or German, or if in Japanese to prepare full abstracts in one of these languages.

A CONFERENCE on steel structures research will be held in the lecture theatre of the Institution of Civil Engineers on Oct. 16 next. The purpose of the conference is to promote discussion of the work and objects of the Steel Structures Research Committee of the Department of Scientific and Industrial Research. This Committee has been set up to review existing regulations for the use of structural steel in buildings and bridges, and to investigate the possibilities of more efficient and economical design. In order to ensure the effective application of the results of the Committee's work, it is felt to be desirable at an early stage to enlist the interest and co-operation of various bodies concerned. The conference will, therefore, provide an opportunity for an exchange of views and for a consideration of various suggestions that have been made, in particular the feasibility of formulating a standard practice in the use of structural steel in building throughout Great Britain. Those interested are invited to communicate with the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1.

MESSRS. A. Gallenkamp and Co., Ltd., have written to us in connexion with the Research Item entitled "Electrical Heating in Laboratories" which appeared in NATURE of Aug. 30, p. 326. They have sent us lists No. 75 G and No. 231 F describing small electric furnaces and electrically heated laboratory apparatus which they have been making for several years. We think that apparatus of this type might

advantageously be more widely used in many laboratories in Great Britain. In several districts the cost of electricity has been largely reduced recently and the many uses of electrically heated apparatus should be more generally appreciated.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant teacher of nautical subjects at the Boulevard Nautical School and School for Fishermen, Hull —The Director of Education, Education Offices, Guildhall, Hull (Sept. 16). A bacteriologist and pathologist for the County of Lanark—The County Clerks, Lanarkshire House, 191 Ingram Street, Glasgow, C.2 (Sept. 17). An assistant bacteriologist for the City of Bradford—The Medical Officer of Health, Town Hall, Bradford (Sept. 18). A head of the Building Department of the Leeds Technical College The Director of Education, Education Department, Calverley Street, Leeds (Sept. 25). A lecturer in logic at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, E.C.4 (Sept. 25). A demonstrator in physics at St. Bartholomew's Hospital Medical College—The Dean, St. Bartholomew's Hospital Medical College, Smithfield, E.C.1 (Sept. 27). An assistant research and advisory officer in plant husbandry at the West of Scotland Agricultural College—The Secretary, Blythswood Square, Glasgow (Sept. 27). A principal of the Municipal Technical College, Bath—The Director of Education, Education Office, Sawclose, Bath (Oct. 7). A principal of the L.C.C. South-East London Technical Institute, Lewisham High Road—The Education Officer (T.1), County Hall, Westminster Bridge, S.E.1 (Oct. 11). An assistant in the Cancer Research Laboratories, Bristol Royal Infirmary—The Secretary, Royal Infirmary, Bristol. A Dr. Robert Pollok lecturer in materia medica and therapeutics in the University of Glasgow —The Secretary, University Court, The University, Glasgow. A research assistant, with degree in engineering, under the Research Association of British Motor and Allied Manufacturers—The Technical Secretary, Research Association of British Motor and Allied Manufacturers, 5 Bolton Road, Chiswick, W.4.

Our Astronomical Column.

Eros.—*Circ.* No. 296 of the U.A.I. announces that the first observations of the present very important apparition of this planet were obtained at Neubabelsberg by Dr. G. Struve, as follows:

1930.	U.T.	R.A. 1930·0.	N.Decl. 1930·0.	Mag.
Aug. 26^d	$0^h\ 55^m\ 30{\cdot}7^s$	$3^h\ 33^m\ 4{\cdot}13^s$	$34^\circ\ 25'\ 44{\cdot}6''$	11·8
27	23 44 18·6	3 38 22·47	35 0 35·6	

It was very close to the position indicated by a manuscript ephemeris prepared by Prof. G. Witt, who discovered the planet in 1898. Prof. Witt published an approximate ephemeris for the present apparition in *Mon. Not. Roy. Ast. Soc.*, vol. 85, No. 9. He gives a more precise one for October 1930 in *Astr. Nach.* No. 5729. The perturbations were computed partly by himself, partly by E. Noteboom; he notes that the 1928 observations show a puzzling discordance of some 3·5 sec. in R.A. Further search for its cause is postponed until after the present apparition. The distance of Eros from the earth is now just under a unit. It will be only one-sixth of a unit at the end of January. The magnitude will then be 7; it will be 9·6 on Nov. 1.

Rotations of the Stars.—A recent bulletin issued by Science Service, Washington, D.C., describes some investigations on this subject by Mr. C. T. Elvey at Yerkes Observatory. Provided that the axis of the star is not directed towards us, its rotation causes different portions of the star's surface to have different radial velocities. This produces a widening in the spectral lines. Mr. Elvey selected for examination the magnesium line at 4481, since it is normally sharp and narrow, so that its widening may be mainly ascribed to rotation. The contour of the line is studied by a microphotometer, which exhibits on a large scale the degree of opacity of each portion of the negative. If the whole of the widening of the line is correctly attributed to rotation, the majority of the stars studied are rotating much more rapidly than the sun. The mean rotational speed found for fifty-nine stars is 60 km./sec., about thirty times that of the sun; if a correction were introduced for limb-darkening, the value for the stars would be still greater. Drs. Shajn and Struve deduce that the variable star W Ursæ Majoris has a diameter of 650,000 miles, and rotates in one-third of a day. This, if correct, would produce great ellipticity of form.

Planets and the Sunspot Cycle.—There have been many attempts in recent years to find an explanation of the variations in solar activity by planetary action. The latest is by Mr. Luby in *Astr. Jour.* No. 943. He notes that several investigators have made out a good case for the influence of Mercury, Venus, and the earth on individual spots, but that, to explain the principal cycle we must look rather to the giant planets; the tidal action of Jupiter is twenty-three times as great as that of Saturn, which in its turn bears a still higher ratio to those of Uranus and Neptune. It seems, however, that the length of time through which they act in the same direction raises the action of these last-named planets to an appreciable amount. Mr. Luby contends that the true sunspot period is 11·86 years, agreeing with Jupiter's period of revolution; but that it is subject to disturbance by the three other giant planets, so that it needs a long series of observations to deduce the correct value; he says that Wolf gave too much weight to the rough observations of the eighteenth century, which were made before the sunspot cycle was recognised. It is well to point out, however, that confirmation of the 11·2-year period has been obtained from ancient Chinese observations of sunspots, also by study of the annual rings in old trees; Mr. Luby's period should therefore be received with some caution. As a check on his theory he notes that the present cycle should be an abnormally long one, lasting until 1936. He further suggests that the variation of solar rotation with latitude may also be due to planetary action, comparing the similar behaviour of Jupiter and Saturn.

Mention may also be made of Prof. Dinsmore Alter's work, on the lines laid down by Prof. E. W. Brown, of which a description was given in the *Journal* of the British Astronomical Association for last January. This ascribes the principal term in spot-variation to the combined action of Jupiter and Saturn, but recognises the action of the inner planets in producing variations of shorter period.

Research Items.

Sumerian Copper.—Further analyses of samples of prehistoric and early copper have been made on behalf of the British Association's Committee on Sumerian copper, the report of which was presented at the Association's meeting at Bristol. The number of specimens containing nickel is again to be noted, though no further light is yet thrown upon the sources of Sumerian copper. Specimens from Mohenjo-Daro numbering sixty-four were examined. Most were of copper, showing no traces of nickel, but twenty contained appreciable quantities, the highest being 1·49 per cent and the usual 0·3 per cent, this proportion being similar to that found in specimens from Mesopotamia. Nine specimens were of bronze, the tin ranging from 5·6 to 19·1 per cent. The specimens from the 1927 excavations were richer in nickel than those found in 1926. Specimens from the grave of Queen Shub-ad at Ur contained 0·51 per cent of nickel, while six bronzes from Kish (1928) showed 0·006 to 0·21 per cent with tin from 5 to 15 per cent. Mr. Woolley provided specimens from last year's excavations at Ur of First Dynasty date which showed nickel ranging from 0·165 to 0·46 per cent, while of five further samples from the British Museum two only showed nickel in appreciable quantities—0·84 and 1·61 per cent. The spearhead from the stratum immediately above the flood level, held to be the earliest metal object so far found, proved to be of copper with no more than traces of foreign material. Twenty specimens from Makran furnished by Sir Aurel Stein, in which tin ranged from 0 to 27 per cent, contained no nickel or only traces, except in one specimen, which contained no less than 1·27 per cent. In view of the suggested connexion between South African and Sumerian copper, a number of specimens from South Africa were examined but yielded no support to this theory, and an examination of Chinese bronzes ranging in date from the Chow to the T'ang period also demonstrated that their material appeared to be derived from entirely different sources from that of Sumeria.

Ancestor Cult in Ancient Egypt.—Mr. G. D. Hornblower, in *Ancient Egypt* for 1930, pt. 1, has a further note on ancestor worship in ancient Egypt. In his previous communication Sir Flinders Petrie's identification of the *ka* as an ancestor's spirit was confirmed and amplified. When Egyptian civilisation developed, the ancestor cult took on a form which obscured the essential principle. The cult originated in fear of the dead generally, who if neglected led a miserable existence, for which they might exact vengeance from the living. From this it was only a step to the loving care of the family for the spirits of the forefathers. In Egypt it was the sons, and especially the eldest son, who were responsible for carrying out the periodical funerary rites; and offspring were greatly desired to ensure the continuance of the funerary offices. The connexion was very close, and a son on receiving an injury would call on one or both of his parents for help. A dead husband or dead wife was addressed in the same way. Ancestor cult eventually culminated in the king, as the son of the strongest and greatest of the ancestors and the source of fertility. The king himself became a god. Thus, when in the sixth Dynasty the king assumed the title "Son of the Sun," it was with the political object of extending to the new sun worship the popularity of the earlier cult of the great ancestor Osiris, while by a compromise it was conceived that the king had two fathers, the sun and Osiris.

African Fresh-water Fishes.—Mr. Henry W. Fowler ("The Fresh-water Fishes obtained by the Gray African Expedition 1929." With Notes on Other Species in the Academy of Natural Sciences of Philadelphia. Vol. 82, 1930), in continuation of his studies of fishes from the Academy collections, describes a very interesting series obtained by Mr. Prentiss N. Gray on his recent expedition to equatorial Africa. Mr. Gray was accompanied on the expedition by Mr. W. W. Bowen representing the Academy as field collector, and valuable fishes were secured of twenty-five species, twelve of which are new to science. These belong to the Characidæ, Cyprinidæ, Clariidæ, Pœciliidæ, Anabantidæ, and Cichlidæ. There are detailed descriptions and good text figures, in many cases showing striking variations in marking. Besides Gray's fishes, other African fresh-water fishes from the Academy Collection are also described, including those from Lake Rudolph, collected by Dr. A. Donaldson Smith, and from Angola and Chilosngo, chiefly in the Quanza basin, purchased from Dr. W. J. Ansorge. Amongst these are two species of Polypterus, *P. bichei* and *P. senegallus*, in both of which variation of the head scales is shown.

Diurnal Migration of Plankton in Japanese Lakes.—Dr. Kenzo Kikuchi in his paper "A Comparison of the Diurnal Migration of Plankton in Eight Japanese Lakes" (*Memoirs of the College of Science*, Kyoto Imperial University, Series B, Vol. 5, No. 1, Article 3, 1930) records the results of his investigations in six freshwater lakes, one brackish and one of sea-water, the last closely connected with the Japan Sea by means of a small canal. With very few exceptions there is a distinct diurnal migration on the part of the plankton, and this is of several types, but the type is not constant for the species in all the lakes, the vertical distribution of the plankton in the daytime being presumably affected by the turbidity of the water. In a few cases temperature seems to determine the upper limit of both the diurnal vertical distribution and the nocturnal ascent. The upward movement of Crustacea takes place when the intensity of sunlight is changed. It is found that the younger forms of *Diaptomus pacificus* and *D. japonicus* are distributed nearer the surface than the old animals in the daytime and also they appear on the surface earlier in the evening, whilst the reverse is true in the order of leaving the surface in the morning. The nauplii of *Diaptomus* and *Bosminopsis* in Lake Kizaki have three maxima on the surface, in the evening when the sun sinks, after sunset, and at dawn. Other species have two maxima or one only. *Sagitta* and certain Crustacea are most abundant near the surface a few hours after sunset. Tables are given of the physical features of the lakes, the temperature, oxygen content, and hydrogen ion concentration, and in two cases the chlorine and hydrogen sulphide, taken on the same day as the plankton catches, also of the diurnal changes in the number of individuals and vertical distribution in the various planktonic species in the different lakes.

Origin of Nepheline-Syenite.—The nepheline-syenite gneisses and associated rocks of Dungannan Township, Ontario, are shown by F. F. Osborne to have had a complex origin; in part due to consolidation of magmas; in part to *lit-par-lit* injection; and in part to metasomatism (*Am. Jour. Sci.*, July, 1930). The sequence of differentiation in the granite and nepheline-syenite pegmatite dykes shows a remarkable parallelism. The evidence suggests that the parent magma of the nepheline-bearing rocks did not have the high content of volatile materials that has been claimed by some petrologists as a necessary factor in the genesis of such rocks. It is suggested that during the

formation of schists there is an elimination of the constituents that do not form foliated minerals, and that some of these constituents are those in which nepheline-syenite is rich. If they could reach a magma, they would necessarily modify its composition in the required direction. A similar suggestion for the origin of the spilitic suite of albite-rich rocks has been offered by Holmes (*Geol. Mag.*, p. 277, 1927). Both are supported by the work of Cooke on the constituents eliminated during thermodynamic metamorphism (*Museum Bull.* 46, Geol. Surv. Canada, p. 22, 1927).

The Disappearance of the Huronian.—Under this title T. T. Quirke and W. H. Collins describe the results of an investigation to ascertain what became of the Huronian formations of the Pre-Cambrian of Canada east of the line north-eastward from Killarney (Georgian Bay, Lake Huron) against which they seem to end (*Mem.* 160, Geol. Surv. Canada, 1930). They find that vestiges of the Huronian, highly metamorphosed and merging into gneisses of igneous aspect, do occur east of the line. The gneisses graduate in turn into massive granite from which it is not practicable to separate them. The authors suggest that the granite is mainly derived from parts of the transformed Huronian sediments which became liquid, while the gneisses were produced without reaching the fluid state. Structural considerations indicate that some of the belts north-west of the line were once buried about six miles and that the country to the south-east represents a still deeper section of the earth's crust, probably one of the deepest to be seen anywhere on the earth's surface. The gneisses and granites are called Killarnean. Sills and dykes of probably Keweenawan diabase (quartz-dolerite) preceded the intrusion of the Killarnean batholiths, and scattered dykes of fresh olivine-diabase followed. These facts show that the problems of the correlation and succession of the Canadian Pre-Cambrian are still very far from being solved.

Carthaginian Lenses.—The July issue of the *British Journal of Physiological Optics* contains a communication from Mr. H. L. Taylor on "The Origin and Development of Lenses in Ancient Times", which ascribes the development of the lens to the Cretans of 1800 B.C. His examination of the contents of museums of the eastern Mediterranean has led him to the conclusion that ivory and steatite, the materials used for beads prior to 2000 B.C., were replaced at a later period by rock crystal, onyx, agate, and cornelian. The discovery of the magnification produced by a bead of rock crystal led to the production of lens-shaped beads, and eventually of lenses such as those of the "royal gaming board" found in the palace at Cnossus and to the perfect lenses, found also at Cnossus and at Mount Ida, now in the museum at Candia. They are all plano-convex with powers between 5 and 8 diopters. The Phœnicians appear to have carried such lenses to the mainland, to Troy, Tyre, Nineveh, and Britain. At Carthage five glass lenses have been unearthed at the ancient necropolis, two of them, of power 5·5 diopters, in the sarcophagus of a prominent individual, who it is presumed suffered from presbyopia and wished to protect himself against this disability in his next existence.

Iridescent Colours.—In a paper in the August issue of the *Proceedings of the Royal Society*, Lord Rayleigh, after describing in some detail his experiments on the origin of the iridescent colours of birds and insects (see NATURE, vol. 125, pp. 211 and 474), discusses the action of light and of chlorine on these. The phenomena are complex, and perhaps the only generalisation that can be made is that stability of a colour under the chemical action of chlorine is a proof that no pigment is involved. The colours of the moth *Urania ripheus*, of the *Morpho* butterflies, and of metallic beetles survive such treatment, and there is much in favour of regarding these as interference colours. In other instances, such as that of the peacock's feather, where there is definite evidence that the colour is a structure effect but it is nevertheless affected by light, the conclusion reached is that the action of the latter probably consists in a photochemical destruction of the materials going to build up the structure. In another case, faded and unfaded parts of a *Morpho* wing were exposed to ultraviolet light, and it was found that the latter fluoresced, whereas the former did not; it seems likely that what had been destroyed in fading was some fluorescent body, itself colourless, which was built up into the colour-producing structure. A number of the properties of the peacock feather still remain to be explained.

Polar Properties of Ice Crystals.—In spite of its importance, there is still little general agreement on the crystallography of ice, largely because of the difficulty experienced in producing authentic single crystals. Prof. J. M. Adams, in some work described in the *Proceedings of the Royal Society* for August on crystals of microscopic dimensions, has obtained evidence that they are polar. When these were observed in an atmosphere favourable to their disintegration, individuals were occasionally found which, although possessing the simple external form of a short right hexagonal prism terminated by basal planes, nevertheless developed a pit at one end only of a certain axis (the *C* axis). In addition, two other types of disintegration were found with crystals of the same external form, one characterised by a pit at each end of this axis, and the other by a cavity at the middle, these being explicable as due to the two possible modes of twinning on the basal plane. Prof. Adams points out that there is further evidence for polarity in the form of certain rod-like snowflakes which appear to be pointed only at one end, whilst others, terminated at both ends by basal planes, look as if they have grown by the union of two of the former, point to point, and ascribes the polarity tentatively to an asymmetric location of hydrogen ions in a non-polar oxygen lattice.

Wave-Length of Hydrogen Atoms.—Although the wave-properties of electrons are now so well established that a 'camera' has been described for the application of electron diffraction to the investigation of structure (Prof. G. P. Thomson, August issue of the *Proceedings of the Royal Society*), very few experiments have been performed which show the undulatory nature of atoms or ions. The fact that the proton and electron of a moving hydrogen atom are together equivalent to a wave is, however, demonstrated by an investigation of the reflection of atomic hydrogen by lithium fluoride, described by T. H. Johnson in the issue of the *Journal of the Franklin Institute* for August. The hydrogen atoms were generated in a discharge tube, and after passing through a collimating system, were reflected from the crystal on to a target coated with white molybdenum oxide (MoO_3). This is reduced to a blue lower oxide where the atoms are incident, and so gives a permanent record which can be examined visually or photographed. So far only first order diffraction patterns have been obtained, with rather poor definition, but the wave-length of the atoms calculated from these is in accord with theory. Lithium fluoride is of special value for this work because it appears to retain any hydrogen atoms

which are not immediately reflected for a sufficient length of time for them to recombine to molecules, which do not then affect the target.

Alkali Photoelectric Cells.—The second July number of the *Physical Review* contains a paper by A. R. Olpin, of the Bell Telephone Laboratories, on the properties of photoelectric cells in which the alkali cathode has been coated with a film of a simple dielectric or an organic dye. Most of the substances studied have been found to increase considerably the sensitiveness of the cell to red and infra-red light, their action being accompanied by the appearance of a new maximum in the spectral response curve for the composite surface, to the long wave-length side of the single important maximum in the curve for an untreated surface. The frequency difference between the maxima is often about the same as that of the $1 \cdot 5\ \mu$ infra-red vibration of the oxygen–hydrogen, carbon–hydrogen, and nitrogen-hydrogen linkages, and it is suggested that there is a real connexion between this vibration-rotation frequency of the molecules and the changes in the properties of the surfaces. One important fact which emerges incidentally from this investigation is that many of the substances used to sensitise photographic plates also increase the electron current of a photoelectric cell, and, at least in some instances, affect primarily the same spectral regions. Einstein's equation for the maximum energy of emission of photoelectrons has been found to be valid for composite surfaces exposed to near infra-red radiation.

Transmission of Short-Wave Beams.—If the wavelength of a radio beam is less than about ten metres, experiments have shown that it will act in a very similar way to a light beam. These beams follow the inverse square law and obey the ordinary laws of refraction. In addition, obstacles of every kind appear to produce shadows. In a paper in the *Wireless World* for July 23, Dr. F. Noack describes experiments on the transmission and reception of these beams recently carried out in Germany. Messrs. C. Lorenz, of Berlin, in conjunction with Prof. Esau, of the University of Jena, have made experiments with a transmitter placed on the peak of the Brocken, in the Harz Mountains, at a height of 1140 metres. It was found that reception was best north-east of the Brocken, where the country is more or less flat and from whence the peak can always be seen. According to theory, the range would be about 110 kilometres, the distance of the visible horizon. At first the transmitter was erected at ground level on the Brocken, and it was found that the range varied between 76 to 100 metres. It was noticed that all over the range the signal strength was practically constant. Beyond this range it decreased with extraordinary rapidity, the width of the region over which this rapid decline took place being about 10 kilometres. It seems probable that in this region reception is no longer carried out by the aid of direct radiation, but is due to indirect refracted rays. It seems highly probable that the range of reception depends mainly on the distance of the horizon from the transmitter. Further experiments at a height of 500 metres, the transmitter being placed on a tower 16 metres high so as to cut out possible 'earth' effects, confirm this conclusion.

Indium.—The element indium, although widely distributed, occurs only in very small quantities and it is usually recovered from zinc blendes and flue dusts. In the *Chemical News* for July 18, Dr. G. Druce describes the preparation of indium sulphide from the black residue left after generating hydrogen sulphide from commercial ferrous sulphide and sulphuric acid. About half a gram of the element was obtained from about 150 lb. of the commercial iron sulphide.

The Geber Problem.—The question of the authorship of the Latin treatises ascribed to Geber and their relation to the Arabic chemical works of Jabir ibn Hayyan has been somewhat complicated by a discussion as to the authenticity of the latter. In a note in *Forschungen und Fortschritte*, July 10, Prof. Ruska announces the results of an investigation of some hitherto unknown writings of Jabir published by Dr. Holmyard in 1928. He concludes that the whole system of Jabir's writings are of Ismaelite origin.

Ignition of Carbon Monoxide.—A criticism of the work of Smithells, Whitaker, and Holmes on the above subject, reference to which was made in NATURE of April 5, p. 545, has been published by Bradford and Finch in the July number of the *Journal of the Chemical Society*. The authors describe experiments which lead them to consider that the experiments of Smithells, Whitaker, and Holmes were vitiated by the circumstance that the dielectric strength of the mixtures of carbonic oxide detonating gas with water vapour and with hydrogen were different. The conclusion of the previous experimenters, that hydrogen is more effective than water vapour in conferring ignitibility, is considered to be valid.

Adsorption by Silica Gel.—In the July number of the *Journal of the Chemical Society*, D. C. Jones and L. Outridge describe experiments on the adsorption by silica gel in the system *n*-butyl alcohol and benzene. Measurements on the adsorption both from the liquid and vapour phases were made, and the difference between the true adsorption as defined by Williams and that given by the equation of Ostwald and Izaguirre is attributed to capillary adsorption. The concentration of the solution thus adsorbed is shown to be equal to that of the equilibrium solution, in agreement with theory. Success in the measurements was possible owing to the use of a new method of analysis devised by D. C. Jones, which could be used with both very dilute and very concentrated solutions. The main theoretical point of interest of the paper is probably the use of the assumption that a certain amount of internal gel solution, varying considerably with the equilibrium concentration, is adsorbed not by the solid but owing to the liquid capillary forces, and in experiments where the adsorbent is immersed in the solution, or where the adsorption is from saturated mixed vapours, this portion will have the same concentration as the equilibrium solution.

Complex Soil Colloid.—Most of the information at present available concerning the colloidal complexes existing in the soil has been derived from consideration of the analogies in behaviour which such complexes exhibit when compared with similar complexes prepared by synthetic methods. In the *Rendiconti* of the *Reale Istituto Lombardo* for the present year (Parts 2-5), Dr. C. Antoniani describes a soil colloid containing 93 per cent of organic matter which he has succeeded in separating directly from soil. This substance maintains a constant composition, even after dialysis, and is regarded as homogeneous. In an acid medium it coagulates when the *p*H value is equal to or less than 6, whilst peptonisation occurs for values below 8; the isoelectric zone is included between these limits. The complex is composed of three distinct individual colloids of humic, silicic, and ferric character, the last being electropositive and protected. The protective influence is exerted by both the electronegative constituents, but mainly by the humic colloid.

Soils and Fertilisers in South Africa.*

By Sir FREDERICK KEEBLE, C.B.E., F.R.S.

THE problems of South African agriculture which await solution fall into two groups—those of arable and those of grassland. Of the two, the problems of grassland are potentially of greater importance.

GRASSLAND.

The grasslands of South Africa are poor and barren. Over vast areas the scant herbage serves scarcely to cover the ground even during the growing season. It turns brown and grows yet scarcer during the dry season. There are green hills in Natal and green pastures, and even in regions of low rainfall after summer showers the brown herbage grows green again. There are large areas of grassland in which the spring herbage is luxuriant and nutritious, but as spring advances the feeding value of the grass declines and cattle have often to submit and succumb to conditions of starvation.

It seems to be universally assumed that this state of affairs is due to lack of water and that it can best be remedied by introducing from other countries grasses of greater powers of resistance to drought. Much work of great interest along these lines, both on irrigated and non-irrigated land, has been done in South Africa, particularly by Dr. Pole-Evans at Pretoria. He has shown that it is possible to establish many grasses from other parts of the world and to obtain large amounts of food for stock from them. But the suggestion which has now to be made casts doubt upon this method as being the most important means of rejuvenating the pastures of South Africa. This suggestion is that many of the troubles attributed to drought are more properly to be ascribed to mineral deficiency. The hunger of the soil for phosphates is only one symptom, albeit a most important symptom, of these deficiencies. The land, or much of it, also lacks lime, and although the lack is well known, little is being done to remedy it. Yet lack of lime may prove to be a limiting factor of yield on both arable and grassland. Many officials maintain that the addition of lime depresses yield, and fail to consider that this in itself may be a passing symptom of a deep-seated trouble and want. It is encouraging therefore to report that both in Natal (Cedara) and in Rhodesia (Salisbury) experiments are now being carried out which point to benefits from liming.

With an insufficiency of lime and phosphates in the soils the herbage must perforce be deficient in these essential materials; the yellow or pale green colour of the grass betokens that it lacks nitrogen: and it is certain that there are also deficiencies in potash. What other deficiencies there are of other more obscure elements which may prove to be important only further research will show.

It is suggested that all these deficiencies have been brought about by simple cosmic processes.

South Africa is the stem of a funnel, the mouth of which is the equator. Of all that teeming life bred in the warmth and moisture of the tropics there must from time to time, as bees swarm, have migrated hordes of all kinds of animals. Debarred by the desert from invading the north, these migrant hordes have gone ever southward. Sometimes the grasslands which these migrants invaded were lush with spring grass and sufficed to feed the beasts; but at other times when the sun was fierce in summer and the growth of grass stood still, there was lack of herbage. Thus pushed by hunger the herbivora grazed the pasture bare to the bone. The grass over-grazed became worn and thin. Like a garment too much used, the herbage became rent, and through the rents rains, often of torrential violence, pierced and swept away the soil, aggravating the effects of over-grazing. So the vicious circle was completed and remains complete to the constant impoverishment of South African soils.

Any traveller in the Union may see the rivers leap to life in the rains which attack the earth, carve it out and bear it away, and run red with the soil washed from the land. He may likewise see in the veldt-burning practised by farmers yet another aid to soil impoverishment: for though burning brings young and sweet and early grass, the partial sterilisation of the soil which it produces releases the little store of hardly won organic nitrogen which is absorbed greedily by the young grass in the flush of its spring growth. The soil is soon depleted, so that long before drought imposes its veto, growth wanes and the veldt becomes brown and bare and barren. Flocks and herds are decimated, and the patient farmer praying for rain fails to realise that he himself offered them as a burnt-offering to the god of ignorance.

Under these conditions of over-grazing and erosion an age-long struggle for existence must have waged among the plants of South African grassland, and the struggle must have been of ever-increasing intensity as the soil became more and more depleted of its mineral contents and its nitrogen compounds. In this struggle those grassland plants with larger requirements of minerals and of nitrogen were the first to succumb. They ceased to be members of the grassland community but, retiring from the unequal struggle, continue to survive here and there in those favoured mineral oases wherein their larger mode of life finds satisfaction. The struggle is still going on, and now only the most niggardly of the plants, mean in what they get and what they give, survive. Except for a brief period in the flush of spring they yield but little sustenance to the animals which graze upon them.

If this picture of the evolution of the grassland of South Africa be true, conclusions of fundamental importance follow. The first of these conclusions is that the restoration of South African pastures is possible. The second conclusion is that the way of improvement lies in the restoration to the soil of conditions under which plants of larger requirements and higher nutritive value may live. The third conclusion is that the picture of the decadence of grassland in South Africa, although more vivid, is none the less identical with the, albeit more drab, picture presented by the world as a whole. The factor which has determined the trend of evolution in this as well as in earlier geological epochs is the decreasing supply of minerals stored in the grasslands and arable fields of the world.

Deficiency of nutritiveness of the plants of arable crops means deficiency of nutrition in man and beast, which in turn means disease, and it may be that the wealth of animal diseases which Africa possesses is but another symptom of the gradually lowered vitality of living things due to gradual decrease in the supply of essential minerals.

If this be true, then in grassland management with its insistence on the restoration of minerals there are means of arresting the downward trend of evolution, or at least of slowing down the rate at which nitrogen

* From a paper read before Section M (Agriculture) of the British Association at Bristol on Sept. 5.

and phosphorus escape, the one into space, the other into the abysms of the ocean.

Whether these large conjectures prove true or no, the first two conclusions require brief consideration. If it be true that a restoration of minerals to the soil brings about a return of plants of good grazing value, we shall have a most important vindication of intensive grassland management. For the general principle underlying the intensive management of grassland is that conditions may be provided wherein more nutritive native and introduced plants will flourish. That it will prove possible to transform the grassland of South Africa is rendered probable by the remarkable results which Mr. T. D. Hall's small scale experiments on grassland in different parts of South Africa have already achieved.

These experiments show:

(1) That grassland in South Africa responds in an almost magical way to nitrogen.

(2) That the relation between nitrogen and phosphates which obtains in grassland is the reciprocal of that which obtains on arable land. Though a dressing of phosphates adds but little growth to that produced by a single dressing of nitrogen, a dressing of phosphates added to a double dressing of nitrogen brings about a marked increase. The explanation would appear to be that the grassland plants surviving to-day are able to extract even from the impoverished soil just enough phosphates to live on; but in that grassland there is not enough nitrogen to go round, and so growth languishes until additional nitrogen is supplied. Addition of more nitrogen produces little effect. Addition of more phosphates as well as more nitrogen gives rise to a further increase in growth.

(3) The treatment of grass with a complete fertiliser together with lime gives the largest response.

These experiments suggest the conclusion that a brilliant future awaits South African grassland. It is even safer to conclude from them that our knowledge of the proper fertiliser treatment of grassland is only just emerging from the empirical into the scientific stage, and that the investigation of the nitrogen-phosphate balance with potash in attendance will lead to the discovery that grass can be made far more productive than is at present supposed.

The opinion that grass will play an important part in the future of South African agriculture is reinforced when South African rainfall is considered. Much of South Africa is a land of summer rainfall. Grass is the opportunist among plants; it grows during growing weather and dies down when conditions are unfavourable to growth. A drought may cut off an arable crop in its prime, but it can rarely do more than check the growth of grass. Experiments now being conducted in Natal, at the Cedara School of Agriculture, lend confirmation to the view that grassland in South Africa will respond to intensive management no less readily than the grassland in Great Britain. Mr. R. A. Fisher's experiments show that even a grass (*Paspalum* sp.) reputed by farmers to be of low grazing value, responds to fertilisers so remarkably as to produce enough food during the grazing season to enable one cow to yield 1000 gallons of milk.

One more suggestion may be made with respect to nitrogen on grassland. Owing to the intensity of the struggle for existence, grassland plants must always be hungry for nitrogen. Such nitrogen as grassland contains, and for which the plants have perforce to scramble, is derived from the breaking down of organic nitrogen compounds. The breaking down proceeds by orderly stages until compounds of ammonium are formed. The nitrifying bacteria then convert the ammonia first into nitrites and then into nitrates. It is usually believed that all plants of grassland, hungry as they are for nitrogen, wait passively until nitrate is formed before they attempt to supply their wants. It would seem more likely, however, that with capacities sharpened by the struggle, there would emerge from among some of the grasses the capacity to absorb nitrogen in the form of ammonia, or even in organic form, and such plants would be victorious in the struggle for existence. It may therefore be predicted that amongst grassland plants, some at all events may be found which possess the power of obtaining nitrogen in the form of ammonia, and it may prove that the grass family is distinguished from other plants by this capacity.

The dicotyledons, including the common weeds of pastures, can obtain nitrogen only in the form of nitrates, and to them ammonium compounds are poison. But the grass plants are able to utilise and thrive on the nitrogen obtained in the form of ammonia. Two facts support these suggestions. The first is that sulphate of ammonia and ammonium phosphates have a lethal effect upon the common weeds of grassland; the second, that sulphate of ammonia is at least the equal of nitrate nitrogen in calling forth the growth of grassland in spring. This equality is difficult to explain if the common view be accepted that before ammonia can be utilised by the plants it must first be converted into nitrates.

The power of sulphate of ammonia to evoke early growth of grass would be self-evident were it to be proved that ammonium compounds are the proper nitrogenous food for grass, and, needless to say, such proof should be of great value. Of no less value should be the proof, if it can be obtained, that ammonium phosphate is the right fertiliser to use on a plant which responds markedly to a proper balance of nitrogenous and phosphatic fertilisers.

ARABLE LAND.

The arable crops of South Africa are poor. The yield of maize in the Union is on the average three bags to the acre, that is, about one-third of a crop even when measured by American standards. Poor cultivation is in part responsible for low yields, far more so indeed than seems to be realised in South Africa. Other limiting factors are water and phosphatic deficiency, and it is a general obsession in South Africa that most of the agricultural troubles from which that country suffers are due to lack of water. Science should aid effectively in curing this obsession. It has already shown that in spite of low rainfall, crops can be produced if the deficiency of the soil in phosphates be made good. But even after applications of phosphates the crop remains small, and the expert attributes the low yield to insufficiency of water. In this he is partly, albeit only partly, right. When he adds nitrogen on the top of his phosphates the result is often disappointing, and he draws the conclusion that nitrogen, by encouraging the growth of leaf and stem and thereby increasing the loss of water from the plant by transpiration, does more harm than good by making the limited amount of water in the soil still more insufficient. For this reason the expert and the farmer avoid using nitrogen. Sometimes an additional reason is advanced; namely, that nitrification goes on so quickly in South African soils that there will always be enough nitrogen available when the plant needs it.

The latter explanation may be considered briefly and dismissed. South African soils are desperately poor in organic matter. Organic matter is the sole source of supply of natural nitrogen. If the source

of supply of natural nitrogen is almost non-existent, to believe that nitrification can supply enough nitrogen to the plants is to believe in the making of bricks without straw; albeit that it is possible to hold, as has been suggested, that the plant residues in the soil supply just enough material to permit of an amount of nitrogen fixation sufficient, and no more than sufficient, to make good the annual loss through nitrification.

The extreme poverty of South African soils in humus and the essential part which organic matter plays in the feeding of crops are facts which those interested in the use of fertilisers must take into careful consideration. Observations in South Africa have led me to propound some ideas which may throw light upon the rôle which organic matter plays in the soil. Hitherto it has been believed that the chief virtue of organic matter, apart from its physical effect on the soil, lies in the nitrogen which it supplies. Experiments made in South Africa on irrigated land are claimed by their authors to show that, whereas the addition of inorganic nitrogen produced no increase in crops, the addition of even so small an amount as 1 ton per acre of Kraal manure brings about marked crop increase. It is difficult, although perhaps not impossible, to believe that a small quantity of nitrogen in organic form is more beneficial to plants than a larger quantity of inorganic nitrogen. It is more reasonable to seek the benefit of the Kraal manure in the carbon which it contains, and it may be conjectured that the chief chemical rôle of organic matter is to supply carbon for the soil bacteria, and particularly for those soil bacteria which are engaged in nitrogen fixation. This consideration suggests a line of research of practical importance. If carbon in organic form be proved to play such an important part in enhancing soil fertility, it may become necessary to use as a 'filler' in the manufacture of complete fertilisers some cheap waste product rich in organic carbon. There are expert growers, some of them among the best in the world, who act empirically as though they held this view and use always large amounts of organic matter together with artificials in order to produce large crops of fruit and vegetables.

Considerations of the bacterial changes in the soil lead to yet a further suggestion; the wattle growers in Natal have proved that phosphates give a much larger growth of the tree than is obtained without their use. Now in a fairly wide excursion throughout South Africa, one of the few signs of nitrogen plenty was shown in the green-black colour of the leaves of wattles treated with phosphates. The dark colour suggests that the wattles have received plenty of nitrogen. But the soil is poor in nitrogen. Therefore the trees must have obtained it from the nitrogen-fixing nodule organism which infects the roots.

Inquiry showed that on the roots of the phosphate-treated trees the nodules are far larger than on the roots of trees without added phosphates. Phosphates are known to encourage nitrogen-fixing bacteria, but it is now suggested that these latter organisms are no less intimately connected with phosphates than they are with nitrogen; in other words, that they not only bring nitrogen from the air into organic combination, but also that they do the like for the phosphates of the soil. If so, these nitrogen-fixing soil bacteria are the foundation-stones of soil fertility and their prevalence is determined first by the supply of organic carbon in the soil, and secondly by the supply of phosphates.

In support of this suggestion it may be mentioned that the nodule-forming nitrogen-fixing organism of clover is said to possess the power (denied to other grassland plants) of obtaining its phosphates from insoluble sources — a belief which could be easily verified. If it be true, it should be possible to balance, as a juggler does balls, the clovers and grass constituents of a pasture by supplying phosphates now in soluble now in insoluble form. If this possibility were achieved it would have great practical value. All these things considered, it may prove that although South African soils are at present poor, their defects can be gradually remedied by the systematic use of fertilisers containing nitrogen and all the essential mineral elements as well as carbon compounds in a suitable form.

Another and extraordinary fact lends confidence to this prediction. Trees of many kinds and in the different States of the Union—Natal, Orange Free State, and Transvaal—grow with far greater vigour than they do in Europe. This fervour of growth is attributed in South Africa to water. It cannot be: for water could at best make the trees grow only as fast as they grow in Europe and not faster. Therefore among contributing causes to the vigour of growth not the least must be larger supplies of minerals. Unlike surface-rooting plants, trees can dive deep in the soil and from the deepest layers recover the phosphates which have vanished from the surface.

Lastly, there remains to consider the second of the two alternatives already mentioned in explanation of current failure of nitrogen to give increased crop production on land treated with phosphatic fertilisers; this suggestion may be stated thus. The amount of phosphates given to crops is 200 lb. to the acre —an extremely light dressing. The soils of South Africa are desperately hungry for phosphates. There is no reason to suppose that 200 lb. per acre satisfies their needs, especially for such a phosphate-greedy crop as maize.

Lack of phosphates may still be limiting crop production, and if so the addition of nitrogen would certainly do more harm than good. A double dressing of phosphates is known to give further increase of crop yields, but there is no reason why even a double dressing should completely make good phosphatic deficiency. There is evidence that 800 lb. or 1000 lb. to the morgen goes on increasing yields; and it is therefore suggested that the fundamental experiment is one in which a phosphate-needing plant (for example, maize) is grown in a series of soils which receive from 200 lb. to 1200 lb., or more, per acre together with a uniform light dressing of inorganic nitrogen, in order to ascertain whether when phosphate deficiency is completely remedied, nitrogen does not begin to come into beneficent operation.

With that experiment should be made an inquiry into the morphological effect of phosphates, that is to say, the effect of phosphates on modifying the relative growth of the root system and the shoot system. Phosphates are known to encourage root growth. It is suggested that with progressive increases in phosphates root growth may be more and more increased with the corresponding discouragement of stem growth. That would mean that the plant becomes both a more and more efficient collector and a greater and greater economiser of water. For with increased root more water is absorbed, and with reduced leaf and stem loss of water from the plant is reduced. If this proves indeed to be the case, then a changed technique might vindicate nitrogen as a crop producer in the dry soils of South Africa. The change would consist in regulating the amount of nitrogen in relation to the phosphates and in applying it as a top-dressing after development has proceeded to a certain extent, and not as at present with the seed. Along with this series of experiments there should be another which would analyse more

completely than has yet been done the well-established fact that fertilisers increase water economy in the growing plants. It has been shown in India and elsewhere that when fertilisers are supplied to plants economy in the production of dry matter is increased. But at the same time the total amount of dry matter may be so increased as to make more demands upon the soil water-supply than are made by the plant which receives no fertilisers. One of the most important problems before scientific agriculture must therefore be a working out of the most water-economising ration of artificials to be supplied to different kinds of plants.

There are also experiments to be made in discovering varieties of maize and corn which will respond to fertilisers more effectively than those now grown, and there are also other genetical experiments which need to be carried out designed to discover races with male inflorescences which will continue to produce pollen over a long period, so that even if drought comes there may still be some pollen left after rain has restored growth to the plant.

There are other experiments of no less essential importance in relation to liming - a practice which is neglected in South Africa—and there are yet others: to seek in carbon fixation carried on in uncropped soils the origin of the amazing renewal of fertility which fallowed fields display.

This sketch of the scientific problems which await solution shows incidentally how closely the future of the industry of agriculture depends upon the advances of pure science, and suggests how important it is for that industry both to encourage the investigations and to take part in them.

I found South Africa in large part barren land; if the ideas with which it has inspired me are true, they may yet make it fertile. I myself believe that a great future lies before that country, for I think that on those high uplands so near the skies and so richly irradiated by the sun the plants and the animals derive greater sustenance from the irradiated foods than do the animals of lower altitude and lesser suns. I believe, moreover, that in that great mineral deficiency which has been described lies the original source of all those troubles which South Africa endures. It is, I believe, defective nutrition that has brought in its train the many maladies which afflict man and beast. If so, when the grass is restored to its full vigour animals will renew their youth and defeat the attacks of now victorious parasitic pests. On those parts of South Africa from which those parasites are banished the trees grow stronger than they do elsewhere, the men and women are sturdier, and even the flowers are more exuberant and more substantial than they are when we grow them under our sadder skies.

Anthropology—Old and New.*

WHEN we look back to the times in which Dr. Beddoe lived and worked and note the doings of the men who were searching into the beginnings of the British people, we see that we owe more to him than to any other anthropologist of the Victorian epoch. It was he who laid our present knowledge upon a sure basis. He set out in his youth to find an answer to an age-old query: Of what race or races are we British?

Dr. Beddoe was born in Galton's 'brain-belt', which, passing from Liverpool to Swansea, includes the English counties bordering on Wales. Bristol is indebted to this belt for many of her most distinguished citizens. It gave her Dr. James Cowles Prichard, who made England famous in the annals of anthropology in the first half of the nineteenth century. This belt coincides with an old ethnological frontier across which Saxon and Celt have freely exchanged their heritage of blood; and it was their place of birth which turned the minds of Prichard and Beddoe to the problems of race.

Beddoe while still living in his father's house at Bewdley listened to discussions concerning the Celts, especially as regards their colouring. No one, he discovered, had made a census of the colouring of the people called Celts or of any other race of mankind. He determined to investigate the colouring of the British races by exact methods. He entered into a virgin field of investigation, and it was necessary for him to invent methods of making records of colour of hair, eyes, and complexion. He began his investigations at the age of twenty, and visited Ireland, Wales, the Highlands of Scotland, the Orkneys and Shetlands, and France in the pursuit of his investigation. The Crimean war, in which he served as a medical man, and a subsequent period of study at Vienna gave him the opportunity of observation in the Baltic, the Near East, Croatia, Styria, and Italy. When he settled down to practise in Bristol in 1857 there was no one in Europe had his exact knowledge of the western peoples. There was not a single year between 1857 and 1891, when he retired to Bradford-on-Avon, that Dr. Beddoe did not carry out an anthropological raid of some kind—on the Continent, or in Ireland, Wales, Scotland, or England.

There was another side to Dr. Beddoe's inquiries. There were many in Dr. Beddoe's day who feared that industrialism would ultimately undermine the health and strength of the people of England; but he was one of the few to pass from speculation to actual inquiry. So he set himself to measure height, weight, size of head, colour of hair and eyes, not only of every stratum of the population of Bristol, but also of the open-living inhabitants of surrounding counties. From his results there emerged a suspicion that city life was shortening stature and favouring the lighter rather than the darker haired types.

Beddoe was the first to ascertain how city life affects racial types. He found that far from the type becoming uniform under the influence of city life, there was a tendency to segregation of types: the racial traits which prevailed among business men were not those which marked the artisan. In the selection of their mates, the men of Bristol preferred blondes to 'reds' and 'blacks'. Disease and conditions of industrial life, on the other hand, favoured those who had a dark complexion rather than those who were fair-skinned. Emigration was selective; it tended to rob Bristol of its best. Beddoe perceived that the effects produced by city life on the body and mind of man presented problems which could be solved only by patient and careful inquiry. It is this side of Beddoe's pioneer labours which needs to be stressed. We cannot be comfortable concerning our future until we know what is happening to us. A city population cannot stand still. The medical officer keeps his finger on the pulse of public health; there should be an anthropologist to keep his finger on the pulse of type—physical and mental. Beddoe's work on the population of Bristol should find its logical outcome in the institution of a chair of physical anthropology in the University of Bristol.

Dr. Beddoe devoted the spare time of his manhood to amassing data concerning the colouring and other physical traits of the peoples of western Europe—

* Abstract of the Beddoe Memorial Lecture delivered by Sir Arthur Keith, on Sept. 5, in connexion with the Bristol meeting of the British Association.

particularly of the communities of the British Isles. What was the net result of all this labour? The gain was two coloured anthropological maps—one of the British Isles, another of Europe. It may be felt that Dr. Beddoe's 'unequalled perseverance' had a meagre reward. That is not the case; these two maps are the most valuable contribution ever made to our knowledge of the history of the inhabitants of western Europe. Dr. Beddoe was born in a period when men believed that all that can be really known about the history of our ancestors was in the works of ancient writers. Dr. Beddoe was the first to show us that our racial history is written in our hair, eyes, skin, skulls, faces, and temperaments.

It is the business of anthropology to gather from every source facts which throw light on the origin and nature of nationalities and races. Dr. Beddoe performed this service for Britain in a way that no one has done before or since. How do we treat men who render our country such a signal service? In 1885 Dr. Beddoe published his greatest book, "The Races of Britain". Into this book he compressed thirty-two years of devoted labour. Yet no one proclaimed then what the book was—and what it still remains: the greatest treasury of anthropological fact which has ever appeared in any language. How can amends best be made? Orthodox honours came his way but were not commensurate with his deserts. In what way can we honour his memory better than by seeking for the means to establish in the University of Bristol a chair of anthropology? Beddoe was the great amateur in his chosen subject. With the present century anthropology reached the stage in which professionalism became imperative. In order that a professional anthropologist may live, a university must provide him with a chair. In return he gives a service of knowledge to the university and to the community in which that university is situated. Dr. Beddoe's teaching and example are not dead, and there awaits the occupant of a chair of anthropology in the University of Bristol an infinite number of problems which need solution.

From 1810, when Dr. Prichard began practice, until Dr. Beddoe's death in 1911, Bristol was known throughout the learned capitals of Europe as a centre for the study of the human races. In Bristol the time is ripe—more than ripe—for the institution of a faculty of anthropology. No university, no city, no locality can rival Bristol in the opportunities it offers for the scientific study of mankind. Above all, the institution of a chair of anthropology in its University is an act of justice due to the memory of a great citizen—the late Dr. John Beddoe.

University and Educational Intelligence.

THE Worshipful Company of Woolmen has awarded a silver medal to Mr. F. F. Darling, of the University of Edinburgh, whose thesis on "Studies in the Biology of the Fleece of the Scottish Mountain Blackface Breed of Sheep" is considered as likely to prove basic to all future studies on both this particular breed of sheep and on other breeds in general. The Company has also awarded a silver medal to Mr. N. H. Chamberlain, of the University of Leeds, for a thesis upon "The Thermal Conductivity of Textile Materials and Fabrics". Certificates of merit have been awarded to Miss Emma Stott, of the University of Leeds, for "A Contribution to the Theory of Milling: a New Method of Measuring the Scaliness of Fibres", and to Mr. N. Cryer, of the University of Leeds, for a thesis on "Variation in Spindle Speed".

THE London County Council has again arranged courses of lectures for teachers, and a Handbook has been issued which includes synopses of the courses (County Hall, London, S.E.1). Last year the entries for these courses exceeded 14,000. Any person engaged in teaching in London, Croydon, Kent, Middlesex, or Essex is eligible for admission at fees which average less than 1s. a lecture, while other teachers are admitted at fees 50 per cent higher. The lectures undoubtedly form an important part of the educational system in London, for they bring teachers into touch with new developments in educational methods, and give them opportunities of hearing leading authorities in various branches of learning. Readers of NATURE will be interested in the following courses: Five special single geographical and travel lectures, by Mr. A. Victor Murray, Mr. J. A. Steers, Major R. W. G. Hingston, Dr. T. F. Chipp, and Dr. L. Dudley Stamp; and the courses on types of geographical regions (Dr. J. F. Unstead); geography in senior schools (Mr. R. H. Ducé); history of geographical discovery (Prof. E. G. R. Taylor); mathematics in senior schools (Sir Percy Nunn); practical mathematics in senior schools (Mr. J. A. Phillips); psychology of the junior pupil (Prof. Cyril Burt); fundamentals of psychology (Dr. J. G. Vance); vocational guidance (staff of the National Institute of Industrial Psychology); science teaching in senior schools (Mr. G. H. Leslie); physics in senior schools (Prof. C. R. Darling); biology in senior schools (Miss C. von Wyss). The attention which is being given to the needs of teachers taking up the new post-primary work is noteworthy. It is stated that the loan collection of lantern slides at the County Hall now exceeds one hundred thousand.

HIGHER education in the United States forms the subject of a symposium published in vol. 69, No. 5, of the *Proceedings of the American Philosophical Society*. This comprises an address by Abraham Flexner and papers by Frank Aydelotte and F. J. E. Woodbridge. The first surveys the conditions, actual and probable, of the advancement of knowledge (*a*) by individuals working independently, (*b*) through academies and associations of specialists, (*c*) through research institutions devoted to specific ends, (*d*) through foundations that award stipends for research, and (*e*) through universities. Under the headings (*a*), (*b*), and (*c*) the conditions are pronounced to be propitious. As regards (*d*), Dr. Flexner emphasises the increasing difficulties in the way of proper selection of stipend holders. He devotes the latter part of his address to a trenchant criticism of the "heterogeneous conglomeration of useful and useless, of important and trivial activities, now carried on under this term—university", which he likens to a metropolitan drug store. For the moment the trend in universities is away from what seems to him sound, natural, and ideal and towards what is unsound, unnatural, and unideal. The other two papers deal only with college administration. Both recognise the existence of the evils deplored in Dr. Flexner's address and offer constructive suggestions for combating them, the former by means of a tutorial system for students who have demonstrated their capacity to profit by it. This system has been in operation for some years at Dr. Aydelotte's own college, Swarthmore, with the happiest results. Dr. Woodbridge develops a plausible argument for scrapping half of the ordinary college curriculum, simplifying and strengthening the remainder for the explicit purpose of pre-professional training for the professional schools, and utilising the financial saving thus effected for expanding the calibre of the staff.

Historic Natural Events.

Sept. 14, 1716. Thames Dry.—After an excessive drought, which continued from February to the end of August, a strong west-south-west wind prevented the tide from coming in for 24 hours, so that there was only a narrow channel some 10 yards wide, and so shallow that thousands of persons passed across on foot, under the arches of London Bridge.

Sept. 14, 1899. Floods in Austria.—Heavy rains fell on Sept. 8–14. At Mühlau the fall on Sept. 12 was 11·3 in. in 24 hours, and the total for the six days exceeded 24 in. The Danube rose to a level nearly 25 feet above the low-water stage at Vienna and nearly twice this amount in some other localities. The floods, which were exceeded only by those of 1501, did great damage.

Sept. 15–17, 1929. Thunderstorm near Channel Islands.—A remarkably severe thunderstorm raged almost without cessation over a small area near Dinard and the Channel Islands from 6 P.M. on Sept. 15 to 4 P.M. on Sept. 17, accompanied by violent winds from the north-east. There was considerable damage both by lightning and flood; the power station at St. Brieux was put out of action, and at Dinard an Englishman was blinded. A bridge on the main Dinard-St. Lunaire road was swept away and a motor-car crossing at the time was washed out to sea. St. Lunaire was flooded to a depth of two feet and the streets torn up.

Sept. 16, 1363. Beginning of Severe Winter.—According to various old chronicles, a "very terrible" frost continued from the middle of September into April. Holinshed, quoting "Walsingham and other old writers", says Dec. 7–Mar. 19. In Paris the frost began on Dec. 6 and lasted 14 weeks. The Rhine was frozen from Jan. 5 to Mar. 17, and waggons were driven over the ice. In France the winter was very snowy.

Sept. 17, 1882. Great Comet.—On this day, the great comet, visible to the naked eye in full daylight, was followed telescopically right up to the edge of the sun by Mr. Finlay (the discoverer of the comet on Sept. 7) at the Cape of Good Hope Observatory. Even the nucleus was quite invisible, however, as the comet crossed before the sun's disc. At Melbourne the comet was watched with the unaided eye to within 4° of the sun. By Sept. 24, it was visible with a tail 15° long in the bright dawn. Success in photographing this comet and its background of stars at the Cape Observatory under the direction of Sir David Gill was an important factor in the inception in 1887 of the Astrographic Chart and Catalogue. The period of the comet is 761 years.

Sept. 18–19, 1926. Florida Hurricane.—Early on Sept. 18 the south-eastern coast of Florida from Miami to Palm Beach was struck by an intense hurricane, which on the previous day had ravaged the Turks and Caicos Islands. The centre, moving towards the west-north-west, passed almost over Miami, where the official barometer fell to 936 mb. (27·65 in.). During its approach the wind reached hurricane force (75 miles per hour and upwards) for nine hours, and the greatest velocity is estimated as 130 miles per hour. Then, as the centre passed over, there was a lull and large numbers of people, not realising that a second phase was coming, ventured out, to be caught when the wind rose again to hurricane force in the rear of the centre. The strength of the wind is shown by the nature of the damage; an 18-story skyscraper recently completed was twisted so badly that it had to be demolished, and another tall building was bent over twenty degrees from the vertical. Yachts and small ships were lifted bodily on to the land. After passing Miami the hurricane curved away to the north-west, striking the Gulf Coast between Mobile and Pensacola on Sept. 20 and dissipating over eastern Texas on Sept. 22. In Florida 327 persons were killed and more than 6000 injured, and the damage to property probably exceeded 100,000,000 dollars, and was greater than in any previous hurricane in the United States.

Sept. 19, 1387. End of Hot Summer.—The summer in Europe was extraordinarily dry and hot and was proverbial for centuries as "The Old Hot Summer". From Feb. 28 to Sept. 19 it rained only six times in Switzerland, and men waded across the Rhine at Cologne. The year was not especially dry in England.

Sept. 19, 1540. Drought.—After a calamitous year, fine weather and heat lasted from February until Sept. 19, during which interval scarcely any rain fell in Europe.

Sept. 20, 1909. Storm Wave through Yucatan Channel.—A tropical hurricane of great intensity and large extent passed through this Channel on Sept. 17 and struck the coast of Louisiana a short distance west of New Orleans on Sept. 20. A great storm wave swept inland, and the water, checked by the swamp forests and levees, reached a depth of 7-10 ft. over a large area to the right of the centre, including New Orleans. The damage to property caused by this storm exceeded six million dollars and 353 lives were lost.

Sept. 20, 1929. Hurricane in West Indies.—This disturbance was first reported about 300 miles north of Porto Rico on Sept. 20; at that time it was of moderate intensity, but by Sept. 24 it had reached hurricane force. It was, however, chiefly noteworthy for its abnormally slow rate of movement and aberrant track. From Sept. 24 to Sept. 28 it actually moved in a south-westerly direction across the Bahamas and through Florida Strait near Miami. At Nassau, Bahamas, on Sept. 25 a violent westerly gale caused a 'hurricane wave' which destroyed the sea wall and flooded the town, carrying away many houses. Many others were unroofed, stores, churches, and shipping were damaged, and many lives were lost. In Florida the damage was much less, and the centre was evidently decreasing rapidly in intensity, but at Miami there were a number of waterspouts and at Key Largo the wind velocity during gusts was estimated as 150 miles per hour. From Miami the centre moved very slowly north-westwards to Panama City near Pensacola, where a few wharves and stores were destroyed on Sept. 30.

Societies and Academies.

PARIS.

Academy of Sciences, July 21.—**G. Bigourdan**: The astronomical stations of Châtillon-sous-Bagneux.—**L. Blaringhem**: The heredity of the phases of flower opening in poppies.—**F. Mesnil**: The adaptation to man of the trypanosomes pathogenic to mammals. The author considers that it has been experimentally demonstrated that a trypanosome of animal origin, such as *Tr. brucei*, can adapt itself to man.—**M. Aubert** and **R Duchêne**: The propagation of combustion in carburetted mixtures.—**G. Bruhat** and **J. Terrien**: The comparative absorption of active and racemic acids in aqueous solution. Between the wave-lengths 2653 A. and 2400 A., if racemic acid absorbs light differently from solutions of the active acids, the deviations are always less than 4 or 5 per cent in one direction or the other, and the average of

the results shows that the absorptions are practically identical. These results confirm those deduced by Darmois from polarimetric measurements.—**Daniel Chalonge**: The mechanism of the continuous emission of the hydrogen molecule.—**H. Ollivier**: The thermal variation of the specific magnetic rotatory power in the case of cerium nitrate and nickel chloride.—**F. Joliot**: The determination of the period of radium-*C*′ by Jacobsen's method. Experiments with thorium-*C*′. —**Horia Hulubei**: The preparation of very pure hydrogen in notable quantities by means of an electrolytic osmoregulator with palladium. The palladium tube of an osmoregulator is saturated with hydrogen by electrolysis of phosphoric acid, the anode being arranged so that the palladium tube is not altered in shape. By afterwards heating this tube, relatively considerable quantities of hydrogen are introduced into the vacuous tube.—**Picon**: Rendering some salts of camphocarbonic acid soluble in organic solvents. Various camphocarbonates, rendered anhydrous by prolonged exposure in a good vacuum over phosphoric anhydride, were examined for their solubilities in organic solvents. Some of these (neodymium, cerium, bismuth, gold) are readily soluble in organic solvents, others (copper, calcium, zinc, lead) when anhydrous are practically insoluble. But boiling with benzene, with subsequent removal of all the benzene, renders these salts more or less soluble in organic solvents.—**Mlle. M. Montagne** and **B. Casteran**: The action of potassium hypobromite on some trisubstituted amides. The α-trisubstituted amides give good yields of iso-cyanates when submitted to the Hofmann reaction; subsequent treatment with hydrochloric acid gives the corresponding amines in quantitative yield.—**Jean Gubler**: The geological structure in central western Cambodia (Indo-China). **A. Marin, M. Blumenthal,** and **P. Fallot**: Stratigraphical comparisons between the western extremity of the Betic and Penibetic zones of Andalusia and the north of the Riffian arc.—**Louis Besson**: The daily variation of rain at Paris. A discussion of twenty years of observations made at the Observatory of Montsouris. The mean daily variation has two maxima and two minima, and this is due to two different causes, the daily convection currents and the nocturnal cooling.—**M.** and **Mme. H. Labrouste**: The relation between certain periodical components of the solar activity and the daily amplitude of the magnetic declination.—**Couvreur**: Preliminary note on the structure of the shells of Gastropods.—**Alb. J. J. Vandevelde** and **Alfr. Verbelen**: New biochemical researches on earth. The dye absorption method gives very variable results with the same earth, even with the same dye; results using methylene blue were the most concordant, but further study is necessary. The adsorptions of dye, peptone, and centrifuged milk were compared. The three methods gave roughly comparable results. **M.** and **Mme. A. Chauchard**: Researches on the relation between functional velocity and chronaxy.—**Raymond-Hamet**: The comparative physiological action of aspidospermine and quebrachine. In opposition to the usually accepted view, the alkaloids of *Aspidosperma Quebracho* must be classed in two different pharmacological groups. The experiments described show that the total alkaloids of this plant can act at once on the vagus nervous system and on the sympathetic nervous system. This suggests a new therapeutic application of these alkaloids.—**G. Belloc, R. Fabre,** and **H. Simonnet**: Contribution to the study of the biological activity of the sterols. Study of the plankton sterols. From two samples of plankton, taken at different periods of the year, the sterols were extracted and purified, care being taken to exclude the action of air and light so far as possible. These sterols were submitted to physical (absorption in the ultra-violet), chemical, and biological tests. One, collected in July, was biologically active; the other, collected in April, only acquired biological activity after irradiation. The biological activity of the plankton depends on several factors, the chief of which are light and the zoological nature.—**Mme. Y. Khouvine, E. Aubel,** and **L. Chevillard**: The activity of sodium fluoride towards the transformation of pyruvic acid into lactic acid.—**H. Colin** and **E. Guéguen**: The constitution of the sweet principle of *Rhodymenia palmata*. This is shown to be a monogalactoside of glycerol; the fresh alga may contain up to 5 per cent of this substance.—**M. Marcille**: The injection of formolated ether into the lymphatics of cancerous tumours. Injection of ether containing 0·5 per cent of formol is proposed, and one case in which it proved beneficial is described.

CAPE TOWN.

Royal Society of South Africa, June 18.—**H. H. Karny**: On the geographical distribution of the Indo-African and Mediterranean Gryllacoids. Seven subfamilies are considered, representing the forms occurring in the regions under consideration. In the case of the *Stenopelmatinæ* and *Anostostominæ* there is a discontinuous distribution. In the case of the other subfamilies, some forms are endemic in India, but all other forms occurring in India show relationships to those found farther east, where more species also occur.—**B. F. J. Schonland**: Thunderstorms and the penetrating radiation. An examination of the effect of thunderclouds upon the intensity of the penetrating radiation, using a new type of ionisation-electroscope, was made at Johannesburg, in the summer of 1929–1930. Overhead storms give rise to a reduction in intensity, amounting to so much as 40 per cent. No evidence could be obtained for the existence of beams of 'run-away' electrons below these clouds. The reduction effect indicates that the majority, if not all, of the ionising particles have energies less than 5×10^9 electron-volts.—**Enid Hogben**: Sex differences in serum calcium in different classes of vertebrates. In the rabbit, dogfish, and crawfish, the calcium content was higher in males than in females, but the difference was not statistically significant. In the fowl and toad, the calcium content was significantly higher in females. In the rabbit, fowl, and toad, magnesium determinations gave parallel results to those of calcium. In the crawfish the magnesium content of the serum was significantly higher in females. In the dogfish the magnesium content of the serum gave a wide range of values. This variability may be connected with the different stages of the reproductive cycle in the female.

MELBOURNE.

Royal Society of Victoria, July 10.—**T. Rayment**: New and remarkable bees. *Meroglossa miranda*, a West Australian species with maxillary palpi larger than the antennæ, was described. Also the first recorded female of *Neopasiphae mirabilis*, from the Best collection in the National Museum. Other descriptions include *Paracolletes maculata*, *Neoceratina rubinii*, *Trigona cockerelli*, and the allotypes of *Halictus demissus*. An emendation of *Melitribus* is given.—**C. J. Gabriel**: Catalogue of the land shells of Victoria. The records of previous authors are here brought up-to-date and a critical revision of the species made. Eight new species are described.—**W. J. Parr** and **A. C. Collins**: Notes on Australian and New Zealand Foraminifera. (1) The species of *Patellina* and *Patellinella*, with a description of a new genus, *Annulopatellina*. A trimorphic variety of *Patellina corrugata*

is recorded, resembling *P. advena* Cushman. A new species, ***Patellinella annectens***, is described. The new genus, ***Annulopatellina***, is founded on the genotype *A. annularis* (Parker and Jones).—**F. Chapman and Irene Crespin**: Rare foraminifera from deep borings in the Victorian Tertiaries. Six new species and a new variety are described.

Official Publications Received.

BRITISH.

Canada. Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Test and Research Laboratories), 1928. (No. 711.) Pp. ii+166. (Ottawa: F. A. Acland.)

The Central Library for Students (from March 1930 onwards, The National Central Library). 14th Annual Report of the Executive Committee, 1929-30. Pp. 50. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 23: The Feeding Mechanism, Formation of the Tube, and Physiology of Digestion in *Sabella pavonina*. By Dr. E. A. T. Nicol. Pp. 537-598+2 plates. 8s. 6d. Vol. 56, Part 3, No. 25: Metamorphism in relation to Structure in the Scottish Highlands. By Dr. Gertrude Lilian Elles and Dr. Cecil Edgar Tilley. Pp. 621-642+2 plates. 4s. Vol. 56, Part 3, No. 26: Reports of the Jasper Park Lakes Investigations, 1925-26. The Molluscs of Jasper Park. By Alan Mozley. Pp. 647-669+2 plates. 3s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1929. Pp. 36+4 plates. (Jamaica: Government Printing Office, Kingston.)

Report of British Delegates of the Meeting of the International Council for the Exploration of the Sea, held in Copenhagen, June 1930. Pp. 11. (London: Ministry of Agriculture and Fisheries.)

Madras Fisheries Department. Administration Report for the Year 1928-29. By Dr. B. Sundara Raj. (Report No. 1 of 1930, Madras Fisheries Bulletin, Vol. 24). Pp. vi+103+6 plates. (Madras: Government Press.) 1.4 rupees.

The Journal of the Institute of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 404, August. Pp. 945-1088+xxviii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 42: Report of the Irish Radium Committee for the Year 1929; including Reports by Dr. Oliver Chance, Andrew Charles, Oswald J. Murphy, Dr. Walter C. Stevenson, C. M. Taylor and Josephine Walsh. Pp. 475-489. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 12, 1929. Pp. iv+220+3 plates. (Sheffield.)

Proceedings of the Cambridge Philosophical Society. Vol. 26, Part 3, July. Pp. 285-428. (Cambridge: At the University Press.) 7s. 6d. net.

British Non-Ferrous Metals Research Association. Tenth Annual Report for the Year ending December 31st, 1929. Pp. 57. (Birmingham.)

Research Association of British Motor and Allied Manufacturers. Tenth Annual Report of the Council for the Year ending 31st March 1930. Pp. 7. (London.)

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 31st May 1930. Pp. 372. (London.)

The Quarterly Journal of the Geological Society. Vol. 86, Part 2, No. 342, July 31st. Pp. xlix-cxlvi+129-330+15 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

FOREIGN.

Report of the Aeronautical Research Institute, Tokyo Imperial University. No. 62: Acoustical Properties of some Sound Collectors for the Aircraft Sound Locator. By Jûichi Obata and Yahei Yosida. Pp. 231-247+plates 25-27. (Tokyo: Kôseikai Publishing Office.) 0.15 yen.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. New Land Shells from the Solomon Islands. By E. G. Vanatta. Pp. 263-264+1 plate. (Philadelphia.)

The Cleveland Museum of Natural History. Annual Report for the Year 1929. Pp. 39. (Cleveland, Ohio.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 191: The Geiger Tube Electron Counter. By L. F. Curtiss. Pp. 115-128. (Washington, D.C.: Government Printing Office.) 5 cents.

The Academy of Natural Sciences of Philadelphia. Special Publication No. 3: Gabb's California Cretaceous and Tertiary Type Lamellibranchs. By Ralph B. Stewart. Pp. 314+17 plates. (Philadelphia.) 3.50 dollars.

Smithsonian Miscellaneous Collections. Vol. 82, No. 8: Four New Raccoons from the Keys of Southern Florida. By E. W. Nelson. (Publication 3066.) Pp. ii+12+5 plates. (Washington, D.C.: Smithsonian Institution.)

Bulletin of the National Research Council. No. 76: Handbook of Scientific and Technical Societies and Institutions of the United States and Canada. Second edition. American Section compiled by Clarence J. West and Callie Hull; Canadian Section compiled by National Research Council, Canada. Pp. 352. (Washington, D.C.: National Academy of Sciences.) 3 dollars.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 1, July, R.P. Nos. 183-193. Pp. 211. (Washington, D.C.: Government Printing Office.) 40 cents.

Field Museum of Natural History. Museum Technique Series, No. 3: Restoration of Ancient Bronzes and Cure of Malignant Patina. By Henry W. Nichols. Pp. 51+11 plates. (Chicago.)

Proceedings of the American Philosophical Society. Vol. 69, No. 4. Pp. 117-256. (Philadelphia.)

Smithsonian Institution: United States National Museum. Bulletin 152: The Cancroid Crabs of America of the Families Euryalidae, Portunidae, Atelecyclidae, Cancridae and Xanthidae. By Mary J. Rathbun. Pp. xvi+609+230 plates. 2 dollars. Bulletin 153: Birds collected by the Childs Frick Expedition to Ethiopia and Kenya Colony. By Herbert Friedmann. Pp. xiii+516+12 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Acriflavine "B.D." Brand, with references also to Euflavine and Proflavine. Pp. 26. (London: The British Drug Houses, Ltd.)

Laboratory Fittings, including "Technico" Standard Unit Type Benches. (List F, revised August 1930.) Pp. 48. Electrically Heated Laboratory Apparatus. (List No. 231F.) Pp. 24. Small Electric Furnaces for Laboratory and Works. (List No. 75G.) Pp. 20. (London: A. Gallenkamp and Co., Ltd.)

Diary of Societies.

TUESDAY, SEPTEMBER 23.

INSTITUTE OF MARINE ENGINEERS, at 6.—Lt.-Comdr. Sir August B. T. Cayzer, Bart. (Presidential Address).

MONDAY, OCTOBER 6.

IRON AND STEEL INSTITUTE (Additional Autumn Meeting) (at the Cleveland Technical Institute, Middlesbrough), at 7.30 P.M.

CONGRESSES.

SEPTEMBER 13 TO 20.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Liverpool).

SEPTEMBER 15 TO 20.

IRON AND STEEL INSTITUTE (Autumn Meeting) (in Czechoslovakia).

Monday, Sept. 15, at 10 A.M.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.

J. Šárek: What Reasons Compelled the Prague Ironworks to Introduce Thin-Walled Blast-Furnaces.

W. H. Hatfield: Permanence of Dimensions under Stress at Elevated Temperatures.

Tuesday, Sept. 16, at 10 A.M.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

H. C. Wood: Open-Hearth Furnace Steelworks. A Comparison of British and Continental Installations and Practice.

D. F. Campbell: High-Frequency Steel Furnaces.

L. W. Schuster: The Effect of Contamination by Nitrogen on the Structure of Electric Welds.

SEPTEMBER 19 TO 22.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at New College, Oxford).

Friday, Sept. 19, at 7.15 P.M.—Dr. H. T. Tizard: Presidential Address.

At 8.30 P.M.—Brig.-Gen. M. Mowat: The Year's Work of the Association.

Saturday, Sept. 20, at 9.45 A.M.—Col. Sir H. G. Lyons, Dr. F. A. Bather, and J. M. Walker: The Dissemination of Information by Exhibition and Display.

Capt. C. W. Hume: Animal Welfare, its Dependence on Accurate Information.

At 11.45 A.M.—Prof. A. F. C. Pollard and Dr. S. C. Bradford: The Inadequacy of the Alphabetical Subject Index.

At 5.30 P.M.—Annual General Meeting.

At 8.30 P.M.—D. A. Bremner: The World Power Conference.

Sunday, Sept. 21, at 9.45 A.M.—C. C. Fagg, G. L. Pepler, and S. K. Ruck: Surveys and Planning, their Relation to Organised Information.

G. F. O'Riordan and B. M. Headicar: The Technique of Information in the Training of Students.

At 11.45 A.M.—T. W. MacAlpine: Suggestions for the Improvement of Scientific Literature.

At 8.30 P.M.—A. Schlomann and Dr. Prinzhorn: The Organisation of Information in Germany.

SEPTEMBER 22 TO 24.

CERAMIC SOCIETY (Joint Meeting of the Refractory Materials Section and Building Materials Section) (at the Building Trades Exhibition, Olympia, London), at 2.30 P.M.

SEPTEMBER 22 TO 27.

INTERNATIONAL CONGRESS OF THE HISTORY OF MEDICINE (at Rome).—Subjects for Discussion: How Europe protected herself against Leprosy in the Middle Ages, introduced by Prof. Jeanselme; The Medical and Scientific Relations between Italy and other European Countries during the Scientific Renaissance in the Sixteenth and Seventeenth Centuries, introduced by Prof. K. Sudhoff and Prof. A. Castiglioni; The Necessity of Making the Study of the History of Medicine a Compulsory Subject in all Universities, introduced by Prof. L. Szumoski; also the following papers: The Problem of Medical Historiography, by Prof. Siegerist; van Helmont, by Prof. Ostachowski; Girolamo Cardano and Leonardo da Vinci, by Prof. Bilancioni; Plastic Surgery in Italy and Europe at the Time of the Renaissance, by Dr. G. Sansevero-Roselli; and The Influence of Folk-lore on Medicine, by Dr. D. Mackenzie.

SEPTEMBER 29 TO OCTOBER 1.

FARADAY SOCIETY (at the Laboratory of Physical Chemistry, Free School Lane, Cambridge).—General Discussion on Colloid Science Applied to Biology.

SATURDAY, SEPTEMBER 20, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Inventions and Unemployment.

FROM the days of the Luddite riots onwards men have felt vaguely that there is some kind of relation between inventions and unemployment. It is a little astonishing, therefore, that at a time when unemployment has become the most pressing of all social problems that that relation should be receiving so little attention from statesmen.

The only systematic attempt to study the economic effect of patents appears to have been that made twenty years ago by Mr. Ravenshear in his little book " The English Patent System ". Mr. Ravenshear regarded inventions as ranging between two extreme types, the originative, which creates new demands and so absorbs labour, and the intensive, which cheapens the production of known commodities and tends, subject to certain reservations, to create unemployment. Mr. Ravenshear concluded that the patent system acts selectively by fostering originative inventions to a greater extent than intensive inventions, the output of which is far less dependent on special encouragement of this kind. If his view be correct, the patent system, in so far as it is efficient, tends directly to promote the absorption of unemployed labour. But however that may be, it is certain that if British manufacturers are to compete successfully with foreign rivals, they must have the advantage of a constant succession of inventive improvements, and the present is not a time to tolerate delays or other defects due to parsimony in the administration of the system.

Early last year a number of questions were asked in the House of Commons with regard to the arrears of work which had accumulated at the Patent Office, and some disturbing facts were elicited. It was learned that inventors had to wait seven months before the Patent Office could begin to turn its attention to their applications for patents, that 8400 complete specifications were awaiting the first action of the examiners, that the amount of work to be done annually had increased by 27 per cent while the strength of the examining staff had decreased by 11 per cent, and that this economy, effected at the expense of efficiency, had enabled the Patent Office to hand over to the Treasury no less than £112,939 in one year. This state of things was generally felt to be a very serious one. It often happens that opportunities for exploiting an invention commercially occur but will not wait, and beyond question these opportunities for creating employment are sometimes lost and

often postponed because of the false economies which have been effected in the administration of the patent system of Great Britain.

It might have been supposed that when attention had been directed to this matter the Board of Trade would have dealt with the problem resolutely and effectively. Actually, however, it was content with some such makeshift provisions as would avert the crisis for the moment without in any sense curing the evil. To-day inventors are not conscious of any material improvement, and meanwhile, according to the report for 1929 of the Comptroller-General of Patents, the annual surplus of fees over expenditure has risen to £157,005.

Another instance of the casual attitude of officialdom towards patent matters is to be found in the treatment meted out to the technical staff at the Patent Office. Applicants for important patents are surprised to find, on visiting the examiner whose demands they are required to satisfy, that he works in an overcrowded and badly lighted room, that he and his contemporaries have served for perhaps twenty-five years without hope of promotion, and that the Comptroller and Assistant-Comptroller, who are responsible for a service on which enormous amounts of capital depend, receive (according to the Civil Estimates) emoluments which amount in all to £1686 and £1306 respectively. Scientific knowledge and ability is cheaply valued by the secretariat of the State. Scientific men are being definitely exploited in the interest of a parsimony which wears very awkwardly the disguise of economy.

Some time ago a departmental committee under Sir Charles Sargant was appointed by the Board of Trade to inquire into the demand which has arisen for a general revision of the patent laws. Departmental committees are sometimes appointed with a practical object, and sometimes for use as pigeon-holes. Is there on the Sargant Committee a majority of positive-minded men whose temperaments will lead them to seek for positive solutions of the problems presented to them? Or has the majority been selected from among men of negative temperament, who can be relied upon to make out "an overwhelming case for doing nothing"? Time alone can answer these questions, and until they have been answered no inference in either direction can be drawn from the appointment of the Sargant Committee.

The general attitude of *Messieurs les Ronds-de-Cuir* is indicated by a reply given on Mar. 5, 1929, to a question in the House of Commons with regard to the Patent Office financial surplus. The Board of Trade has retreated from the position taken up in 1891 by Sir Michael Hicks-Beach, who stated (July 14) that "he did not think that the country ought to look to the Patent Office as a permanent source of income". To-day the Board relies on the fact that patent fees are paid by instalments, and that the first instalment, without subsequent renewal fees, does not pay in full for the administrative cost of grant. "Obviously," said its president, "the applicant for a patent who is charged a fee which does not actually cover the amount of work done is not being charged too much."

Thus, the Board of Trade has entirely misconceived the purpose and the constitutional basis of the patent system. The consideration given by an inventor in exchange for his monopoly is, constitutionally, either the disclosure of his invention or the establishment of a new manufacture. The Board, through the mouth of its president, has now recognised officially a third kind of consideration, namely, a money payment to the Crown, and thus has violated flagrantly the spirit, if not the letter, of the Statute of Monopolies, which is one of the bulwarks of English liberty.

No doubt, like Courteline's *Directeur des Dons et Legs*, the Board only asks that its tranquillity be not troubled, and feels "la rage justement exaltée du monsieur qui a fait l'impossible et au delà pour être agréable à tout le monde, qui a semé sans compter l'or des bonnes paroles et des sourires pleins de promesses, et dont une brute malfaisante vient troubler la bonne petite existence reglée au mieux de l'intérêt général"! So that, whatever the nature of the Sargant Committee's report, and pending its issue, one may well ask whether the Board of Trade will not always be content merely to wipe the floor a little, from time to time, when the pot of public indignation boils over, or whether it will some day begin to deal generously with the cause of these ebullitions.

For our guidance in answering this question, we have only a few facts. The most interesting of these is the fact that as a contribution to the £60,000,000 which is to be borrowed from the Exchequer for expenditure in unemployment benefit, the Patent Office surplus is being extracted from struggling patentees by a sacrifice of administrative efficiency which holds up for a year or more the exploitation of those inventions upon which employment in an industrial country directly depends. This appears to be the only relationship between inventions and unemployment which is recognised by the responsible authority.

Race Crossing in Jamaica.

Race Crossing in Jamaica. By C. B. Davenport and Morris Steggerda, in collaboration with F. G. Benedict, Lawrence H. Snyder, Arnold Gesell, Inez Dunkelberger Steggerda and many Residents of the Colony of Jamaica. (Publication No. 395.) Pp. ix + 516 + 29 plates. (Washington, D.C.: Carnegie Institution, 1929.) 7.00 dollars.

IF length of title, weight of names, and number of printed pages can make a great book, this work should certainly be such. An 'abstract' printed at the back of the title tells us that the work is a *quantitative* study of three groups of agricultural Jamaican adults: blacks, whites, and the hybrids between them. Further, that the *variability* of each race and sex in respect to each bodily dimension and many bodily organs is discussed. We are also informed that it appears that mental traits which seem to have a genetic basis vary just as morphological traits do. In some sensory tests the blacks are superior to whites; in some intellectual tests the reverse is found. A portion of the hybrids are mentally inferior to the blacks. The studies embraced in the book are "morphological, physiological, psychological, developmental, and eugenical".

Now it will be seen from what we have cited from this abstract that the book claims to deal quantitatively with the type and *variation* of blacks, whites, and their hybrids. In other words, it is an anthropometric study and must be subjected to the accepted canons of biometric criticism. Let us first endeavour to ascertain the purpose that the numerous investigators concerned in the production of this work set before themselves. It appears to be the comparison of the White with the Negro and of both with the hybrid between them, in as many characteristics as can be conveniently measured. Now in order to do this we must first obtain (i) adequate-sized homogeneous samples of the three classes, and (ii) we must be acquainted with the genetic history of the hybrid. We must know whether he or she belongs to the F_1 or F_2 generation, etc., or whether there have, or have not, been back-crosses. Neither of these conditions appears to us to have been even approximately fulfilled.

The numerous authors, so far as we can judge, have paid no attention to the size of their samples. For the 'adults' the following table of numbers measured will emphasise what we mean:

Race.	Males.	Females.
Blacks	54	51
Browns	93	72
Whites	50	50

Even within these anthropometrically extremely small groups, there is no homogeneity. To begin with, the classification appears to be by skin colour, and is subject to personal equation. Several of the authors are Mendelians and believe in segregation in the F_2 generation. What is to be done, or has been done, with the 'pass-for-whites'? And, if we accept Mendelian segregation, a black-skinned person or a 'pass-for-white' may be respectively as close to the white or as close to the black race as any 'brown'. The fact is that Jamaica with its centuries of racial intermixture is the last place where a study of the relative physical and mental traits of White and Negro can be made. At least 500, better 1000, Europeans of reasonably homogeneous race should have been compared with the same number of West African Negroes. Take, for example, the 50 male 'whites'. Of these, 23 were agricultural workers, the bulk of them coming from Seaford and probably of *German* descent; 19 were able-bodied seamen, said to be 'huge men' of English descent, and 8 were office workers from Kingston. Their ages varied from eighteen to forty. Although whites do not reach their prime for most characters before 25-26 years, no correction is made for age. The 54 male 'blacks' are equally heterogeneous in age, social class, and environment, consisting of small groups of students, cultivators, firemen, candidates for the police force, and prisoners. Such characters as weight and stature are compared for mixed groups like these.

The authors do not hesitate to calculate percentages for one, two, or three individuals. For example, they conclude on material such as this, and after deducting a round 4 lb. for the minimum clothing in which the whites were measured and *not* taking off 0·5 lb. for the residue of the blacks' clothing, that browns and whites have about the same mean weight while "the blacks are much the heaviest, on the average" (p. 49). They may be or may not be, but the present data prove nothing. Deducting the 0·5 lb., the blacks are 145·70 lb. ± 1·69 lb. and the whites 140·30 lb. ± 2·24 lb. The difference is accordingly 5·40 lb. ± 2·98 lb., or it is only 1·8 times its probable error, which cannot be considered of any significance.* On such heterogeneous small

* Weight does not reach its maximum in the white until about forty years. Hence if there were any significant difference between the above numbers of blacks and whites, it would have no racial meaning until correction had been made for the individual ages in the two groups.

populations with resulting high standard deviations and consequently large probable errors, no inference as to differences in type can be safely drawn. Again, with cephalic index, what scientific conclusions can possibly be deduced from a small group of 50 whites admittedly of mixed German and English descents, and from a group of 54 blacks, who if they have no white blood in them—which may well be doubted—may originally have come from many districts of Africa ?

Strong adverse criticism can easily be made of nearly all the anthropometric measurements in the volume, and this not only on account of the race, age, and class heterogeneities of the small samples used, but also on the basis of the descriptions as to how some of the measurements themselves were taken. Consider such a statement as the following:

"With a soft lead pencil, a line was drawn from the base of the orbit to the tragion, which is known as the 'Frankfort Horizontal'. The individual was informed of the importance of this line, and that his head was always to be held in a particular position. The individual was placed in the proper position and asked to remain quiet. Another line was drawn slightly below the glabella, and this represented for this study the nasion" (p. 20).

Anything more obscure it is hard to conceive, and the plates show that the photographs, so far from being standardised, were taken with the head and even the body with every variety of inclination and tilt—they are useless for anthropometric purposes. Even the light has not been studied by the photographer. For example, on Plate 13 two apparently complete blacks (if we are to judge by the colour of face and hands) are seemingly the parents of three thoroughly white daughters—a strong argument, if we could trust the photographs, in favour of Mendelian segregation ! On Plate 27 we are introduced to a boy with a white face and black knees, the son of a brown mother. We have not succeeded in finding any comment on this remarkable photograph. Was the boy piebald ?

When we come to basal metabolism, the author of this section has no hesitation in computing pulse rate, respiration rate, and basal metabolism on *eight* male blacks, and publishes standard deviations and probable errors for this sample of eight !

In discussion of the blood-groups we are suddenly confronted with a sample of 144 Jamaicans (147 in the text, 144 in Table 193, p. 277). We are not told how they were selected nor what proportions of whites, browns, and blacks occur in this number, but the 144 "Jamaicans" are classed with other presumably pure black and brown races. When we come to muscular strength as hand-grip, the numbers dealt with are 12 blacks, 25 browns, and 21 whites. On such numbers standard deviations and probable errors are computed. The results are 43·80 kgm. $\pm$ 1·40 for blacks and 41·96 kgm. $\pm$ 0·84 for whites (p. 274). The difference is 1·84 with a probable error of 1·63. The authors remark that "the blacks and browns exerted more pressure than the whites ; although it is not certan that the difference is significant". It certainly is not, and no such small heterogeneous samples could be expected to give anything significant. The twelve blacks are divided into twelve grades: four of these contain a single black, four two blacks, and four no blacks, and the percentages of these grade frequencies on the total of twelve are then tabled to two places of decimals ! The authors seem unaware that the percentage 8·33 of 1 in 12 has a standard error of 8·00 and the percentage of 2 in 12 a standard error of 10·07. In other words, both are wholly unreliable.

In the case of the mental tests, we have exactly the same inadequacy of numbers ; there are, indeed, cases in which only 6 or 7 whites were tested, and the authors do not hesitate to calculate means and standard deviations with their probable errors on such series. A more valuable result, based, however, on *only* 33 cases, is a correlation between skin colour and nasal index * of 0·477 $\pm$ 0·091 for blacks. The authors term this "an astounding result" (p. 296) ; presumably because they are thinking in terms of independent Mendelian factors. They remark : "It is possible that one of the factors for brown skin colour may reside in the same chromosome with a factor for broad nose, so that the two tend to be inherited together—are linked. Correlation is, however, not the criterion for linkage." Some persons may prefer to believe that some of the 33 blacks were not pure Negroes, and just as their skin colour had been lightened by European admixture, so their chamærrhinia had been diluted by European leptorrhinia. One of the most remarkable anthropometric processes is that adopted on pp. 257-259 ; no justification appears to be provided for it. Hair colour is divided into five classes—(i) black ; (ii) dark brown ; (iii) medium brown ; (iv) light brown ; (v) flaxen—and immediately below we find the means, standard deviations and probable errors presumably of hair colour. After some puzzling we find out that these

* Unfortunately, the correlation table is not published. It would appear that there were only four categories of skin colour.

had been obtained by using the index numbers of the above classes as the quantitative measure of 'blondness'.* In Table 176 'red hair' (vi) was added in with an intensity of blondness 6, that is, as blonder than 'flaxen'. The average red hair of whites has intensity of pigment granules, which places it among the brown hair group. No scale of melanotic pigment granules would distribute their intensity in black and flaxen hairs in the inverse ratio of 1 to 6.

As the points we have been endeavouring to emphasise in this notice turn on the heterogeneity as to age and race and its effect on 'small samples', we think it well to point out the fallacies which may arise, when arguments are based on such small samples by a final illustration.

We take the author's table for change of stature variability with age.

STANDARD DEVIATIONS OF FEMALE WHITES FOR STATURE AT VARIOUS AGES IN CENTIMETRES.

Age.	Book under Review.		British School Girls.	
	No.	Standard Deviation and its Probable Error.	No.	Standard Deviation and its Probable Error.
5	..	..	894	6·13±0·10
6	..	..	3,104	6·47±0·06
7	5	4·60±0·86	3,828	6·60±0·05
8	9	6·67±1·06	3,928	6·78±0·05
9	8	7·07±1·19	3,819	7·11±0·05
10	6	4·72±0·92	3,762	7·27±0·06
11	10	12·00±1·81	3,518	7·57±0·06
12	16	5·27±0·63	3,658	7·91±0·06
13	15	6·53±0·80	3,225	8·39±0·07
14	9	6·67±1·06	1,229	[7·90±0·11]
15	5	4·00±0·86	..	..
Total	83	..	30,965	..

On the left we have the data for white girls from the present research, and on the right data for adequate numbers of British girls.

We have enclosed the last figures for girls of fourteen years on the right in square brackets because, during the age-year 14 to 15, 2000 of the girls had left school, and the remainder were a relatively stringent selection with lesser variability. Now compare the two variability columns. On the right we see a steadily increasing variability in stature as the girls increase in age. On the left we have an irregularity of variability, absolutely screening by the inadequate numbers in the age classes any discovery of the law so obvious on the right! Yet it is on the basis of such series screening the continuous increase of variability with age that our authors draw the conclusion that: "It is apparent, also that among females, the blacks and browns are more variable than the whites between twelve and fifteen years of age" (p. 379).

The only thing that is apparent in the whole of this lengthy treatise is that the samples are too small and drawn from too heterogeneous a population to provide any trustworthy conclusions at all. There are sound biometricians and anthropologists in the United States, and it would have seemed worth the while of the Carnegie Institution of Washington to have placed the manuscript of this work before them before authorising its publication. We can scarcely believe that even some of those whose names appear on the title-page as an "Advisory Committee" have seen before issue this book with the biometric errors which abound in its pages.

KARL PEARSON.

* Any such order of classification neglects the existence of two fundamental hair pigments.

Strong and Weak Electrolytes.

The Conductivity of Solutions and the Modern Dissociation Theory. By Cecil W. Davies. Pp. viii + 204. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

THE theory of reversible ionisation, advanced by Arrhenius in 1887, owed its widespread acceptance to the fallacy that the degree of dissociation of a salt can be calculated independently from the conductivity and the osmotic properties of its solutions. In more recent years the concordance between the values deduced in these two ways has been denounced on the grounds that it has no sound theoretical basis and that the numbers cited by Ostwald and others do not in fact provide the experimental justification that was claimed for them in the days when the study of dilute solutions was heralded as the birth of a new science of physical chemistry.

Although tentative attacks on Arrhenius's theory had been made in pre-War days by Sutherland and by Milner, the detonation of the charge was delayed by the distracting influences of the War-period, and the apparently final shattering of the theory did not take place until 1923, when Debye and Hückel showed how the waning conductivity of strong electrolytes with decreasing dilution could be explained by changes in the mobility of the ions instead of in their number. Their formula had the merit of providing a theoretical foundation for the experimental law, discovered by Kohlrausch in 1900, that the fall in equivalent conductivity is proportional to the square root of the concentration, $\Lambda_0 - \Lambda_c = b\sqrt{c}$, so that a straight line is obtained by plotting Λ against $\sqrt{c}$. This relation, which

was illustrated by Hartley in NATURE of Feb. 26, 1927, p. 322, had not hitherto received the theoretical justification which Kohlrausch had anticipated, and its interpretation by Debye and Hückel in terms of well-established phenomena was at least as important as the discovery of Ostwald's dilution law for weak electrolytes such as acetic acid. Consequently, in spite of the fact that the predicted slopes of the lines were quite different from those found experimentally, the theory of complete ionisation was received with the same enthusiasm which had been accorded thirty-six years before to the theory of reversible ionisation.

The general acceptance of the new theory (which was obviously in harmony with the ionic structure assigned by X-ray analysis to the majority of crystalline salts) was a noteworthy feature of the general discussion on strong electrolytes held at Oxford in April 1927 under the auspices of the Faraday Society (see NATURE, May 7, 1927, p. 676). On that occasion, indeed, the main obstacle to its general acceptance was removed by Onsager's development of a formula, in which, by allowing for the effects of molecular bombardment as manifested in the Brownian movement, the slope of the lines referred to above was increased to a point at which it appeared to correspond closely with that which is actually observed in solutions, provided that these are sufficiently dilute.

So recently as three years ago, then, it was possible to suppose that salts which crystallise in ionic aggregates are not merely ionised completely in solution, but also are dissociated almost completely into free ions, since calculation indicated that the proportion of ionic doublets was almost negligible. This position, however, is no longer tenable in view of the experimental work done by A. R. Martin and others, since it must now be admitted that, when the Debye-Hückel-Onsager correction for electrostriction has been applied to the mobilities of the ions, the resulting ionic concentrations are not 100 per cent except at extreme dilution, and that (especially in non-aqueous solutions) there is still a diminishing of equivalent conductivity with decreasing dilution which must be explained by decreasing dissociation of the molecules (or ionic aggregates) of the solute, and which appears to apply to Kirch Ostwald's dilution law just as well as it does to weak acids and bases. The time is thoroughly ripe for a further review of the situation, perhaps under form of a general discussion on weak electrolytes, at which the impression created at the previous Oxford discussion could be corrected, and brought to date.

From this point of view the appearance of Mr. Davies's book is very opportune. During recent years, the authors of a number of books on physical chemistry were in the unfortunate position of being afraid to scrap the deductions made by applying the law of mass action to electrolytes, but were forced to admit (usually in a separate chapter !) that the theory of electrostriction had made these calculations both obsolete and irrelevant. It was, therefore, possible to claim as a novelty a treatment of the subject in which the existence of reversible ionisation was admitted as freely as that of non-reversible ionisation. This contention, which is rapidly becoming quite orthodox, is the fundamental creed of Mr. Davies's book, since he admits that " two types of electrolytes will be looked for ", and after citing the evidence in support of Onsager's equation, goes on to say that " there is every indication that in solvents of low dielectric constant no salts are completely dissociated at attainable dilutions ".

This dual aspect of the phenomena makes the conductivity of solutions a more complex problem than it was when Kohlrausch wrote his " Leitvermögen ", since the activities as well as the concentrations of the ions must be taken into account when calculating such apparently simple quantities as the solvent-correction in dilute solutions or the limiting values of the ionic mobilities, as well as when trying to deduce the coefficient of ionisation or the equivalent conductivity of solutions of finite dilution. These problems are treated, perhaps for the first time in a systematic manner, in Mr. Davies's work, and it can be asserted that no worker who undertakes research in this field will feel quite safe in his deductions unless he has weighed up the considerations which are here advanced. For this reason, the book can be commended heartily to the specialist as well as to the general student of chemistry, since both will find in it facts and deductions which are too important to be overlooked.

T. M. LOWRY.

Science in Soviet Russia.

Science in Soviet Russia. By J. G. Crowther. Pp. 128 + 13 plates. (London: Williams and Norgate, Ltd., 1930.) 7*s*. 6*d*. net.

MR. CROWTHER is one of the few English men of science who have ventured into Russia in recent years. He was impressed by the extent of the researches projected and prosecuted in the various institutes which he visited. It appears that the study of the different branches

of science have been placed in contact with the social institutions to which they are naturally related. Thus, all bodies concerned with applied botany are controlled by the State Department of Agriculture. The thousand workers at botany work to one planned scheme. Unnecessary overlapping has been reduced by centralisation. Institutions conducting researches of industrial value receive their endowments from the Supreme Economic Council and they work in contact with the industry upon which the research directly bears.

With regard to emoluments it would appear that men of science are among the better paid workers and their conditions are still improving. Engineers are the best paid and the highest salary quoted is £3500 per annum. Nevertheless, even the lesser paid research workers concentrate upon their tasks and attain a high degree of skill and efficiency. There is still a shortage of trained investigators, especially in physics and engineering, and the author suggests that there is scope for young English graduates to gain valuable experience in posts available in the Soviet's numerous electrical works which are in course of construction and extension.

Among the work in progress Mr. Crowther mentions the speeding-up of tobacco fermentation, the isolation of sulphur from the dioxide obtained in roasting copper ores, the synthesis and preparation of drugs hitherto imported from abroad, petroleum refining, and improved technique in the preservation of wood. Apparently investigations of a purely academic nature are not countenanced, although the term 'applied science' is being interpreted very broadly. At the moment large electro-technical developments are being made as a part of the five years' industrialisation plan. Power plants and technical factories are being erected all over the Union, and it would seem that Russia is making notable contributions to the progress and development of science. Russia is a vast country with well above a hundred million inhabitants, and although Mr. Crowther has seen many scientific institutes in the two chief centres, Leningrad and Moscow, his tour was restricted to less than four weeks. Furthermore, without a knowledge of Russian he was dependent on his interpreters, so that the value of his impressions is limited. Nevertheless, the information concerning the condition of Russian men of science and the progress of their researches is at least of interest to their colleagues in the rest of the world.

J. G. F. D.

Our Bookshelf.

Trattato di chimica generale ed applicata all' industria. Per Prof. Ettore Molinari. Vol. 2: *Chimica organica.* Parte seconda. Quarta edizione riveduta ed ampliata. Pp. xvi + 661-1567. (Milano: Ulrico Hoepli, 1930.) 80 lire.

THE death of Molinari nearly four years ago doubtless accounts for the delay in the completion of the new edition of his "Organic Chemistry", the first part of which appeared in 1927. The alterations necessary to bring the contents of this second part up-to-date are due to the author's three sons, working in conjunction with Profs. Bargellini and Contardi. The subjects dealt with in the present volume comprise oils, fats, and waxes, carbohydrates, ring compounds, textile fibres, and proteins. The general scheme of the book, with its inclusion of numerous data regarding production, importation and exportation of raw materials and manufactured products, must by this time be generally known to chemists. The only new feature requiring comment is the insertion of large-scale flow sheets of an olive-oil refinery and of a sugar factory. Similar sheets for other processes might with advantage be given in any future edition.

The volume now published contains 860 pages of text, much of it of small type, but in view of the multiplicity of subjects treated—some quite foreign to the ordinary text-book of pure, or even of applied, organic chemistry—certain of these are necessarily dealt with all too briefly. Thus, vitamins are dismissed in less than two pages, and although the general characteristics of these substances are indicated, important recent results in this field are entirely omitted.

The full index supplied covers the two parts of the "Organic Chemistry", and the price of the whole work amounts to 125 lire, which is modest enough. The book is one which may be recommended to all engaged in chemical industry.

The Use of Iodine and its Compounds in Veterinary Practice. By Lieut.-Col. H. A. Reid. Pp. 88. (London: De Gruchy and Co., Ltd., 1929.) 3*s.* 6*d.*

ALTHOUGH the essential rôle played by minerals in animal metabolism has been recognised for many years, it is only recently that the importance of iodine in the diet has been stressed. The requirement of animals for iodine compounds is only small; nevertheless, a deficiency of such compounds in the diet may lead to acute pathological conditions in animals and human beings. Iodine deficiency, for example, has been shown to be the fundamental cause of goitre, an ailment which is especially prevalent in districts where the soil and water are notably deficient in iodides. Such iodine-deficient conditions are found in parts of the northern half of the United States, in which localities it is now customary to iodise the public water supplies or to insist on the use of iodised table salt.

In the book under review, Col. Reid has gathered

together, in very readable form, the conclusions which have been drawn from numerous investigations into the functions of iodine in maintaining health in animals. The use of iodine, and various compounds of this element, for antiseptic purposes is first dealt with. The author then proceeds to discuss the diseases of iodine deficiency, showing how these diseases are amenable to treatment by iodine and its compounds. Further sections deal with the influence of iodides in nutrition and on growth and reproduction. Mention should also be made of the useful bibliography at the end of the volume. Col. Reid's book should be read by all, whether scientific workers or laymen, who are interested in health problems and the future virility of the race.

An Introduction to Physical Anthropology. By E. P. Stibbe. Pp. vii + 199. (London: Edward Arnold and Co., 1930.) 12*s.* 6*d.* net.

ANYONE conversant with the needs of those entering upon a course of anthropological study will be aware of the difficulty in finding a satisfactory textbook in physical anthropology. Not that there are no text-books in existence; but they are for the most part too detailed for the beginner and recent advances have made them out-of-date. Dr. Stibbe's "Introduction to Physical Anthropology" meets the need admirably. It deals with its subject matter under the heads zoological, palæontological, and ethnological. In the first we are introduced to the methods and findings of comparative morphology; in the second, the palæontologist, geologist, and archæologist are called to the assistance of the anatomist in elucidating the origin, evolution, and antiquity of man; and in the third, racial characters and distribution are considered. Useful instructions for practical work and a glossary of technical terms complete a volume which should fulfil all the requirements of a beginner in anthropological studies, so far as this is possible in a textbook; for one of the most useful features in Dr. Stibbe's book is his insistence on the necessity for handling specimens in a laboratory and for constant practice in measuring the living. The arrangement of the text in the zoological section in which man and the apes are compared in detail will be found most helpful. The author himself would be the first to agree how much his text-book owes to the teaching of Prof. Elliot Smith, and perhaps its greatest merit is the way in which it leads the student inevitably to an intelligent appreciation of Elliot Smith's eminent services to anthropology.

Cours de chimie-physique. Par Prof. L. Gay. Tome 1. Pp. xii + 705. (Paris: Hermann et Cie, 1930.) 85 francs.

THIS volume is the first of a series of three, of which the first two are to be devoted to thermodynamics and the third to classical physical chemistry (electricity and magnetism, colloids, chemical kinetics, catalysis, radiant energy, and photochemistry). The modern and controversial questions of radioactivity, atomic and molecular structure, and the classification of the elements, are reserved for treatment in a later work. The first part of the present volume, covering nine chapters and 220 pages, is devoted to pure thermodynamics and thermochemistry. The second part, covering six chapters and 160 pages, unites rather ingeniously the study of the dilute gaseous state and of the crystalline state. The third part (three chapters and about 100 pages), dealing with osmosis and the phase rule, may be regarded as an introduction to the study of solutions, whilst the fourth part (five chapters and about 160 pages) is devoted to the study of pure substances, including the questions of continuity of state, the Brownian movement, and allotropy. An appendix of about 40 pages is devoted to problems, mainly of an industrial type, for which solutions as well as answers are given, and these may very well prove to be one of the most valuable features of the book.

Antarctic Adventure and Research. By Prof. Griffith Taylor. (Appleton New World of Science Series.) Pp. xi + 245. (New York and London: D. Appleton and Co., 1930.) 6*s.* net.

THERE are few general volumes on polar regions that deal with the scientific problems rather than with the adventure of exploration. This makes Prof. Taylor's volume welcome. As the title indicates, the adventure is not neglected, for about a third of the book treats of the history of Antarctic exploration. The remainder treats of scientific aspects. Prof. Taylor devotes most attention to the Ross Sea area with which he has personal acquaintance, and his predilection for physiography leads him to devote most space to several excellent chapters on topography, scenery, and ice. The biology receives less attention and the chapter on whaling is very brief. There are many graphic diagrams by the author and a useful bibliography, which might, however, be enlarged by more references to the Graham Land area and the Weddell Sea. The book makes no attempt to treat the islands of the Southern Ocean, but for a brief general account of the Antarctic it can be recommended.

Practical Chemistry: for Advanced Students. By Arthur Sutcliffe. Pp. vii + 216. (London: John Murray, 1930.) 4*s.* 6*d.*

MR. SUTCLIFFE'S book is suitable for pupils preparing for higher school certificate and similar examinations. Elementary experiments are not described and much detail concerning manipulation has been omitted, since students of this standard will not require it. The course covers qualitative and quantitative analysis, inorganic and organic preparations, and some simple exercises in physical chemistry. The directions for the preparations are clear and adequate, and the section on qualitative analysis contains all the equations for the reactions and explanatory notes. The course is well planned and the book should prove successful in schools where work of this standard is done.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Ionisation Potential of Radon.

WE have determined the ionisation potential of radon, using the well-known method,[1] due to Hertz, of compensation of the negative space-charge by positive ions formed by accelerated electrons from a subsidiary cathode. This cathode was an equipotential one and differed only in slight details from that described by Hertz and Kloppers.[2] In the original apparatus of Hertz the accelerating grid forms a part of a box which receives the space-limited current from the chief cathode. We have modified this arrangement by introducing a separate accelerating grid which enabled us to measure directly the useful part of the subsidiary emission, that is, the number of electrons penetrating into the box. The contact potential correction of the apparatus was determined by calibrating it with pure xenon and krypton: it was found to be 2·6 volts.

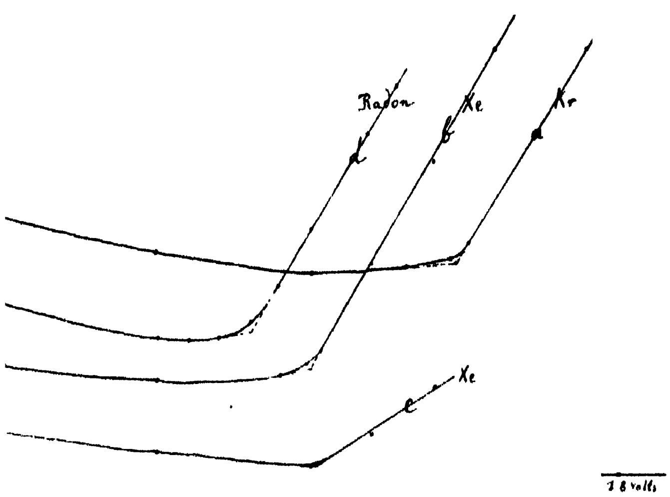


FIG. 1.

The quantity of radon used in different experiments was of the order of 300 millicuries. The volume of the apparatus with auxiliary parts being equal to about 250 c.c., the calculated pressure of radon was of the order of 0·8 bar, and one might think at first that the method would not be sensitive enough for such small quantities of gas. Preliminary experiments have shown, however, that it is quite easy to determine the ionisation potential of xenon when present at a pressure of 1 bar, and the sensitiveness of the method increases in a marked way with the atomic weight of the rare gas used for investigation. It ought also to be mentioned that at such low pressures the number of ions produced by the α-rays is negligibly small compared to the number of electrons involved in the experiment, so that radon can be treated as any other inactive gas.

Another important point was to make sure that the possible impurities of radon would not mask the appearance of discontinuities due to this gas.

We performed, therefore, a set of measurements in which special stress was laid on the purification of radon but not on the exact determination of the critical potential. The method of purification was the same as that previously described by one of us.[3] These experiments put beyond doubt the existence of an ionisation potential due to radon. This potential, in agreement with theoretical expectation, was found to be somewhat lower than that of xenon and therefore of any other permanent gas.

This circumstance facilitates essentially the work with radon. The only impurity which really matters is mercury vapour. Therefore in the final experiments we did not aim at a complete purification of radon, but used a trap kept in a bath at −120°, in order to get rid of the mercury vapour and a tube with caustic potash for absorbing carbon dioxide. The other details of the arrangement will be given in a later publication.

Curves obtained in the final experiments are shown in Fig. 1. In order to make the method more sensitive, the electronic current was nearly balanced against a steady current given by a potentiometer. On the curves the difference between the two currents is plotted against the accelerating potential of the subsidiary electrons. Curve *a* refers to krypton at a pressure of 7·2 bars, curve *b* to xenon at a pressure of 15 bars, curve *c* to xenon at a pressure of 1·3 bars, curve *d* to 250 millicuries of radon. The values of the ionisation potential of these gases corrected for the contact potential are 13·3, 11·4, and 10·6 volts respectively. The last value, that of radon, is in good agreement with the value 10·7 volts deduced recently by Rasmussen[4] from an investigation of the spectrum of radon.

F. HOLWECK.
L. WERTENSTEIN.
Radiological Laboratory,
Scientific Society of Warsaw,
Aug. 5.

[1] Hertz, *Zeit. f. Phys.*, **18**, 307; 1923.
[2] Hertz and Kloppers, *Zeit. f. Phys.*, **31**, 463; 1925.
[3] Wertenstein, *Phil. Mag.*, **6**, 17; 1928.
[4] Rasmussen, *Zeit. f. Phys.*, **62**, 494; 1930.

Fine Structure in the Singlet Series of Mercury.

UP to the present no fine structure has been observed in the singlet series of mercury. In a recent communication to the Physical Society of London (*Proceedings*, August 1930) a description was given of the spectrum of mercury excited at low pressures by a high frequency electrodeless discharge. Amongst other effects it was found that the singlet series and intercombination lines due to transitions beginning on singlet levels, were strongly enhanced relative to the triplets. The line $6^1P_1 - 8^1S_0$ was examined for fine structure with a Fabry-Perot interferometer and found to be single and so narrow (half width $< 0·004$ A.) as to render it of great value in interferometric work.

As a result of recent improvements in experimental conditions, three new components have been detected, one faint and two very faint, the intervals being approximately:

$$-0·012 \quad 0 \quad +0·009 \quad +0·031 \text{ A.}$$

Since these only appear when the main line is heavily overexposed, they have practically no effect on the visibility of the fringes when normal exposures are used, and therefore should not detract from the usefulness of the line as a source. The next member of the same series $6^1P_1 - 9^1S_0$ is also complex.

Many other strengthened lines involving singlet levels show a complex structure; for example,

$$7^1S_0 - 8^1P_1,\ 7^1S_0 - 9^1P_1,\ 7^3S_1 - 8^1P_1,\ 7^3S_1 - 9^1P_1.$$

Three of the lines are shown in Fig. 1, including the unclassified line λ6123·78, the plate separation being chosen to show the widths of the multiplets before overlapping of orders occurs. The intervals between adjacent orders are marked, giving an indication of the separations. The closer components are completely separated for bigger gaps. The structure is not due to reversal, since it remains the same when viewing end-on through depths of vapour varying from 2 mm. to 50 cm.

The two members of the series $6^1S_0 - m^1P_1$ have a sextet structure, thus indicating that both initial and final levels are multiple since the maximum number of possible components when one level is single, is three, assuming the usual selection principle to hold.

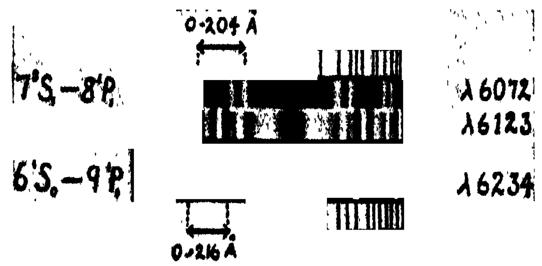


FIG. 1.—Fine structure in mercury spectrum. Fabry-Perot fringes, plate separation 9 mm.

As the final level is a $^1S_0$ level ($j = 0$) it ought to remain single, if nuclear spin is the cause of the fine structure. However, the observed structure shows that it is at least double. It is possible that this multiplicity is due to an isotope effect. This is not the simple mass isotope effect (variation in Rydberg constant with mass) as recently observed in neon, for in mercury this would give maximum separations of approximately 0·00001 A., which is very much smaller than that observed. Schüller and Brück (*Zeit. für Phys.*, **56**, 291; 1929) conclude that in a mixture of isotopes, only those with odd atomic weight possess nuclear spin. Assuming this true in mercury, then two $^1S_0$ levels will result, with f value $0+0=0$ for even atomic weights and $0+i=i$ for odd. If i has more than one value, the level becomes still more complex. A detailed analysis of the observed fine structure will be published shortly. The intensity ratios of the components are also being investigated.

S. TOLANSKY.

Physics Dept., Armstrong College
(University of Durham),
Newcastle-upon-Tyne,
Aug. 11.

Spectra of Doubly and Trebly Ionised Thallium.

CONTINUING our previous work on Tl II and Pb III, the spectra of Tl III and Tl IV have been under examination by us for some time past. A preliminary attempt, by the application of the X-ray doublet-laws, revealed a number of regularities consisting of mainly the regular doublet terms. As a result of further attempts, it has now been possible to identify the inverted ^2D term ($5d^96s^2$) and the quartet terms of ($5d^96s6p$) and ($5d^96s6d$) configurations. The starting point for the discovery of the inverted ^2D term was given by the identification of ν 76150, 81834, and 100452 as $6s'^2D - 7p^2P$. The super multiplet accompanying the electron transition $6p' \rightarrow 6d'$ contains about forty lines in the ultra-violet. A few combinations due to transitions $6p \rightarrow 7s$ have also been established. The ($5d^96s^2$) ^2D term interval is found to be 18618. The combinations that could not be identified are either very faint or out of range.

Thallium IV: The spectrum of trebly ionised thallium was recently studied by K. R. Rao, by Pattabhiramayya, and by J. E. Mack, who have all identified the triplets due to the combinations of $6s^3D$ and ^1D with $6p^3PFD$ and ^1FPD. As a result of attempts by one of us, it has been found possible to extend the analysis and identify the super multiplet due to the combination of $6p^3PFD$ with $7s^3D$ and ^1D.

In both these spectra the line intensities, term differences, and interval ratios are of the right order expected. A complete report will be published shortly elsewhere.

A. L. NARAYAN.
P. PATTABHI.
A. S. RAO.

Kodaikanal Observatory,
India, June 25.

Raman Spectra of the Mercaptans.

AN investigation by me of the Raman effect in a series of mercaptans has yielded some noteworthy results. As is well known, the mercaptans are chemically analogous to the alcohols, the SH group in them replacing the OH group characteristic of the alcohols. The oscillation of the SH group comes out prominently as an intense though somewhat diffuse line in the Raman spectra of all the mercaptans examined, with a frequency shift of 2574 wave numbers. This is in marked contrast to the behaviour of the OH group, of which the broad band ($\nu = 3400$ cm.$^{-1}$ approximately) appears only in water and methyl alcohol but not in the higher alcohols. Another strong line appears with all the mercaptans giving a frequency shift of about 657 wave numbers, and is evidently due to the oscillation of the CS group; it is in the same position as the most intense line in the spectrum of carbon disulphide. The analogous oscillation of the CO group with a frequency of about 1050 wave numbers appears strongly in methyl alcohol but only very weakly in the higher alcohols.

These differences in the behaviour of the SH and OH groups are sufficiently remarkable. Another notable feature is the unusual width and diffuseness of the lines ascribable to the oscillations of the carbon chain in the mercaptans. This character is presumably referable to the influence of the sulphur atom on these oscillations.

S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, July 12.

Hydrion Concentration of Rain and Potable Water.

FOR a study of the hydrion concentration of rain water New Milton appears to offer certain advantages. It is a small town equidistant between the Channel and the New Forest, about ten miles east of Bournemouth and seventeen miles south-west of Southampton, and it has the reputation of enjoying particularly pure and fresh air. For the past year and a half the hydrion concentration (pH) of the rain has been recorded together with the general direction of the wind, these observations having been made with the view to their possible value as part of the general problem of the influence of meteorological conditions upon plant diseases.

Indicators supplied by British Drug Houses, Ltd., were used to test the pH of rain collected from various plants and from two collectors about nine inches in diameter.

The pH of the water obtained from the collectors and from the plants varied between 5·5 and 7·6, with practically all intermediate values. The readings taken simultaneously from the collectors and from the

plants were sometimes identical and at other times very different values were obtained. The same remark applies to a comparison of the unboiled (*U.B.*) and the boiled (*B.*) water from the different sources. A few typical examples may be cited.

Date.	Wind.	Collector 1.		Collector 2.		Plant 1.		Plant 2.	
		U.B.	*B.*	*U.B.*	*B.*	*U.B.*	*B.*	*U.B.*	*B.*
Jan. 11	W.	7·2	7·2	7·2	7·2	7·2	7·2	7·2	7·2
Jan. 21	E.	5·0	5·0	5·0	5·0	6·4	6·4	6·0	6·6
Jan. 27	N.	5·2	5·2	6·2	7·0	5·2	5·2	6·2	5·2
Feb. 5	N.	6·0	6·0	6·0	6·0	7·0	7·4	6·0	6·0
Mar. 5	S.E.	5·2	5·0	5·0	5·0	6·2	6·4	6·0	6·0
May 13	W.	5·8	6·8	5·8	6·4	6·6	7·0		
June 22	S.W.	7·4	7·4	6·6	6·8	7·4	7·4	6·4	6·0

It is difficult to interpret the capricious variations obtained; possibly extraneous matter and dissolved gases (for example, carbon dioxide) might have some effect. The means at my disposal have not enabled me to make chemical analyses. Although the number of observations are not of sufficient extent to enable any general theory to be advanced, yet it appears that the rain borne upon winds direct from the sea is practically neutral, while that from the direction of towns or long stretches of country tends to become acid.

The data so far obtained indicate that wide variations in *p*H are to be expected in the rain falling upon living plants, even when growing close together, and the extent to which these variations may affect the micro-organisms present upon plants ("Bacteria in Relation to Plant Pathology", presidential address, British Mycological Society, 1909) might be the subject of an important research. To the well-known factors of atmospheric humidity, temperature, and light intensity which influence the infection of the host by parasitic fungi, the hydrion concentration of the surface moisture upon the plant may require to be added. This problem of the influence of the *p*H of a medium upon the germination of fungus spores is being made the subject of investigation by Mr. A. W. Bartlett, at Newcastle-upon-Tyne.

The hydrion concentration of potable water was tested by samples taken from various parts of England. The extreme readings were *p*H 5·0 and 9·0, the former obtained from wells which give good potable water, the latter from house pipe supply. Intermediate gradations were recorded in both these sources of supply, but good well water generally indicated more acidity than that from a pipe supply.

Often a great difference of *p*H is found between the unboiled and boiled samples from the same source. The pipe supply from one company varied from 6·8 to 8·2, while the boiled sample was practically always uniform at 9·0. It was found that an unboiled sample, as drawn from the tap, registered 7·4 but after standing some hours (protected from dust) it registered 9·0. It is of some interest to note that when breath was blown through the latter the original determination was restored. This fact is an indication that the hydrion concentration of a pipe supply may be affected by the carbon dioxide dissolved in the water. Thus, water from the same supply drawn directly from the tap or from an open cistern might have very different properties. Possibly the *p*H of a water under pressure in pipes might be a favourable medium for certain bacteria, while the same water after exposure to the air might be inimical to their activity.

While filtration has been shown to be of the highest importance in removing micro-organisms from water, the suggestion may be offered that the hydrion concentration should also be considered as a limiting factor for their growth. M. C. POTTER.

Corley Croft, New Milton, Hants,
Aug. 16.

Animal Plasticity and Environment.

WHILE recently making a zoological collection in the Sevoke River in the Teesta Valley at the base of the Darjiling Himalayas, I observed remarkable differences between the individuals of a Cobitid fish, *Acanthophthalmus pangia* (H. B.), collected from two diverse 'niches' in the same habitat. In Fig. 1 are shown the two types of individuals. The chief difference, which is readily noticeable in the two drawings, is that in the lower drawing the ventral fins are present, while in the upper these structures are totally absent. There are also other differences of a minor nature; for example, the extent of the nasal flap and the form of the caudal fin. Two specimens * possessing ventral fins were obtained from among pebbles and shingle in a swift current, whereas 18 examples devoid of ventral fins were netted from among debris at the bottom of pools in the course of the stream.

It seems to me very likely that the structural differences in the specimens are correlated with the two types of environment in which the fish lives. If this be so, a very interesting taxonomic problem arises. In 1860, Blyth [1] established the genus *Apua* on two specimens which he distinguished from *Pangio* (=*Acanthophthalmus*) primarily by the total absence of the ventral fins. Both Günther [2] and Day [3] recognised Blyth's genus, and evidently regarded the

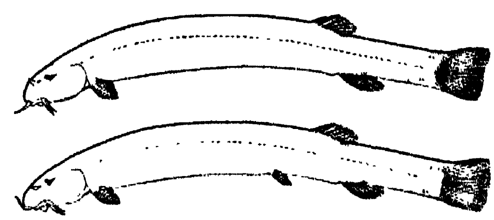


FIG. 1.—*Acanthophthalmus pangia*, × 1½.

absence of ventrals as a character of generic importance. Vinciguerra [4] considered *Apua* a synonym of *Acanthophthalmus*, and remarked that in the unique specimens of the former genus the ventrals must have been either overlooked or accidentally lost. In 1921, I published a note [5] on the occasional absence of paired fins in fishes and pointed out that *Apua* cannot stand distinct from *Acanthophthalmus*, and that the two specimens should be considered as abnormal so far as the absence of the ventrals is concerned.

Now arises the chief point for consideration. In view of the discovery of so many as eighteen examples from a specific habitat of *Acanthophthalmus pangia* without the ventral fins, what is the systematic position of *Apua*? Is *Apua* to be regarded as a distinct genus or should the specimens without the ventrals be considered as a 'habitat-variety' of *Acanthophthalmus pangia*? I am personally inclined to the latter view, and feel no justification in regarding the two kinds of individuals as separate species. As to the factors in the environment responsible for the loss of the ventrals, it is not possible to say much in the present state of our knowledge regarding animal ecology. It is probable, however, that the ventrals are an encumbrance for life among debris and are, therefore, suppressed. If this be so, then this case will be parallel to certain Chironomid and Trichopterous larvæ [6] that do not form their tubes or discard them when living in submerged debris. Some workers attribute the absence of the ventral fins in *Channa*, another genus of apodal fishes, to the habits of these fishes, but how far this is true I am unable to say at present.

* Special efforts were not made to obtain specimens possessing the ventral fins, as they are present in large number in the collection of the Zoological Survey of India.

The example cited above raises several important questions. Do these 'habitat-varieties' interbreed? If so, what is their progeny like? If not, then physiologically they are distinct species, though morphologically they are so similar. It is probable that after a freshet there is a mixing up of animals living in different habitats in a stream, and that on such occasions these two 'habitat-varieties' might interbreed. It is also known that torrential animals resort to slow waters (either in pools and puddles in the course of the stream or near the banks), and thus probably different 'habitat-varieties' come together at the time of breeding. If the progeny of these fishes include both types of individuals, how do they become segregated into their respective habitats? If, on the other hand, the progeny are alike, do some of them lose their fins after segregation into different habitats?

SUNDER LAL HORA.

Zoological Survey of India,
Indian Museum, Calcutta,
July 14.

Blyth, *Jour. As. Soc. Bengal*, **29**, p. 169.
Günther, *Cat. Fish. Brit. Mus.*, **7**, p. 371; 1868.
Day, *Fish. India*, p. 611, pl. clv. fig. 6; 1878.
Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, **29**, p. 220; 1890.
Hora, *Rec. Ind. Mus.*, **22**, p. 31; 1921.
Hora, *Phil. Trans. Roy. Soc. London* (B), **218**, p. 265; 1930.

Siliceous Shells of Protozoa.

WE regret that circumstances have prevented an earlier reply to Prof. T. D. A. Cockerell's letter published in NATURE of June 28. In our opinion, there can be no question of either convergent or divergent evolution in the case of organisms belonging to separate families as widely separated as *Miliolina* and *Miliammina*. We thought we had made their absence of relationship sufficiently clear by the statement that *Miliammina* was a siliceous isomorph of *Miliolina*, isomorphism being understood among rhizopodists, at any rate, to mean the development of similar structures in unrelated organisms owing to unknown physical or biological conditions.

Even the American school of rhizopodists, who are so addicted to the construction of more or less imaginary 'family trees', would hesitate before suggesting a common ancestor for the two genera. At any rate we should have to go a very long way back, and probably to a theoretical non-testaceous reticularian, to find an organism capable of evolution into such widely differentiated structures, for the porcellanous Miliolidæ have existed since Carboniferous times, and *Silicosigmoilina*, a close relative of *Miliammina*, occurs in the upper Cretaceous.

The difference in the shell structures of the two genera is fundamental. The Milioline shell is normally smooth and porcellanous, but there are many species which habitually incorporate mineral particles to a greater or less extent in the outer coating of their porcellanous tests. Such a Milioline test consists of three distinct layers:

(1) an inner chitinous membrane surrounding the protoplasm;

(2) the normal porcellanous test formed of $CaCO_3$, and

(3) the outer siliceous coating.

The application of even a very weak solution of hydrochloric acid is sufficient to dissolve the middle calcareous layer, and the test is resolved into a little mud in which the chitinous membrane may be detected.

In the tests of the Silicininæ, however, there are but two layers, chitinous and sandy. Immersion in strong acid produces little or no effect.

Chapman evidently regarded his specimens from their external form as *Miliolina oblonga* (Montagu), and, very reasonably assuming that it was a local variety which had assumed the agglutinating habit (not previously recorded in *M. oblonga*), added var. *arenacea*. The fact remains that in the absence of chemical tests they were regarded by him, and by ourselves and others afterwards, as *Miliolina oblonga*, and we maintain that in removing his specimens to a different genus and family, we acted more correctly in conveying the specific name rather than a varietal name, which then became tautological and applicable indifferently to any of the species in the new genus.

We do not attach a great deal of importance to Prof. Cockerell's designation of *Miliammina arenacea* (Chapman) as the type species, but we regret that he should not have communicated with us before publication. Had he done so he would have learned that further investigations since the paper was written had shown that the distribution of Chapman's form was somewhat distinctive, and that it was intended to raise it to specific rank in the *Discovery* Report now in course of preparation. In that report it will appear as *Miliammina arenacea* (Chapman), while the much commoner and more widely distributed species, which is the true genotype, will become *Miliammina oblonga*, H. A. and E. (*non* Chapman).

EDWARD HERON-ALLEN.
A. EARLAND.

Discovery Investigations,
c/o British Museum (Natural History),
Aug. 27.

Transition of Kinetic into Vibrational Energy by Collisions with Particles.

IN the work of Leipunsky and one of us[1] it was shown that dissociation of hydrogen molecules by collision with positive potassium, sodium, and lithium ions occurs only with such energies of the ions that the part of their energy transmitted (according to the energy and momentum law) to the hydrogen molecule is not 4·3 volt (dissociation energy), but 12·4 volt (exciting energy).

Recently one of us has repeated this experiment, using a Pirani gauge, which increased the sensitivity of the method tenfold. The result obtained was the same as that mentioned above. According to the usual point of view, dissociation by collision with a massive particle is a result of transition of kinetic energy into vibrational energy of the atoms of which the molecule consists.

We are thus forced, by the results of the abovementioned work, to admit that such an energy transition occurs, if at all, very seldom. It seems that the inverse process, recombination of hydrogen atoms by a triple collision, also occurs, not indeed at every collision, as well as recombination of bromine atoms, which is, by the by, effected by the addition of nitrogen and oxygen (diatomic molecules, which can receive vibrational energy), and not effected by helium and argon. It follows, therefore, that the transition of vibrational into kinetic energy also is not a process which proceeds readily.

To prove the correctness of the assumption that molecules dissociate by collisions with ions only when previously excited, we have tried to get dissociation of nitrogen by collision with positive ions. The exciting potential and the dissociation energy of nitrogen are very near one another. Accordingly, we have not observed any appreciable difference between the critical energy of the ions and the energy of dissociation of nitrogen. This shows that the results obtained for hydrogen are not experimental errors.

The necessity thus arises for a more detailed study of the mechanism of transition of kinetic into vibrational energy. It seems to us to be interesting (1) to study directly the distribution of speeds of the ions once reflected from monoatomic and diatomic molecules; (2) to study the critical potentials of the radiation of polar molecules excited by collisions with ions, and (3) to investigate the thermal capacity of a stream of diatomic gas, preserved from contact with the walls by a concentric stream of monoatomic gas.

We intend to carry out investigations in these directions. The question as to transition of kinetic into vibrational energy is a fundamental one in chemical kinetics. Therefore we intend also to determine the energy of ions at which begins the decay of some molecules, the kinetics of which follows the monomolecular law, as well as to determine at which energy of the ions some reactions begin which require a previous dissociation of one of the molecules.

N. SEMENOFF.
A. SHECHTER.

State Phys.-Tech. Institut,
Leningrad, July 14.

A. Leipunsky u. A. Shechter, *Zeit. f. Phys.*, **59**, 857; 1930.

Foaming of Beer.

SOME little time ago, seeking refreshment in a wayside tavern, I heard a man give an order in a most implacable manner, for a "half pint of bitter and in a dry glass if you don't mind". With great zest and concentrated attention this connoisseur drank his ale and departed, leaving me free to question the landlady on the merits of a dry glass. She explained that some people asked for a dry glass because they liked a head on their beer, and on occasion when Bass's, Guinness's, and the like were a bit fiery, they were compelled to wet the glasses to keep them down.

I have verified this fact by questions of other ale drinkers and I have discussed the matter with three physicists of standing to whom the matter was novel.

The froth on beer normally assumes a peaked cap, showing what might be the effects of a viscous drag on the sides of the glass, but the effect may not be due to viscosity so much as wetting action with film tensions against the glass walls. The matter is possibly worthy of investigation in connexion with industrial processes where foaming liquids are used, and more generally, in connexion with ebullition, the wetting of the walls by a liquid different from that contained in the vessel may be interesting or useful.

I confess that I write this with mischievous but respectful curiosity. Is there more than one very important journal to which such a contribution could be addressed?

H. S. ROWELL.

39 Spencer Road,
Chiswick, W.4.

THE foaming or frothing of beer has been discussed fairly extensively from time to time, although the point now raised by Dr. Rowell does not appear to have been specifically mentioned. The actual frothing is, no doubt, due to a lowering of the surface tension of the beer, but the primary cause of this lowering has not been definitely established. It is most likely due to the concentration of certain dissolved constituents, such as peptones and albumoses, being greater in the surface layers of the beer than in the bulk of the beer. The retention of the dissolved carbon dioxide in the froth may also assist in the formation of the 'head', although this view is not accepted by some observers. Very small traces of impurities, such as oil, grease, or higher alcohols, disturb surface tension, and the wetted surface of a glass may act similarly.

At the Government Laboratory we have carried out a few experiments with a number of ales and stouts, and the results agree with the facts stated in the early portion of Dr. Rowell's letter, although in some instances the difference between the size of the 'head' in the 'wet' and 'dry' glasses was not very marked.

R. ROBERTSON.

Infection of *Phlebotomus perniciosus* Newstead with *Leishmania infantum*.

ALTHOUGH a considerable amount of research has been carried out in recent years on the transmission of kala-azar in China and India, very little has been added to the problem of the transmission of infantile kala-azar in the Mediterranean basin, apart from the infection of *Phlebotomus papatasii*, *P. perniciosus* var., and *P. major* on cultures of *Leishmania infantum*.

Working in Catania in Prof. Longo's clinic, we were able to infect *P. papatasii* and *P. perniciosus* (wild and laboratory bred) on a Chinese hamster infected with local strains of *L. infantum* during the earliest stages of the infection.

Out of 18 ♀♀ *P. perniciosus* (5 wild and 13 laboratory bred), 15, that is, 83 per cent, became infected. Control, 319 ♀♀ wild *P. perniciosus* were dissected and found negative. Out of 123 ♀♀ *P. papatasii* (51 wild and 72 laboratory bred) fed on the same hamster, only one became infected. Control, 2694 ♀♀ wild *P. papatasii* were dissected and found negative.

In both *P. perniciosus* and *P. papatasii* the flagellates tended to adopt an anterior position; in *P. perniciosus* at a temperature of 29° C. to 30° C. flagellates were found in the pharynx three and a half days after the infecting feed.

Wild *P. papatasii* was also infected by feeding through membranes on infected human bone marrow. It was found that there was occasionally a slight infection rate if smears of the bone marrow showed an average of at least one Leishman-Donovan (L.D.) body per twenty fields (Oc. 4 Obj. $\frac{1}{12}$) and no infection with one L.D. body per forty fields. By culture methods we could demonstrate the presence of L.D. bodies in the circulating blood in almost 100 per cent of cases of infantile kala-azar (in some cases with only 5 c.mm. of blood), but a concentration as heavy as one L.D. body per forty fields in the blood has never yet been observed by anybody in this disease. *P. papatasii* can therefore be excluded as an important vector of *L. infantum*. Up to the present we have not succeeded in producing an infection rate of more than 26 per cent in wild *P. papatasii* after feeding on heavily infected bone marrow.

P. perniciosus takes on an average a much smaller feed than *P. papatasii*, and the high infection rate produced in *P. perniciosus* by relatively few L.D. bodies shows that *L. infantum* is particularly well adapted to this sandfly, which should be considered as a good carrier of kala-azar in Italy.

S. ADLER.
O. THEODOR.

Kala-Azar Commission of the Royal Society
and Hebrew University of Jerusalem.

The Quantum and Vision.

THE statement is frequently made that one quantum of light delivered instantaneously is just sufficient to excite the sensation of vision. We have made some measurements on the subject, and find that this is not the case.

By working with a pinhole aperture in a light-tight room, we found that a steady source equivalent to

one-tenth candle at one kilometre is just sufficient to excite vision. When a sector was rotated in front of the pinhole, a source 16 times as strong as this acting for $\frac{1}{12}$ sec. or $\frac{1}{60}$ sec. according to the observer was sufficient to excite vision.

One-tenth candle at one kilometre delivers about $4{\cdot}51 \times 10^{-5}$ erg per sec. on a pupil of 45 sq. mm. area. Only about 1 per cent of this lies between 410$\mu\mu$ and 760$\mu\mu$. If we assume that the source has the same energy distribution as that of a black body at 2000° K, and use Hecht's values for the visibility of light to the dark adapted eye, we can obtain the distribution of the light of the source over the spectrum. About 0·21 of the whole light lies in the range 520-540$\mu\mu$, and about 0·017 of the energy between 410 and 760$\mu\mu$ lies within this range. The quantum at 530$\mu\mu$ has the value $3{\cdot}71 \times 10^{-12}$ erg. sec. This gives the result that 9840 quanta per sec. of green light are required to produce the sensation of a continuous point source. For a flash to be visible 1400 or 2600 quanta of green light are necessary, according to the observer. If the flash is red or violet, a much greater number of quanta will be required. In making the calculation we have neglected the absorption of light in the media of the eye, but this cannot affect the result seriously.

There is a striking result connected with the visibility of small sources: visibility requires the same quantity of light, no matter what is the angle subtended by the source, up to an angle of one or two degrees. This is known as Riccò's law of foveal vision. It might be supposed that there is some connexion between this law and the quantum. But the numerical values show that there is none.

R. A. HOUSTOUN.
JAS. F. SHEARER.
University of Glasgow, July 24.

Effect of Magnetic Field on Dielectrics.

IN a letter in the issue of NATURE for July 12, Prof. P. L. Burns states that the power factor of certain dielectrics is decreased when a constant magnetic field is superimposed on the dielectric which is being subjected to an alternating electric stress. One would expect that on the Debye dipole theory of polar molecules in a viscous medium the power factor would be changed by a magnetic field.

The motion of the electrical charges, or, if the molecule contained a magnetic moment, the motion of the magnetic field in a superimposed electrical or magnetic field, would give rise to a loss of energy. The force acting on the molecule would be of a nature similar to the frictional force due to the viscosity of the medium. The relaxation time is given approximately by $4\pi\eta r^3/KT$. These forces could be considered to increase the value of η and hence increase the relaxation time. This would tend to shift the peak of the power factor against frequency curve toward lower frequencies. Therefore, depending on which side of the peak one was measuring the power factor, the power factor would be either increased or decreased by the magnetic field.

It would be interesting to know on what materials Prof. Burns found his results. It seems clear that power loss in dielectrics cannot be completely explained on the Debye theory. Some work has been done here considering the double layer surrounding colloidal particles and its effect on the power factor. Possibly these experiments of Prof. Burns would make it possible to distinguish between the two mechanisms.

JOHN B. MILES, JR.
Experimental Station
E. I. du Pont de Nemours and Company,
Wilmington, Delaware, Aug. 12.

The Space-Group of Strychnine.

IN connexion with the recent work on strychnine described by Prof. R. Robinson in his recent Bakerian lecture, the results obtained from an X-ray investigation may prove of interest.

The substance forms extremely good crystals, for which I am very much indebted to Prof. Robinson.

Results:

Unit cell	$a = 11{\cdot}9_2$ A.					$c = 11{\cdot}3_0$ A.	
	Volume 1634 A³.						
Axial ratio	a	:	b	:	c		
	0·983	:	1	:	0·931		
	0·9827	:	1	:	0·9309	(Groth)	
No. of molecules	4						
Space group	Q_4	(Astbury and Yardley, *Phil. Trans.*, A, vol. 224; 1924).					

The dimensions of the cell, and the space group, are such that four molecules of the disc-shaped form suggested by Prof. Robinson can be fitted into the unit cell. Owing to the complicated nature of the molecule, and to the fact that it is composed of comparatively light atoms which have approximately equal scattering power for X-rays, it is impossible at this stage to make any further assumptions as to its structure.

THORA C. MARWICK.
The Davy Faraday Laboratory,
London, Aug. 11.

Occurrence of Mannitol in Spike Disease of *Santalum album* (Linn.).

WHILE investigating the water soluble constituents of the spiked leaf of sandal, it was found that crystals of mannitol separated on slowly evaporating the extract after clarification with basic lead acetate. 2-3 per cent of the alcohol, calculated on the weight of the green material, has been found in all the samples so far examined (15), while in no case has it been detected in healthy samples. The significance of this fact at the present stage is difficult to understand, but it appears that mannitol is one of the metabolic products of the virus. Whether such characteristic products are formed during the course of other well-known virus diseases or not is a matter for future investigation, and workers in similar fields will, no doubt, be interested in this discovery.

M. SREENIVASAYA.
Department of Bio-Chemistry,
Indian Institute of Science,
Bangalore, Aug. 25.

The Existence of the Cellobiose Residue in Cellulose.

THE chemical evidence for the view that cellobiose is preformed in cellulose is considerably strengthened by some observations we have made on the acetolysis of trimethyl cellulose. Under mild conditions of treatment at low temperatures fully methylated cellulose suffers cleavage to give a diacetyl-hexamethyl cellobiose, which is readily transformed into crystalline heptamethyl β-methylcellobioside. The experimental conditions under which this derivative of cellobiose is isolated preclude its occurrence as a reversion product of the reaction. Moreover, the yield of the crystalline β-cellobioside is equal to that of cellobiose octa-acetate obtained by the direct acetolysis of cellulose.

W. N. HAWORTH.
E. L. HIRST.
H. A. THOMAS.
University, Edgbaston,
Birmingham, Aug. 18.

Johann Kepler, 1571-1630.

THE great German astronomer and mathematician Johann Kepler, the tercentenary of whose death is being commemorated this year, was born at the little town of Wiel or Wielderstadt, not far from Stuttgart in Württemberg, on Dec. 27, 1571, and died at Ratisbon in Bavaria on Nov. 15, 1630, in his fifty-ninth year. A cenotaph to his memory was erected at Ratisbon in 1803, and commemoration celebrations will commence on Sept. 24 with an address before the memorial by Dr. von Dyck, of the Munich Technical High School.

Born at a time when his country was already torn by religious dissensions, Kepler lived to see it drenched with blood by one of the most disastrous of all wars. Altogether he lived under four Emperors, Maximilian II., Rudolph II., whose lack of capacity for government was in no way compensated for by his love of alchemy and astrology, Matthias II., anxious but unable to prevent the coming storm, and Ferdinand II., whose ingrained hatred of Protestantism led to a reign filled with persecution and strife. The Thirty Years' War had been in progress twelve years before Kepler died, but ere it had run its course the land had become a wilderness and in Kepler's native district of Württemberg it is said 58,000 families had disappeared, while the population had shrunk to one-sixth of its former numbers.

Save, however, that Kepler was a Protestant; that he once had to quit his chair on account of his religious views; that he became imperial mathematician to Rudolph; that he compiled the Rudolphine Tables, and that for many years he was dependent on the royal favour for his income, his life's work was little connected with the doings of Church or State. While princes and ecclesiastics schemed, quarrelled, and fought, Kepler steadily pursued his own course and by the exercise of his matchless intellect solved some of the problems which had baffled the greatest minds. Kepler's true contemporaries were such as Gilbert, Napier, Bacon, and Galileo rather than emperors and kings, and though students will long read of Wallenstein and of Gustavus Adolphus and pore over Schiller's famous history, Kepler's name is destined to be handed down to the remotest posterity.

If there was little in the character of the times favourable to scientific studies, neither was there in Kepler's parentage and environment anything conducive to the upbringing of a scholar. His parents, it is true, were of noble descent, but they were also in impoverished circumstances, a condition which perhaps had much to do with the unfortunate family differences. Kepler himself was a sickly seven-months' child and his boyhood was marked by serious illnesses. Yet for all that he was able to attend school at Adelberg and Maulbronn, and at the University of Tübingen in 1591 he gained his master's degree in theology. It was at Tübingen he also heard the German astronomer, Michael Maestlin (1550–1631), lecture on the theories of Copernicus. Theology by then had become of secondary importance to Kepler, and, at the age of twenty-three, through the tolerance of the Archduke of Austria, although a Protestant, he was made professor of mathematics at Gratz in catholic Styria, and it was there he began brooding "with the whole energy of his mind on the subject, inquiring pertinaciously why the number, the size and the motion of the planetary orbits were not other than they are". How he published his hastily conceived explanations; how he was advised by Tycho Brahe to obtain a solid foundation for his views from actual observations; how he met Tycho at Prague and through him was made imperial mathematician, has often been told.

Tycho only lived a year after meeting Kepler, but their association has left its mark on the history of astronomy, and it was Tycho's observations which provided the material for Kepler's researches. Of the thirty or more works published by Kepler, two stand out as epoch-making, his "Astronomia Nova", published in Prague in 1609, and his "Harmonia Mundi", published at Linz in 1619. It was in the former—published, it may be remarked, the year that Galileo first used the telescope—that Kepler enunciated his first two laws, that the planets describe ellipses round the sun with the sun at a focus of each ellipse and that a line drawn from a planet to the sun sweeps over equal areas in equal times, while it was in the second work he gave the world his third law, that the squares of the periodic times are proportional to the cubes of the mean distances of the planets from the sun.

On Kepler's many other works, his commentary on Vitellus, his book on Dioptrics, a copy of which Newton used as an undergraduate, his writings on logarithms and his Rudolphine Tables it is unnecessary to dwell. Neither is it necessary to follow him to Linz, to Sagen, to Rostock, or to recall the domestic afflictions which befell him or the miserable tale of his constant impecuniosity due to emperors whose performances did not keep pace with their promises. Through foul weather and fair alike, Kepler continued constant to the one aim, the advancement of natural knowledge, and in so doing left a great heritage to the world.

In personal appearance Kepler, as we know from his own words, was lank, lean, and spare, and that "for observations his eye was dull and for mechanical operations his hand was awkward". His delicacy of constitution, no less than his weak eyes, was sufficient to prevent him becoming a great observer. He was as remarkable for the exuberance of his imagination as for his powers of thought and his untiring industry. With these he joined an open-mindedness and candour that led him not only to record his wildest fancies but also to emblazon his greatest errors. A staunch Protestant, pinning his faith to the Confession of Augsburg, he was sincerely religious, but averse to controversies. In other directions he declared himself as "troublesome and choleric in politics and domestic matters", yet with all his frankness he was probably an easy

man to live with. His singular action when after the death of his first wife he sought another is one of the most humorous of matrimonial adventures. At his request his friends sought for a suitable companion. Eleven ladies with strangely diverse qualifications were passed in review, and of them, after much vacillation, Kepler chose Susannah Reutlinger, the daughter of a cabinetmaker. Of her he wrote that she had an education worth the largest dowry. "Her person and manners are suitable to mine—no pride, no extravagance. She can bear to work; she has a tolerable knowledge how to manage a family; middle aged, and of a disposition and capability to acquire what she still wants." For fifteen years Susannah shared Kepler's joys and sorrows and difficulties, and she bore him seven children.

In his work Kepler found the fullest satisfaction, and a discovery elated him as much as it did Davy. In Kepler there was none of the cold, passionless calm we associate with Cavendish. Like a Luther, he regarded himself as an instrument of the Almighty, and his studies were interspersed with prayer. He had once written a small treatise on the Divine Wisdom as shown in the Creation, and his subsequent works contain many passages of exaltation. When after seventeen years of searching he discovered the third of his laws his delight knew no bounds. "Nothing holds me", he said, "I will indulge in my sacred fury; I will triumph over mankind by the honest confession, that I have stolen the golden vases of the Egyptians, to build up a tabernacle for my God, far away from the confines of Egypt. If you forgive me, I rejoice; if you are angry, I can bear it. The die is cast; the book is written, to be read either now or by posterity—I care not which. It may well wait a century for a reader as God has waited six thousand years for an observer." Kepler's work, however, was appreciated immediately by his contemporaries, while of his discoveries the famous French physicist Arago once wrote: "Les lois de Kepler sont le fondement solide et inébranlable de l'astronomie moderne, la règle immuable et éternelle du déplacement des astres dans l'espace. La gloire de Kepler est écrite dans le ciel; les progrès de la science ne peuvent ni la diminuer ni l'obscurcir, et les planètes, par la succession toujours constante de leurs mouvements réguliers, la raconteront de siècle en siècle."

The Taxonomic Outlook in Zoology.*

By Dr. W. T. CALMAN, F.R.S.

THE anatomist, the physiologist, the field naturalist, the student of one or other of the innumerable specialisations of biological science, has always been inclined to regard with distaste, if not with contempt, the work of those whose business it is to denominate, classify, and catalogue the infinite variety of living things. The systematist is generally supposed to be a narrow specialist, concerned with the trivial and superficial distinctions between the members of some narrow group of organisms which he studies in the spirit of a stamp collector; happy when he can describe a new species, triumphant if he can find an excuse for giving a fresh name to an old one.

It would be idle to deny the truth that there is in these criticisms, just as it would be easy, although unprofitable, to point out that the substance of them might be directed against the practice of most other branches of research. The specialist, of whatever kind, has a tendency to mistake the means for the end, to become fascinated by technique, and to suffer from a myopia that blurs his vision of other fields than his own.

I think, however, that there are some signs of an increasing appreciation of the usefulness and even of the scientific value of taxonomy among the younger generation of zoologists. More particularly, those who are concerned with the applications of zoology to practical affairs are, for the most part, although not invariably, aware of the need for exact identification of the animals they deal with. They do not always realise the difficulties that may stand in the way of this identification. It is a common experience with us at the Natural History Museum to have some mangled fragments of an animal brought in by a practical man, who expects to be supplied with the name of it while he waits. I am afraid that he often goes away with a low opinion of our competence.

It may not be without interest, therefore, if I attempt, in the first place, to give some idea of how matters stand with this part of the systematist's task, the identification and description of the species of living animals.

When Linnæus published in 1758 the first volume of the tenth edition of his "Systema Naturæ", he named and described about 4370 species of animals. If we ask how many are known to-day, the diversity of answers we get is some indication of the confusion that exists. Some years ago, at the request of the late Sir Arthur Shipley, I endeavoured to get from my colleagues at the Museum estimates of the numbers of species in the various groups with which they were specially conversant. Some of the answers obtained were very interesting. With regard to mammals I was told "anything from 3000 to 20,000, according to the view you take as to what constitutes a species". For the most part, however, the authorities consulted were unwilling to suggest even an approximate figure, for a very different reason. They told me that great sections of the groups with which they were concerned were so imperfectly surveyed that it was quite impossible even to guess how many of the supposed species that had been described would survive reconsideration.

It may be worth while to consider for a little the

* From the [presi]dential address to Section D (Zoology) of the British Associa[tion] delivered at Bristol on Sept. 4.

second of the two obstacles thus indicated as standing in the way of obtaining a census of the known species of animals. In the days of Linnæus, it is likely that a very experienced zoologist might have been able to recognise at sight any one of the four thousand species of animals that were then known, and when the expansion of knowledge had made such a feat no longer possible, the specialist who confined his studies to one section of the animal kingdom could still aspire to a like familiarity with the species of his chosen group.

With this kind of knowledge it is literally true that, as has been said, a systematist recognises a new species by instinct and then proceeds to search for the characters that distinguish it. Some of the great zoologists who were still working in the British Museum when I entered it more than a quarter of a century ago, men like Albert Günther, Bowdler Sharpe, C. O. Waterhouse, and Edgar Smith, had actually an amazing personal familiarity with vast sections of the animal kingdom. They had studied and digested all that had been written on their subject, and, if they did not carry the whole of this knowledge in their memory, they could, without searching, put their hand at once on the volume that would help them. They had no need of 'keys' to help them to run down their species: indeed, they rather distrusted such aids, for they knew how easily they betray the heedless.

Specialists of this type there must always be, and we may be thankful for it. Nothing can altogether replace that instinctive perception of affinity that comes from lifelong study. It has often happened that men such as those I have named were able, when confronted with new and aberrant types of animals, to allot them at once to a place in classification which subsequent research served only to confirm. As time goes on, however, the extent of ground that can be covered in this fashion by the most industrious worker is rapidly diminishing. The torrent of publications catalogued in the "Zoological Record" increases year by year, and the specialist, if he is not to be overwhelmed by it, must not allow his curiosity to stray beyond the limits of a narrow corner of the field.

By far the greater part of this literature is written by specialists for specialists, and much of it is unintelligible to anyone else. From the time of Linnæus, however, there have not been wanting publications that have a different aim. We have monographs, synopses, revisions, of all sorts and sizes, attempting to render possible the identification of species without demanding a lifetime of study for each special group. The ideal for such monographs would be, I assume, that they should be intelligible to, and render possible the determination of species by, any properly trained zoologist, even without previous experience in dealing with the particular groups of which they treat.

The Zoological Department of the British Museum may fairly claim to have done more towards this re-editing of the "Systema Naturæ" than any other institution in the world. The long series of monographs, of which the true character is somewhat concealed under the official title of 'catalogues', is a monument to the learning and industry of the great zoologists who planned and executed them. Though they remain indispensable to all serious students of the different groups, however, they are now, for the most part, long out-of-date, and, vast as is their scope, they cover only a fraction of the animal kingdom.

In 1896 the German Zoological Society began the publication of "Das Tierreich", afterwards continued by the Prussian Academy, which was planned to give nothing less than a revision of all the species of living animals. Here again, however, after thirty-four years, only a small part of the ground has been covered and already the progress of research has rendered many of the earlier parts obsolete. Col. Stephenson tells me that Michaelsen's revision of the Oligochæta, published in this series in 1900, deals with exactly half the number of species enumerated by the same authority in 1928.

Apart from these attempts at comprehensive revision, we have, of course, numerous surveys of local faunas on a larger or smaller scale, besides monographs of restricted groups, but scarcely ever do these fit together without leaving gaps, geographical or systematic.

The number of described species of animals has been estimated at something in the neighbourhood of three-quarters of a million. It is not at all improbable that between a quarter and a third of that number would be suppressed as synonyms or put aside as *species inquirendæ* by careful monographers, and that in many groups the proportion would be far higher.

The prospect is not one that can be contemplated with any satisfaction. The successively expanding volumes of the "Zoological Record" give us a picture of systematic zoology being smothered under the products of its own activity. The confusion will grow steadily worse unless systematists come to realise that the mere description of new species is a far less important thing than the putting in order of those that are supposed to be already known, and until, on the other hand, zoologists in general cease to regard taxonomy as a kind of menial drudgery to be done for them by museum curators.

I have alluded to another obstacle to obtaining an enumeration of the animal kingdom, in the divergences of opinion as to what constitutes a species. I am not sure that these divergences are not sometimes over-estimated. I think that it will be found that in most orders of animals there exists a considerable body of species regarding the limits of which there is no serious difference of opinion among competent systematists; but alongside these we find in almost every order, in most families, and even in many genera, a 'difficult' residue in which the delimitation of specific groups sometimes seems to be little more than a matter of personal taste. Mr. G. C. Robson has recently brought together a great deal of information on

this subject in his book "The Species Problem", to which I would refer anyone who needs to be convinced how complex the problem really is. For our present purpose it is enough to take the empirical fact that the majority of animals can, with more or less trouble, be sorted into assemblages or kinds that we call species. We have seen how imperfect and confused is the present state of knowledge even as regards the mere description and identification of those kinds.

The business of the systematist, however, does not end with identification. Even identification requires some kind of classification, if it is only the classification of the dictionary. Since the time of Linnæus, or rather, since the time of John Ray, zoological systematists have believed in the existence of a natural system of classification which it was their business to discover; since Darwin it has seemed plain that this natural system must be, in some way, based upon phylogeny. It is now realised that the relation between the two is not always so simple and straightforward as it once appeared to be. Dr. F. A. Bather, in his presidential address to the Geological Society in 1927, discussed the historical and philosophical bases of biological classification. He concluded that "The whole of our System, from the great Phyla to the very unit cells, is riddled through and through with polyphyly and convergence", and that "Important though phylogeny is as a subject of study, it is not necessarily the most suitable basis of classification". I am not sure that I quite understand what is implied by the second of these statements, but I do not suppose that even Dr. Bather would be prepared to suggest a system of classification entirely divorced from phylogenetic considerations.

Forty years ago the reconstruction of the evolutionary history of the major divisions of the animal kingdom was almost universally regarded as the chief end of zoological research. To-day, except among palæontologists, one might almost say that the phylogenetic period in the history of zoology has come to an end. When one recalls the extravagances of its later developments, the derivation of vertebrates from arachnids and of echinoderms from cirripedes, one cannot be surprised that zoologists of the modern school take little interest in it. If we accept this attitude, it follows that problems of affinity and relationship are not worth worrying about. We are told, in so many words, that our business as systematists is identification, not classification; that what we have to do is merely to devise some kind of key or card-index that will enable animals to be quickly and easily sorted into species. So far as the really scientific branches of zoology are concerned, an artificial system of classification is as good as, and may even be better than, any other.

It is quite true that the categories of the physiologist, the ecologist, the geneticist, and so on, often cut across the dividing lines of the most natural classification we can devise, but both the divergences and the coincidences are worthy of closer consideration than they sometimes receive. If there is any truth in the theory of evolution, it is obvious that functions and habits have an evolutionary history behind them, but it is no less obvious that this history has not been independent of the history of the organisms that display them. The details of this history we shall never fully know, and even its broad outlines may perhaps always remain misty. A natural system of classification expressing even these broad outlines may prove to be an unattainable ideal, but each step towards it holds out the promise of usefulness in other and possibly remote fields of research.

A great deal of current work and still more of current speculation in zoology seems to me to suffer from this neglect of the taxonomic outlook. In the zoology of the later nineteenth century the comparative method was still the chief tool of morphology. The relative importance of structural characters was measured by the extent of their persistence through larger or smaller divisions of the animal kingdom. This point of view tends to be lost sight of with the increasing emphasis on the experimental method. The systematic zoologist, in listening to the exponents of the modern lines of research, is apt to be impressed by the little account that is taken of the vast variety of animal life. To say this, is not to underrate in any way the advances that have been made in these lines within the present century or the revolutionary changes they have made in our views on many fundamental questions. Physiology, for example, is to-day a vastly different science from what it was thirty years ago, partly because the physiological laboratory has a more varied fauna than it had then. Nevertheless, the zoologist, conscious of the unending diversity of structure and of habits among animals, sees the physiologist's results against a background of which the physiologist himself seems to be sometimes forgetful.

One hesitates to suppose that the students of heredity are really so forgetful of this background as they sometimes seem to be. No doubt intense specialisation is needed for intense research; but the Poet of the Breakfast Table, laughing gently at the narrow specialism of the Scarabee, can scarcely have foreseen the day when a university in his own country would have upon its teaching staff an officer named in the university calendar as a 'Drosophilist'.

It is possible, however, that the prevailing lack of interest in questions of phylogeny may have a deeper significance. Those departments of biology that are being most actively studied at the present day are preoccupied with the interplay of forces acting here and now. They ignore the impressions that time may have left on the material of their study. It is as though a crystallographer, studying a pseudomorph, should endeavour to explain its form in terms of its chemical composition and the forces governing the arrangement of its molecules, without taking account of its past history.

From ignoring anything, it is but a short step to denying its existence, and here, it seems, we have already arrived. In a lecture delivered in

London in the early part of last year by that very distinguished experimental biologist Dr. Hans Przibram, he suggested that we might have to consider the possibility that every species of metazoan has developed independently of all the others from a distinct species of protozoan. The same view was set forth by him in a lecture delivered in Paris on the theory of apogenesis (*Rev. Gen. Sci.*, **11**, No. 10, May 31, 1929, p. 293). As the English lecture has not been published, I will translate as closely as I can from the French one. "I do not think it likely", he says, "that a single substance can have given rise to a general phylogenetic tree according to the classical diagram representing the affinities of species and their distribution in space and time. All the facts would be explained more easily by supposing that there existed, at the beginning, many organised substances developing side by side into species, each of the latter passing through stages more and more advanced without actual relationship of descent between the different species."

Many authors have believed in a multiplicity of the primordial forms of life, but few have suggested an independent origin for grades lower than the main phyla. Przibram, with strict logic, has carried the same reasoning down to the individual species. Most biologists with whom I have discussed the matter refuse to take his suggestion seriously. This, I venture to think, is a mistake. Przibram has simply carried to their inevitable conclusion certain lines of thought that we meet with everywhere in current biological literature; that conclusion is either one of the most significant results of recent biology or it is the *reductio ad absurdum* of much contemporary work.

Geneticists have made us familiar with the doctrine of the inalterability of the gene, with its corollary of evolution by loss of factors, which, by the way, seems to differ little from Przibram's apogenesis. The experimentalists have proved (if it wanted proving) the plasticity of the phenotype, as, for example, when Przibram himself shows that the length of a rat's tail is a function of the temperature to which the individual and its immediate progenitors have been exposed. As for the inheritance of impressed modifications, the more unequivocal the experiments devised to demonstrate its reality the more clearly do they show it to be of so fugitive a kind as to have no significance in evolution. Palæontologists, as Dr. Bather has told us, have proved beyond the possibility of doubt the occurrence of parallel and even of convergent evolution, without telling us where we are to stop in applying the principle. Many supposed examples of adaptation fail to stand closer scrutiny, and therefore the whole idea of adaptation is declared to be a subjective illusion. All these results at any rate place no obstacles in the way of Prof. Przibram's suggestion.

It is to be noted that although the theory of apogenesis is called a theory of evolution, it does not deal at all with evolution as that word was used by Darwin. It has nothing to say on the origin of species. On this question it is no more than a doctrine of special creation at one remove. It has no light to throw on classification. If we are to abandon belief in community of descent, the whole architecture of the "Systema Naturæ" becomes meaningless.

Prof. Przibram claims that "All the facts would be explained more easily" upon his hypothesis, but there is one point on which he speaks with a hesitant voice, and it seems to me a very significant exception. "We cannot decide", he says, "whether the differing though related species that inhabit islands or isolated territories are descended from a common source or result from the accidental separation of species which formerly occupied the region together."

Let me recall the opening words of the "Origin of Species". "When on board H.M.S. 'Beagle' as naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent." So Przibram ends where Darwin began. The geographical and geological distribution of organisms, which for the one are merely the negligible residue of unexplained facts, were for the other the very heart and core of the problem he set himself to consider.

It is worth remembering that among Darwin's other qualifications as an interpreter of Nature, he was an experienced taxonomist, and before he wrote "The Origin of Species" he had produced one of the finest systematic works ever written in his "Monograph of the Cirripedia". Those of us who were present at the memorable Darwin-Wallace celebration of the Linnean Society in 1908 remember how the veteran Alfred Russel Wallace discussed "the curious series of correspondences both in mind and in environment" which led Darwin and himself, alone among their contemporaries, "to reach identically the same theory", and how he gave the first place to the fact that both he and Darwin began by collecting beetles and thus acquired "that intense interest in the mere variety of living things" which led them to speculate upon the 'why' and the 'how' of "this overwhelming and, at first sight, purposeless wealth of specific forms among the very humblest forms of life". It might be worth while to inquire whether a training that proved useful to Darwin and to Wallace would not be of some value to students of zoology even at the present day.

The experimental method has answered many questions and it will answer many more, but there are some questions, and these well worth the asking, to which experiment will never find an answer. No one will maintain that taxonomy by itself will answer them, but it will often suggest where the answer is to be sought for, and it will provide a point of view from which both questions and answers will be seen in a true perspective.

Finally, I would recall a remark once made in my hearing by a wise old naturalist, the late Dr. David Sharp. Someone had been remarking on the

decline of systematic zoology and predicting the extinction of systematic zoologists. Dr. Sharp replied, in effect, "I have seen many passing fashions in zoology, many departments of research becoming popular and then falling into neglect; the one branch that will never fail to attract is the systematic one. The æsthetic satisfaction to be derived from contemplating the mere variety of animal forms, and from tracing the order that runs through all its diversity, appeals to a very deep instinct in human nature. There will always be systematic zoologists."

Obituary.

PROF. H. W. WILEY.

IN Harvey Washington Wiley, who died on June 30, we lose a man who was a great Uesanian warrior in the cause of pure food, a man of imperious character, officially a perfervid Puritan idealist and extremist, yet in the society of friends the perfect Yorick, "a fellow of infinite jest, of most excellent fancy". As first administrator of the American Food and Drugs Law, his own beloved child, he was nothing short of an all's-fair-in-love-and-war man: perforce, in fact, he had to adjust his methods of attack to the times and to those of his foes, as he was severely up against trade interests. He trod heavily upon not a few corns and it is clear that, occasionally, his pendulum swung beyond the limits of scientific reason; still, the end was one to justify almost any means. He had courage and, in large measure, won, as he definitely established a sound public opinion.

I first met Wiley in 1903, at his most active period, at a gathering of Agricultural Experiment Station workers, in Minneapolis, at which I was present as Lawes lecturer. He was the life and soul of a large meeting; ever full of resource. Thus, on one excursion, in a dry town on a very hot day, displaying a surprising geographical instinct, he took some of us poor sufferers to a pharmacy and tendered a prescription on our behalf: the medicine we got passed all the Brer Rabbit tests for good ale and no doubt saved our lives. A few years later he and I forgathered at Washington, in the Cosmos Club, an institution the worth of which will be known to many. We met one afternoon in the main square, to go out to the Country Club. He was carrying a parcel and there was a suggestive bulge at his hip. We were to pass the county border, into an arid region. The parcel and that bulge were of no slight aid to our evening's pleasant intercourse. There is an immoral to this tale. At the time of his retirement, late in life, he passed under petticoat rule, to become thereafter an exemplar of dryness. The injury done to him by his previous depravity—at least so his friends claimed—was made obvious by the arrival, without undue delay, of two healthy boys. Several months ago, hearing that he was very ill, I wrote to cheer him, suggesting that he set an example by repenting of his later sin. This amused him, I was told. The reply, bearing his signature, gave too much advice for the good of my soul to be his. I could only write back that John Barleycorn had not done much obvious harm to either of us. My old friend became in fact a first-class humbug in the matter of drink: probably he was never a man of really balanced, scientific judgment. We have to hold such men very much in mind, however, in taking stock of the States: too few realise how rigid the American outlook often is.

Only recently, the *Times* told us, an American Senator wrote to our Ambassador in Washington to protest against the exercise of his right to take liquor into the Embassy, suggesting that such action was likely to have the most serious effect upon our international relations. Do Americans recognise how entirely they are cutting us off from rational intercourse with them? We welcome them here in crowds and they do not seem to return habitual drunkards. Few of us go from this side as travellers —we only visit the States when compelled, either on business or when imported to join in colloid worship at Cornell or some similar academic frivolity. Few Uesanians understand how impossible it now is for us to risk travelling in their country—the danger of their soft drinks. Yet it is one that is full of beauty and interest, as I can vouch; the only difficulty is that there is so much of it. Whatever it be, it is a land in which, at times, every pore of you aches for beer; one where the hart ever pants for the cooling Milwaukee stream.

Straining at the gnat ethanol, to-day, Americans swallow the camel caffeine in canfuls: however, a missionary from here is now in Canada who will disabuse them (of course piously, on week-days) of this delight. As a matter of fact, Wiley, in 1912, warned the American public against the danger of too much caffeine. He was often here and always amusing. Describing once the activities of his Department, he told how advice was given which led to the need for water in one of the arid regions of Texas being overcome: this was done by growing onions between rows of potatoes; the eyes of the potatoes watered so much that artificial irrigation became unnecessary.

It matters little where a man like Wiley came from. *Pro forma*, let it be told that he was born in Indiana on October 10, 1844. In 1863 he went to College; in 1868 he began to study medicine, graduating M.D. from the Indiana Medical College in 1871. Probably medical education at that time was no great shakes. He then had a year in the Lawrence school at Harvard; became professor of chemistry in Butler College, in 1873; from 1874 to 1883 he was professor of chemistry at the Agricultural College, Purdue, Indiana, spending a year in Germany during this period. State chemist of Indiana in 1881, he was made chief of the Division of Chemistry in the U.S. Department of Chemistry in 1883. He was president of the American Chemical Society in 1893–94. In 1901 he was pro-

moted chief of the Bureau of Chemistry. Then it was that food reform became his master passion.

Wiley resigned in 1912, after great provocation. The Food and Drugs Law had been enacted after half a century of effort and discussion. The measure came into operation in January 1907. Almost at once, he has told us, he discovered that his point of view was fundamentally different from that of his superiors. During six years the feeling grew that the differences were irreconcilable and he became conscious of an environment which was essentially inhospitable. The fundamental principles of the Bill, as they appeared to him, one by one, were paralysed and discredited. It is easy to imagine what happened: the thorn he must have been in the side of the provision trade and the attempts that will have been made to unseat him. Convinced that he could work more fruitfully by rallying public opinion to the support of the cause he had so much at heart than by exercising the limited activity left to him in his official position, he resigned. On retiring into private life, he interested himself in his farm and became a diffuse, popular writer of food propaganda.

We have, I think, to quarrel severely with Wiley's extreme attitude towards preservatives in food. His view was that there should be no addition of any kind made to food. As the primrose to Peter Bell, every food spade, to the public, was to be a spade absolute, nothing more. His most celebrated work is the inquiry he undertook, with a set of young men as subjects, to ascertain the effect of preservatives, especially boric acid: the results were recorded in a very lengthy report of about 2000 pages. Grave exception has been taken to this work. He was probably not qualified, either as chemist or biologist, to undertake such an inquiry: he was far too much a victim of preconceived opinion and not sufficiently trained either as observer or as logician. He would have excluded every preservative. Owing, however, to Ira Remsen's intervention, whose higher scientific standing prevailed, benzoic acid was allowed. Wiley, I believe, managed later to persuade the President to subvert this decision.

As is well known, within recent years, our Ministry of Health, which is a hive of idealisms, has followed the American suit. No scientific proof has yet been given that, used as an antiseptic, boric acid does harm when added in the small amounts needed to preserve even so perishable an article as cream. The officials of the Ministry are no more competent than Wiley was to settle such an issue. The decision was taken by a Departmental Committee on idealistic grounds. As a result, the cream industry is severely dislocated, if not destroyed. The public have full right to complain, the more as sulphur dioxide is still allowed in some beverages: its evil effect is well known to many who go to public dinners. I hold no brief; my mind is open. I know what the danger is in lead works, when there is real exposure. I also know the great boric acid works in Tuscany; these reek of the acid in every direction—yet the work-people are all healthy. If only in justice to Wiley's memory, we ought, without delay, to study the problem afresh scientifically, with complete thoroughness and detachment, so that we may either justify or cancel his finding. It is farcical for us to hold the cake of science and not eat it. We can't afford such extravagance to-day.

HENRY E. ARMSTRONG.

MRS. ALBERT HOWARD.

A SEVERE blow has been dealt to the progress of science in India through the death at the age of fifty-three years of Mrs. Albert Howard, which took place at Geneva on Aug. 18 last. Miss G. L. C. Matthaei entered Newnham College, Cambridge, in 1895 and secured the double distinction of a first class in both parts of the Natural Science Tripos. Thereafter she continued to reside at Cambridge, being elected a fellow, and later an associate, of her College. She was fortunate at that time in coming under the powerful influences of Miss Ida Freund and Dr. F. F. Blackman. Her work in association with the latter developed in her a capacity for patient pursuit of the elusive in research which was so marked a characteristic of her work to the last. That early work is to be found in the *Philosophical Transactions* of the Royal Society, and has found a permanent niche in the literature on vegetable assimilation.

From 1905, when she married Mr. Albert Howard, the scene of her activities shifted to India. With that marriage commenced a comradeship which, if not unique in the annals of science, is at least unique in that it received official recognition from the Government of India, for, in 1910, she was appointed personal assistant to her husband and, in 1913, Second Imperial Economic Botanist. She was also awarded, by H.M. the King, the Kaisar-i-Hind medal of the First Class.

It is not possible, even for one who has had the privilege of sharing in part of the labours of the Howards in India, to apportion merit between the two comrades. Their work stands, and is best left, as a joint record of their devotion to each other and to India. But Mrs. Howard's association with Pusa introduced a definite economic trend, absent from her earlier work but becoming more and more marked with time. In 1905 the Agricultural Department in India was but recently reorganised and the impetus given by the rediscovery of Mendel's work was still fresh. The earlier papers are tinged by these facts and many plant breeding problems in this new field were brought to solution by these new methods. But even at this period the economic aspect was not neglected, as the 'Pusa wheats', already entering into general cultivation, and now covering more than three million acres, witness. This earlier work culminated in the monograph on "Wheat in India", and thereafter an ever-widening field opened out. The logic of a position in a country where rotations are habitually practised cannot be denied; the whole field of crop production and the methods of applying science thereto becomes the centre of investigation. This urge to a wider field of

investigation is traceable through the large series of publications which have appeared. It is an urge which found its consummation in the foundation of the Institute of Plant Industry at Indore, where the last six years of her life's work have been conducted.

The same widening outlook found an outlet in the first proposals for the founding of an Indian Science Congress. In that movement Mrs. Howard took a deep personal interest and she presided over both the Botanical and Agricultural Sections. It is not possible to estimate the material benefit of her work to India—undoubtedly it has been great; but the greater loss is that which arises from the balanced judgment, on both scientific and practical problems, which she was ever ready to place at the disposal of all who sought it.

PROF. JEAN BRUNHÉS.

JEAN BRUNHÉS, the French geographer, who died at Boulogne-sur-Seine on Aug. 25 at the age of sixty-one years, was one of the leading exponents of human geography of his time. By his teaching and published works he did much to put the subject on a sound scientific basis, and to lift it from the narrow lines of geographical determinism into which it tended to fall some years ago.

Brunhés was born at Toulouse and studied law at the university there before turning to science at the École Normale. His first work was on the geographical conditions of irrigation in Spain and Northern Africa. This was published in 1902 and showed a grasp of geographical correlations and a width of outlook. Much of his later work was done during the sixteen years when he held the chair of geography in the University of Fribourg, to which he was the first appointment.

In 1910 Brunhés published his "Géographie Humaine", which immediately became a standard work and has remained so to this day. It was afterwards expanded into a much larger work, and it also appeared, with some changes, in an English edition. Brunhés was also responsible for the geographical chapters in Gabriel Hanotaux's great history of France. These constitute a whole volume entitled "Géographie humaine de la France". A third important work was his "Géographie de l'histoire". According to the *Times*, he was engaged at the time of his death on a history of races. Brunhés was elected a member of the Institut de France in 1927.

WE regret to announce the following deaths:

Mr. Walter Deane, a past president of the New England Botanical Club, who was known for his work on the flora of north-eastern North America, on July 30, aged eighty-two years.

Prof. Cornelius Doelter, emeritus professor of mineralogy in the University of Vienna, and author of works on chemical mineralogy and related topics, on Aug. 8, aged seventy-nine years.

Mr. Henry W. Henshaw, formerly chief of the Biological Survey of the U.S. Department of Agriculture, and author of "Birds of the Hawaiian Islands," on Aug. 1, aged eighty years.

Dr. Wyatt W. Randall, formerly chief of the Maryland Department of Health, and president in 1926 of the Association of Official Agricultural Chemists, on July 22, aged sixty-three years.

Mr. J. W. Wilson, from 1892 until 1908 president of the Society of Engineers and co-founder with his father of the Crystal Palace School of Engineering in 1872, on Sept. 3, aged seventy-eight years.

News and Views.

IN our last issue (NATURE, Sept. 13, p. 391) we referred to the measures which are being taken or are under consideration by the Commonwealth Government of Australia to ameliorate conditions among the aborigines. Of the suggestions which have been made, the most important is undoubtedly that which recommends that the aborigines as a whole should come under the control of the Commonwealth Government. It involves many difficulties and would entail numerous adjustments as between the Commonwealth and State authorities; the obstacles, however, should not be insuperable, and the advantages which would accrue are too great to be lost without determined effort. Not the least of these would be that continuity and uniformity in policy could be secured by one authority dealing with the aboriginal question as a whole; and further, a wider and more effective public opinion would be brought into play when any question affecting policy or any specific measure was under consideration. All competent observers are agreed that in present conditions the extinction of the aborigines is a matter of only a comparatively brief period. With the lamentable example of the extinct Tasmanians to point the moral, no measure, however difficult of achievement, should be left untried to avert a similar fate from the Australian tribes, in some cases, unfortunately, already reduced to the merest fragment.

THE question of the aborigines is more than a domestic matter which concerns Australia alone. Apart from humanitarian considerations, the question touches a wide circle of interests in the world of science. At the recent Bristol meeting of the British Association a resolution submitted to the Council pointed out that the Australian aborigines are now among the most valuable peoples available for scientific study, and offer opportunities of unequalled importance for research and future investigation in the early history of mankind. The resolution, while recognising the value of the measures now proposed by the Commonwealth Government, went on to ask the Council to urge upon that Government the need for anthropological training for officials entrusted with the administration of the affairs of the aborigines and the adoption of every means to prevent their extinction and the further disintegration of native society. Notwithstanding the economic and financial

difficulties in which Australia is at present involved, the time is favourable to the initiation of an enlightened policy. Under the Anthropological Research Fund of the National Research Council, now well on its feet after three years' work, the Government has a body of expert workers who are making an intensive study of the aborigines ; in the existing system of Protectors of the Aborigines it has the machinery through which, given the requisite anthropological training, the results of that intensive study can be brought to bear upon the problems of administration ; and lastly, in Papua and the mandated territory of New Guinea, the administrative officers of which receive an anthropological training in the University of Sydney, it has the example and the experience necessary for guidance in dealing with the problems of training and organisation.

EXCAVATIONS at Kent's Cavern, Torquay, have been continued during the past winter from October to May by the joint Committee of the British Association and the Torquay Natural History Society. According to the report of the Committee, the trench begun last year has been carried to a length of 60 feet and a depth of 7 feet below the upper stalagmite floor, bed rock being reached near the entrance of the Wolf's Cave. Finds, probably not in their original position, included a quartzite pebble of Budleigh Salterton Pebble Bed type, which had been used as a hammerstone, three flints showing signs of use, and an interesting bone implement shaped to a sharp and much used point. These finds were in the 'Sloping Chamber'. The fauna, all of late Pleistocene type, included horse, still predominating over hyena, rhinoceros, stag, mammoth, *C. Megaceros*, bear, bos, and wolf in the numerical order named. The deposit is of mixed ages, the middle crystalline stalagmite floor being absent. In deepening the Bear Den the base of the concrete breccia was reached, revealing a fine silt below apparently identical with the silt at the base of the deposit in the 'Gallery'.

A REPORT on Educational and Documentary Films prepared by a British Association committee, of which Sir Richard Gregory is chairman and Mr. J. L. Holland is secretary, was presented to the Education Section at the recent Bristol meeting. The committee has restricted itself to the consideration of four matters and makes suggestions on cinematograph films, cinematograph apparatus, illumination and eyestrain, and structural conditions. The most important recommendation is that for classroom use the film should be non-inflammable, as is usually the case with films of 16 mm. width. The difference between the nitrate base film and the acetate (or non-flam) film is, however, not so great in the sub-standard size as when the film is of a width of 35 mm. It is pointed out that the 16 mm. film gives excellent results in classrooms not exceeding a seating capacity of 80, and the limit is, or will be, reached in lecture rooms for 120–150. Recommendations are made as to the size of screen suitable for use with this film and the structural conditions desirable when the projector is installed. In an appendix a specification is given of a 16 mm. projector.

WHAT does not appear in the report is the evidence on which the selection of a 16 mm. film is based, as against either larger or smaller sizes, unless it is contained in the statement that "there is a large selection of reliable apparatus for producing such films made by firms of repute". This, of course, is a condition to be taken into account, but when there are only about three hundred schools in Great Britain with apparatus of any kind and probably not half a dozen where it is used in the classroom for teaching purposes, as distinct from school halls for general education purposes, it would be worth while to undertake experiments to determine the ideal size, say, for the classroom. If that size could not be obtained, then it would be time to fall back on the 16 mm. On the face of it, the statement that the 16 mm. film is suitable for classrooms with eighty seats suggests that it is at least unnecessarily large for classrooms of thirty or even sixty, the maximum class number, soon to be done away with. Further, for anything from 30 per cent to 90 per cent of the time a film is used in the classroom, again in distinction to the hall, it is standing still, and in the case of the 16 mm. this has to be accompanied by a diminution of the light or the film will scorch. As the 9 mm. is somewhat too small, it may be suggested that the ideal size is somewhere about 11 mm. or 12 mm.

THE importance of accurate survey as a basis for the utilisation of land in our African colonies was emphasised in the Hilton Young Commission Report. In the *Journal of the African Society* for July, there is printed in full a recent lecture to the Society by Col. H. L. Crosthwait, in which he advocates the use of aerial survey in east and central African territories. Ordinary ground survey in a large colony would entail many years of work and very considerable expense before results of value were available. Col. Crosthwait points out that aerial survey would not only be three or four times as quick, but would also give a far greater amount of information about the economic resources of the country. This was shown in the recent survey of the Zambezi region, where reliable data were obtained regarding the geological structure, the state of the rivers, forestry, and other matters. It must also be remembered that aerial methods overcome many difficulties in swampy, heavily forested, or unhealthy country. Again, location surveys for railways and roads can be carried out much more rapidly by means of air survey than would be possible by the older methods. In a subsequent discussion on the paper, Sir Humphrey Leggett pointed out how much the administrative work of district and provincial commissioners would be facilitated by adequate maps. Col. Crosthwait does not advocate that the aerial surveys should be undertaken by the local governments themselves, but gave reasons why it would be less expensive and give quicker results to utilise private enterprise in the work.

THE programme of the ceremonies by which the Royal Geographical Society will celebrate its centenary on Oct. 21 next and the two succeeding days has now been issued. All the principal geographical

societies and institutions of the world have been invited to send delegates to these celebrations and a very large number have responded. Addresses of congratulation presented by these delegates will be received by H.R.H. the Duke of York, representing His Majesty the King, who is Patron of the Society, at the inaugural meeting at 3 P.M. on Oct. 21, when the Duke will also declare the new Hall, Library, and other buildings open for the use of the Society. The centenary meeting will be held in the newly opened hall at 8.30 P.M. on the same evening, when a series of addresses on the history of the Society will be given by the president and others. On the following evening the president, council, and fellows will entertain the delegates and a large number of official guests at a reception at 9 P.M. in the Society's House in Kensington Gore. The centenary dinner of the Society will be held on the evening of Oct. 23 at the Connaught Rooms, when H.R.H. the Prince of Wales, Vice-Patron of the Society, will preside. The programme announces also a series of communications from British and foreign geographers on the topics of the habitable globe and incidents in the history of exploration, to be presented at meetings on the morning of Oct. 22 and the morning and afternoon of Oct. 23.

THE determination of the permissible practical load an electric motor or dynamo can carry, that is, the determination of the power at which it should be rated, is a practical problem of considerable difficulty. The temperatures of the various parts of a machine must not exceed the limits given in the specification after it has been running on load for many hours and has attained its steady thermal state. Owing to the long time taken before the temperatures of the various parts of a machine reach their steady values, many attempts have been made to devise methods of predicting the final values by taking observations over a brief period of time. Could this be done, substantial economies could be effected in manufacturing works. The theoretical methods attempted generally proceed on the assumption that the heat convected away depends on the square root of the velocity of the rotating part and is proportional to the difference in temperature between the conductors and the surrounding medium. The loss by radiation, being much smaller, is generally neglected. Practical tests have also been made on model machines but hitherto no satisfactory methods of shortening the time of heating tests have been devised. In the *Journal of the Institution of Electrical Engineers* for July, two papers by Dr. E. Hughes describe the results of heating tests on actual machines. He varies the losses and the speeds, and his results show that the conclusions arrived at by experiments on models must be accepted with caution. The machines were tested both when 'totally enclosed' and when cooled by an induced draught. Several empirical formulæ are given, one of which enables the effect of speed to be allowed for when estimating the temperature rise.

A VERY novel use of refrigerating machinery for the salvage of ships is described by D. Mettler in the April–June issue of the *Escher Wyss News*, a journal published quarterly by the well-known engineering firm of Escher, Wyss and Co. of Zurich. Some years ago a Berlin engineer, W. Kiwull, devised a method of sealing a leak on a ship by forming a coating of ice over the rent in the metal hull. In northern seaports in winter time it is quite customary to see the hulls of ships all iced over, and this apparently suggested the idea to him. A company was formed and plans for a test plant were made and elaborated by Messrs. Escher, Wyss and Co. The test plant was to have a gross refrigerating capacity of 120,000 British thermal units per hour, and the power consumption was to be 25 horse power. The specification stated that the plant was to be erected and worked at a depth of between 10 ft. and 15 ft. below the level of the lake of Zurich. It was then to be worked for a fortnight without a hitch, maintaining its guaranteed output continuously. The refrigerating plant was contained in a water- and air-tight iron casing, the electric connecting cables and the connecting branches for the evaporating apparatus coming through. Under these trying conditions, the plant operated at full load continuously for 336 hours, that is, fourteen days and nights. A careful examination showed that it had not suffered the least injury. Many thousands of readings were taken during the tests, and the results show that the mimimum guaranteed output had been largely exceeded. From time to time the ice formation on the evaporative tubes was checked by divers. Ammonia vapour was employed and full technical descriptions are given in the journal of the compressing plant.

THE Report of the Carnegie Institution of Washington for 1929 is noteworthy, apart from its indications of progress in research, for the inclusion of a series of addresses delivered at special meetings at Cold Spring Harbor and on the research ship *Carnegie*, to celebrate the completion of twenty-five years' investigation in the biological and physical sciences. In the course of one of these addresses, Prof. E. G. Conklin summarised the progress of biology as one of four great eras. The first was the era of exploration and classification, when emphasis was placed upon differences amongst species and greater groups, and botany, zoology, and physiology were regarded as distinct and independent sciences. Then came the era of comparative anatomy, embryology, and physiology, when emphasis was placed on resemblances rather than on differences, when botany and zoology were seen to have much in common, though morphology and physiology remained independent. The third era was marked by generalisation and speculation regarding evolution, heredity, and variation, when family trees sprouted like weeds, and hypotheses were erected upon foundations of sand. The last and, according to Conklin, the present era, is one of experiment, of both analysis and synthesis, of a union of morphology and physiology. But we should be inclined to go further than Conklin and say that since there is no certainty that the experimental method, which necessarily interferes with the natural habits of animals, is final in its decisions, an old method in much improved guise is developing alongside the experimental—the close, continuous, and

detailed observation of the habits of creatures in their own environment.

PUBLICATION of scientific books is on the increase. The same may be said of books in every department of literature—a curious commentary on trade depression and the reduced spending power of the nation. The increases are far from being insignificant. Comparing the numbers published in the first half of 1930 with those of the corresponding period of last year (from the tables in the *Publisher and Bookseller* of July 4), we find that, with the exception of poetry, publication in every branch of literature has increased by 20 per cent or more, and following 'essays and belles-lettres' with an enormous increase of 108 per cent, come scientific or technical books with 86 per cent, the actual numbers in these two cases being 115–239 and 124–231. Medical books are grouped separately and here the numbers for last year and this year are 195–246, an increase of 26 per cent. The increase in numbers, which over all the list amounts to 40·45 per cent, is spread over works at almost every price, but the indication is that the average price tends to rise. Leaving out three exceptionally expensive books (priced at £70), it would appear that this year the average price stands at 7*s*. 5½*d*., against 6*s*. 9½*d*. in 1929. The total number of books of all sorts published in the first half of 1930 was 8017, an average of 44 a day, including Sundays. Where do they all find readers ?

THE serious decline in the numbers of the wild fur-bearing animals of California is indicated in *California Fish and Game* for April (p. 164), where a computation has been made of the numbers of skins taken under the trappers' licence law. The grand total of skins for the season 1928–29 stood at 103,508, including 39,407 skunk and 10,758 racoon, against 167,202 in 1927–28. In spite of higher average prices, the value fell in these two seasons from 468,960 dollars in 1927–28 to 280,309 in 1928–29. Some of the creatures concerned seem to be approaching the danger zone of extinction: twenty-nine 'fishers' were taken two years ago, but in the past season only seven, and the wolverine no longer makes an appearance in the list.

THE second number of the *Hong Kong Naturalist* (May 1930) improves even upon the high standard of the first, but as we suggested in noticing the earlier part, the editors have already found that many of their readers demand a larger proportion of simple and popular articles. This is a natural wish, and since it is desirable that the magazine should foster an interest in Nature, as well as constitute itself a guide to the details of fauna and flora in the region, the editors have wisely interspersed amongst the more technical papers, such as those on the orchids and the birds of Hong Kong and the fishes of China, articles of more general appeal on a wide variety of Nature topics.

THE Czechoslovak Ministry of Agriculture, acting in consultation with the chief official, public, and other bodies concerned with land improvement, drainage, civil engineering, etc., has started the preliminary arrangements for holding a land improvement exhibition in 1931. The exhibition will form part of the annual exhibition of the Agricultural League and will take place during the international agricultural congress at the end of May and the beginning of June in Prague. The exhibition will represent fully the activities of the various schools, institutions, public offices, and other bodies concerned with land improvement. It will be supplemented by meetings and discussions, as well as by visits to inspect work in progress, etc. Further information may be obtained from the Agricultural League, Prague.

REFERENCE was made in NATURE recently to the first report of the Bureau of Contraceptive Advice, Baltimore. A second report, covering the period of about a year ending Sept. 26, 1929, has been issued by Prof. Raymond Pearl. Advice has been given to 232 patients, compared with 168 during the first year, and an increasing number of physicians make use of the clinic. The Bureau has been in operation too short a time to make any definite report on the effectiveness of the advice given on contraceptive methods, but a wealth of material for the statistical study of various medical and biological problems has been collected. The largest individual number of pregnancies observed among the 400 women who have attended the Bureau since its inception is 22, and the largest number of children born to one mother is 15 ; this figure occurred three times.

THE Right Hon. the Viscount Chelmsford will open the new building for the Mining Department of the University of Leeds on Sept. 30 next. The building, forming the first portion of the University's scheme of construction, stands facing Woodhouse Lane at the north of the main site of the University.

THE following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies : Mr. R. M. Nattrass, to be mycologist, Cyprus ; Mr. J. B. G. Savory, to be superintendent of agriculture, Nigeria ; and Mr. T. R. Stodart, to be dairy instructor, Palestine.

FATHER H. V. GILL, Rathfarnham Castle, Co. Dublin, commenting on the correspondence in NATURE of Sept. 6, p. 351, reminds us that an English translation of Boscovich's "Theoria Philosophiæ Naturalis" by Mr. J. M. Child was published in 1922 by the Open Court Publishing Co., and a review appeared in NATURE of Dec. 30, 1922, p. 870. In this work Boscovich gives his views on the properties of matter and in one of the Supplements he goes so far towards the theory of relativity as to affirm the inconstancy of length of a measuring rod moved about in space. An article, entitled "A Jesuit Pioneer of Relativity", including quotations from Boscovich's work, appeared in the issue for July 1926 of the *Dublin Review*.

REFERRING to Dr. Dirac's suggestion with regard to 'negative energy', in his British Association paper on the proton, Sir Philip Hartog writes to recall Osborne Reynolds's theory that "matter represents negative mass" ("Sub-mechanics of the Universe", 1903, p. 3).

The theory was originally put forward, with experimental illustrations, in 1902, in his Rede lecture "On an Inversion of Ideas as to the Structure of the Universe". It is worth while supplementing this reminder by mentioning that in a letter in NATURE of Aug. 18, 1898, Sir Arthur Schuster suggested that potential or negative matter might exist, and in a further letter in the issue of Oct. 27 he directed attention to papers by Prof. Karl Pearson and A. Föppl on the same subject.

ARRANGEMENTS have been made for lectures during the forthcoming winter by Mr. H. V. Garner, the guide demonstrator, and other members of the staff of the Rothamsted Experimental Station, Harpenden, to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. No fee is charged for the lecturers' services, but any association engaging them would be expected to defray their travelling and hotel expenses, and to make such arrangements for the lectures as may be necessary. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

DETAILS of a course of lectures on modern methods of analytical chemistry to be given during the forthcoming session have been received from the Principal of the Hackney Institute (London County Council). These lectures cover a wide field, including gravimetric, volumetric, optical, electrical, gasometric, micro and biological methods. Owing to the rapid growth of organic and physical chemistry, the time left for the study of analytical chemistry is a diminishing quantity, and the graduate, possibly with a good honours degree, taking up a position in a laboratory, soon finds that there is a large gap between his academic knowledge and the requirements of practice. Such a course as that mentioned above, if accompanied by sufficient laboratory work, should help to fill this gap. The teaching of analytical chemistry in Great Britain is still far behind that given in the United States and Germany.

A JOINT committee of the Association of Special Libraries and Information Bureaux (Sir Frederic Nathan and Lieut.-Col. L. Newcombe, National Central Library) and the British Society for International Bibliography (Dr. S. C. Bradford, Science Library, and Prof. A. F. C. Pollard, president of the Institut International de Bibliographie) has been formed to advise and assist in the adoption and use in Great Britain of the Universal Decimal Classification of the Institut International de Bibliographie, which has proved to be a suitable system for international use and is already widely employed. The international adoption of such a standard system of indexing would enable references to information on any subject, whatever their source, to be brought into their correct places in a bibliography, and this would tend to the preservation and freer exchange of knowledge in every intellectual field. Any one interested is invited to communicate with the Association of Special Libraries and Information Bureaux, 26 Bedford Square, London, W.C.1.

WE regret that by an error the official spelling of Kanchenjunga was incorrectly given in a note in NATURE of July 12 (p. 69). The spelling now adopted by the Survey of India is that given above.

THE summer issue of *The Fight against Disease*, the journal of the Research Defence Society, contains the annual report of the Committee, and an appeal is made for additional support as the expenditure has been £400 in excess of income during the last four years. The fourth Stephen Paget memorial lecture, by Mrs. Edward Mellanby, on "Diet and Dental Disease", is reported, and gives an interesting survey of the subject, illustrated with plates, as well as demonstrating how much we have learned on this subject from experiments on animals.

THE Cambridge Instrument Co., Ltd., has published a catalogue (No. 162) of alternating current instruments suitable for high frequencies. Recent progress in radio telegraphy and telephony has produced a demand for accurate instruments of this type. In reading the catalogue, we were specially interested in the alternating current potentiometer, the standard mutual inductometer, and the capacitance bridge, all designed by Albert Campbell. We also noticed the thermionic voltmeter designed by E. B. Moullin, which has both scientific and industrial uses. It has the unique qualities of absorbing practically no power from the circuit and possessing very little capacitance. At low voltages it is about forty times as sensitive as an electrostatic voltmeter. The Cambridge Instrument Co., Ltd., has also published a very useful Supplement to List No. 162, describing the best methods of measuring inductance, capacitance, and resistance with the instruments given in the list.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for work on virus diseases of the potato—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Sept. 27). A city engineer and surveyor to the Urban Sanitary Authority—Chairman of the Health Committee, under cover to the Town Clerk, Municipal Buildings, Liverpool (Sept. 30). A principal of the Aston Technical College—Chief Education Officer, Education Office, Margaret Street, Birmingham (Sept. 30). An assistant inspector of education and agricultural assistant—Director of Education, Springfield, Maidstone (Oct. 6). A principal of the Constantine Technical College, Middlesbrough—The Acting Secretary, Education Offices, Middlesbrough (Oct. 8). A junior assistant (male) in the directorate of ballistic research—Chief Superintendent, Research Department, Woolwich, S.E.18. An advisory agricultural chemist under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice to farmers—The Registrar, University, Reading. A full-time teacher of engineering at the Chelmsford School of Science and Art—E. W. Alston, Education Office, 80 Duke Street, Chelmsford. A water and sanitary engineer for the Public Works Department, Trinidad—The Crown Agents for the Colonies (quoting M/2269), 4 Millbank, S.W.1.

Research Items.

Maori Fortification.—The *Records of the Auckland Institute and Museum*, vol. 1, No. 1, contains an account of the examination of the Piraunui Pa at Matawhana, Waikato, N.Z., by Messrs. J. W. Delph and Gilbert Archey, director of the Institute. The elaborate terraces of the Maori fortification are situated on natural strongholds formed by series of rock-capped headlands of the high rhyolite plateau of Central Waikato. The general layout of the fortifications is as follows: (1) A flat portion of the *marae* high up on a broad spur, below which is (2) a series of terraces on either side of the steeper ridge formed by the narrowing spur, leading down to (3) a still narrower and much steeper sided ridge cut across by a deep fosse and so forming a strongly protected approach to (4) the stronghold and citadel, a rhyolite-capped, vertical-walled spur rising with precipitous cliffs above the Waikato valley. The *pa* is very rich in storage pits of both the subterranean and semi-subterranean type. The former are built on flat ground wherever available, the latter at the base of some of the terrace walls. The subterranean pits are 6–9 ft. in diameter and about 5 ft. to the dome. In one which was cleared it was found that the floor was divided into bins, which would indicate its use for the storage of roots. In one, the original door-frames were still in place, tightly fitting to keep out the loose soil. Resting on the upper edge of one was a slab, the wood being well cut and originally about 2 in. in thickness. These pits penetrated into the hard rhyolite, and it was possible to see the method of working. Blocks of stone were worked behind or undercut so as to enable large slabs of rock to be broken off. The finish showed a skill which would not disgrace the efficient tools of a modern mason.

Marine Mollusca of Islands of the West Coast of Mexico.—In three consecutive papers, A. M. Strong and G. D. Hanna give the marine molluscan faunas of some islands off the west coast of Mexico visited on an expedition sent out by the California Academy of Sciences in 1925 ((*Proc. Calif. Acad. Sci.*, 4th Series, vol. 19). Each paper consists of a full list of all the known species with introductory illustrative remarks. Guadalupe Island, which lies about 180 miles south-south-west of San Diego, California, is represented in the Academy's collection by 87 species, of which 9 appear to be new. Almost all are shore or shallow water forms and some have a wide northern range. Their presence, the authors hold, can be most satisfactorily accounted for on the supposition that the fry or spawn were transported on masses of floating kelp by a current at some time running along the southern Californian coast and turning out to sea at an angle that carried it past the island. In the Revillagigedo Islands collections were made at Socorro and Clarion islands and 61 species are recorded, the bulk of which would seem more properly to belong with the faunas of the Galapagos Islands or Panama than with that of the Gulf of California. The Revillagigedo fauna has the character of a waif fauna arrived by chance. The islands have probably not been connected to the mainland, even by a shallow submarine ridge, during late geological time and do not seem to have existed at all for a sufficiently long period for the mollusca to have developed insular species. Tres Marias Islands, where the expedition made a short stay, have been comparatively frequently visited before, but the list of known forms of marine mollusca has now been brought up to 211 species.

Starfishes of the Pacific.—A monograph of the "Asteroidea of the North Pacific and Adjacent Waters", by Prof. W. K. Fisher of Stanford University, California, is published as *Bulletin* 76 of the United States National Museum. Part 1 was issued in 1911, Part 2 in 1928, and now the work is completed by a third part, in large quarto, of which 356 pages are numbered as such, while other intervening pages bear outline or half-tone illustrations on one or both sides and are numbered as 93 plates. These bear descriptions and figures of the subfamilies of Asteriidæ—Asteriinæ, Notasteriinæ, and Neomorphasterinæ—first of the northern hemisphere, then of the southern. There are 71 species recognised in the former and 76 in the latter. The former, however, receive much fuller treatment and occupy most of the volume. The Neomorphasterinæ appear to be confined to the southern hemisphere, while of the other two subfamilies, no southern genus is found without doubt in the northern hemisphere. Dr. Fisher establishes two new subgenera of *Leptasterias*—*Nesasterias* and *Hexasterias*, also *Bathyasterias*, a subgenus of *Diplasterias*, *Eremasterias* and *Neosmitaster*, new genera of Asteriinæ. The monograph contains useful keys and name-lists and the descriptions and diagnoses are drawn up with Dr. Fisher's customary care.

Philippine Land Shells.—An exceedingly useful and important "Summary of Philippine Land Shells" has been compiled by L. A. Faustino (*Philippine Jour. Sci.*, vol. 42) as supplement to Monograph 25 of the Philippine Bureau of Science in which his "Summary of the Marine and Fresh-water Mollusks" was given. The work in question consists of a list in systematic order of all species of land shells described or reported to occur in the Philippine Islands, with reference to the original description of each and the name of the individual island where it was found. There is also an alphabetical index to genera and synonymic notes, while occasion has been taken to append a small "Addenda to Monograph 25".

Earthquakes with Deep Foci.—The report of the Seismological Committee presented at the Bristol meeting of the British Association is the last drawn up mainly by the late Prof. H. H. Turner. One of its most interesting sections is that which relates to earthquakes with very deep foci. When the epicentres of these earthquakes are plotted on a map of the world, it is seen that they are not distributed at random but are confined to a comparatively small portion of the earth's surface. The boundary of this area, as drawn by Prof. Turner, is a roughly oval curve, reaching from the coasts of China and Japan to half-way across South America. The centre of the curve is on the equator in longitude about 150°. As the area covers the greater part of the Pacific, it is suggested that this distribution of deep-focal earthquakes offers some support to the theory that the moon was detached from the Pacific bed.

Dislocations of the Crust with the Japanese Earthquake of 1923.—Soon after this earthquake, the Military Land Survey re-levelled several routes in the central area. The results showed such remarkable changes that it was decided to measure the whole Kwanto district. The field-work was finished in 1927, re-observations of the primary triangulation-points having been carried out over an area of about 6500 square miles, and of the secondary and tertiary points over an area in the severely shaken region of about 3000 square miles. A summary of the results is given in English by R. Sakuryobu in the *Bulletin* of the Imperial Earthquake Investigation Committee (vol. 11, No. 4, pp. 1-80; 1930). The base-line lies

in one of the most devastated regions to the north of Sagami Bay. The new measurement made in 1924 showed that, since 1910, its length of about 3¼ miles had increased by 9·7 in. The greatest displacement of a primary point is that of 11 ft. 7 in. in the island of Oshima, but this is exceeded in five of the tertiary points, the maximum being 12 ft. 6 in. To the north of Sagami Bay and for about 14 miles inland, the ground was elevated, the greatest rise being 6 ft. 1 in. near Oiso. In the area of subsidence farther north, no point sank by more than 4 ft. 2 in. In the Boso peninsula, the change is usually one of elevation, the greatest rise being 6 ft. 3 in. at its southern end. Near the centre of the peninsula, however, there are a few small areas of depression, in one of which the ground has subsided by so much as 5 ft. 7 in.

Electrical Resistance of Ferro-magnetics.—The issue of the *Physikalische Zeitschrift* for June 15 contains an account of the measurements of the changes of electrical resistance of iron and nickel wires when magnetised longitudinally, by Dr. O. Stierstadt, of the Göttingen Institute of Applied Electricity. The wires were magnetised in a coil giving fields up to 250 gauss and their resistances were measured by means of a Kelvin double bridge. No influence of the direction or magnitude of the bridge current on the resistance of the wires in any field could be detected. The change of resistance on magnetisation was in all cases found to be an increase and the fractional increase was found for iron $10^{-20}B^4$ and for nickel $10^{-15}B^{3\cdot 4}$, where B is the magnetic induction in the material. The changes of resistance show a small hysteresis effect which probably accounts for the fact that some observers have found a decrease of electrical resistance in weak magnetic fields.

Alternating Stresses and Single Crystals of Metals.—Studies of the behaviour of single crystals of metals subjected to alternating stress have hitherto been confined mainly to crystals of the cubic system. From a theoretical point of view, it is important to know whether the planes of greatest atomic density or the lines of greatest density are the principal determining factors in mechanical slip. For this reason special interest attaches to two papers by H. J. Gough and H. L. Cox in Vol. A127 of the *Proceedings of the Royal Society*, dealing respectively with the behaviour of single crystals of zinc and antimony under alternating torsional stresses. Antimony was chosen because the planes of maximum atomic density in this metal do not contain any of the lines of maximum density, but the results were inconclusive, as the specimen could not be made to deform by slip, but cracked along certain crystal planes. The experiment is to be repeated with bismuth, which has a greater degree of plasticity. On the other hand, zinc, which has a close-packed hexagonal lattice, has given very satisfactory results. Slip occurs, as in static testing, on the basal plane, and its direction is that of the most highly stressed primitive direction. The twinning planes have been accurately determined, and it has been shown that the occurrence of twins as well as of slip-bands is controlled by the criterion of maximum resolved shear stress on the slip plane. Twinning in zinc has many features of interest, some of which are explained and others noticed for the first time in this paper, which is very fully illustrated.

Pulsations in Rotary Converters.—About thirty years ago, Gisbert Kapp and Bertram Hopkinson wrote papers on the abnormal working of synchronous motors. Explanations were given of their irregular working in certain cases and formulæ were obtained for the pulsations which, superposed on the steady running motion, produce the phenomenon of phase swinging. Hopkinson's theory, which shows how these pulsations can be damped by suitable devices, has proved of great use in practice. The analogous problem of the rotary converter can be treated in a similar way. This device consists of a machine which acts both as an alternating current synchronous motor and as a direct current dynamo. It takes alternating current in at one set of terminals and delivers direct current at the other, the power lost in the transformation being at the most a few per cent. These machines when running on a fluctuating load sometimes run irregularly owing to the pulsations produced. H. Cotton, in the *Journal of the Institution of Electrical Engineers* for August, discusses theoretically the theory of the motion in this case. The violent pulsations are caused when the free and the forced periods or harmonics of either synchronise. Formulæ are obtained for them and a rough verification is given by experimental results. The particular case when the machine is short circuited is considered. The mechanical analogy given for this case is the motion of a ballistic pendulum. Incidentally, considerable light is thrown on the requirements for the quick-acting circuit breakers which are in common use on the direct current side of these machines.

The Glass Electrode.—The use of the glass membrane electrode in determining hydrogen ion concentrations, although it has recently been shown by McInnes and others to be liable to error, is extending, and the description of a triode value arrangement for use with the electrode, given by G. B. Harrison in the July number of the *Journal of the Chemical Society*, is therefore of interest. The preparation of a new type of glass electrode is also described in the article. The technique is fully described and the arrangement permits of an accuracy of 0·02 pH unit over the range 1 to 12.

Molecular Weight of Legumin.—An investigation of the molecular weight of the protein legumin from vetch (*Vicia sativa*) by the ultracentrifuge method is described by Sjögren and Svedberg in the August number of the *Journal of the American Chemical Society*. The two proteins, legumin and legumelin, were separated by a process described in detail. A study of legumelin showed that it is not a simple protein. Legumin, on the other hand, is homogeneous with regard to molecular weight, the mean value of which was found to be 208,000 in a phosphate buffer of pH = 6·8. This, and other constants determined, agree within the limits of experimental error with the values for five other vegetable proteins previously investigated. The molecules of legumin are spherical, with a radius of 3·96 $\mu\mu$.

Density of Carbon Dioxide.—Especial interest attaches to the density of carbon dioxide on account of its close relation to several equations of state. In the June number of the *Canadian Journal of Research*, Cooper and Maass describe measurements of the density of the gas of sufficient accuracy to permit of direct extrapolation to zero pressure so as to give the limiting density of the gas. From this, the atomic weight of carbon, 12·0033 ± 0·002, follows directly. It was found that the graph representing the apparent molecular weight at 0° plotted against the pressure was a straight line. Full experimental results are given in the paper. The value of the molecular weight at S.T.P. agrees very well with that obtained by Guye from the weight of a normal litre.

Philippine Archæology.

PROF. H. OTLEY BEYER, head of the Anthropological Department of the University of the Philippines, has collected important archæological material during the last four years. In 1926 the construction of a dam on the Novaliches River brought to light a prehistoric village and cemetery which within the space of four months yielded some eighteen thousand specimens. During the next three years extended reconnaissance and excavation in the neighbourhood, mostly within the province of Rizal, brought to light nearly a hundred sites and an enormous amount of material, running into scores of thousands of objects.

Previously to these discoveries, the archæology of the Philippines earlier than, say, a thousand years ago was a blank. Almost at a stroke it has been carried back at least to the early neolithic and possibly earlier. Although the material has still to be worked out in detail, certain broad conclusions are possible. These are summarised and their bearing upon the prehistory of Eastern Asia indicated by Prof. Roland B. Dixon in vol. 69, No. 4, of the *Proceedings* of the American Philosophical Society.

On the Novaliches site five archæological horizons were distinguished. Of these, the most recent contained celadons, porcelains, and other ceramics, some dating back to the early Sung dynasty. This was preceded by two strata belonging to the iron age, below which were two stone age levels, one characterised by polished implements associated with fairly good hand-made pottery, and the earlier by implements only partly polished, associated with a cruder type of pottery. The extended observations in the province of Rizal revealed two earlier stone age phases, of which one is marked by deeply patinated chipped implements identical with the so-called 'Bacsonian' of Tonkin and not accompanied by pottery, to which both stratification and typology justify the application of the term mesolithic; and a second in which typical microliths and deeply patinated Mousterian-like forms suggest, in Prof. Dixon's view, the conclusion that they are palæolithic, even though the evidence of stratification is lacking.

While it would be well to accept Prof. Dixon's final suggestion only with very considerable reserve pending further evidence, there can be no two opinions as to the great value of Prof. Beyer's contribution to Philippine archæology. Its full significance, however, will not become apparent until it has been correlated and studied comparatively with the archæological material which has been, and is still being, brought to light in China, Tonkin, the Malay Peninsula, and the Dutch East Indies. When the time is ripe for the collation of the material from the whole area, and further, when it is brought into relation with the material from India, it should throw a flood of light on the racial and cultural drifts of eastern Asia.

In commenting on the material from the iron age strata in the Philippines, Prof. Dixon points out the similarity, and in some cases identity, of the iron and glass objects to those found in the dolmen tombs and urn burials of southern India, and refers to similar finds in the Malay Peninsula, Java, and Borneo. As he goes on to urge the necessity for research in southern India as a 'way-station' between western Asia and the Philippines, it may not be inopportune to refer to the work of the Indian Research Committee of the Royal Anthropological Institute on the archæology of the bead in India. A collection of type series of Indian beads has been formed which is available for students, and the first instalment of the Committee's work, with coloured illustrations of beads from southern India and Sarawak, is, we understand, to be published as a special number of *Man* in October.

Seventy-fifth Annual Exhibition of the Royal Photographic Society.

THE annual exhibition of the Royal Photographic Society was opened at 35 Russell Square, London, W.C.1, on Saturday, Sept. 13, and will remain open until Saturday, Oct. 11, from 10 A.M. to 9 P.M. each weekday except Tuesdays and Fridays, when it will be closed at 6 P.M. The following lectures are being delivered during the exhibition, at 7 P.M. on the evenings stated: Tuesday, Sept. 16—"The Mystery Bird of Britain and other Stories from Birdland", by Oliver G. Pike; Tuesday, Sept. 23, "From Alp to Apennine", by J. Dudley Johnstone, president of the Royal Photographic Society; Friday, Sept. 26, the lantern slides selected for the exhibition will be projected on the screen; Tuesday, Sept. 30, a popular lecture on astronomical photography, by F. J. Sellers; Friday, Oct. 3, "Kew Gardens—Some of its Beauties in Colour", by F. R. Newens; Tuesday, Oct. 7, "Tunis to Algiers", by the Rev. H. O. Fenton; Friday, Oct. 10, the amateur cinematograph films on 16 mm. (sub-standard) film which have been selected for the exhibition will be projected on the screen.

This exhibition may be divided roughly into three classes: pictorial work, record work, and research concerning photographic materials.

The pictorial work shown is from all parts of the world and is, of course, first-rate. Practically all of the important methods of photographic technique in both colour and monochrome are represented.

Photographic recording is now used as an aid to a vast number of activities; teaching, advertising, and research all make use of it. The exhibition contains examples of all these applications. In the natural history section are many beautiful photographs of wild animals and birds in their natural surroundings, and also of other objects. Two striking prints by Mr. J. A. Speed show a field-mouse in the act of rescuing its young. Mr. D. P. Wilson exhibits a good series of marine subjects, including one of Golden Star corals found on the shore at very low water in Cawsand Bay, Cornwall. Mr. W. C. Davies has three prints of the fossil remains of some very large insects, one being a kind of dragonfly with a wing span of about 12 inches.

Archæologists will be interested in several series of photographs of the Roman Wall and other Roman remains shown by C. Mason and G. E. Peachey. Aerofilms Ltd. show a vertical view of Ashdown Forest on which may be noted the faint indication of a Roman road and an enclosure probably built sometime about the commencement of the Christian era. This print shows the way in which aerial observation assists in the search for ancient remains which are almost invisible at ground level.

As usual, cloud photography is very well represented, and for his work in this field Mr. G. A. Clarke has been awarded a medal.

Last year note was taken in NATURE of some very fine spark photographs by P. B. Quayle, who showed several records of bullets and shot clusters in flight.

In this present exhibition, Mr. Quayle shows the bullet just as it penetrates a steel plate and just after, its jacket stripped off and its lead core broken into fragments mingling with flying particles of the steel plate itself. The main part of his exhibit is, however, devoted to a study of guns at the instant of firing. It is shown that the 'high shooting' of revolvers is not nearly accounted for by change of aim due to recoil, but is due in part to an upward velocity given to the bullet as it leaves the muzzle. Another series of photographs shows the bursting of shot guns caused by plugs of clay inserted in the muzzle before firing, a fine object-lesson to the sportsman who is inclined to carry his gun carelessly over clayey country.

General Motors Research Laboratories show a photographic study of combustion in engines. The examples given are for various mixtures of fuels. Some of these show pressure diagrams obtained during detonation.

The very great extension of research in the photographic industry during recent years is well shown in this exhibition. Five pieces of apparatus are shown, each one being of considerable importance. Kodak Ltd. exhibit a sensitometer designed for testing sensitive materials; a colorimeter intended for checking the colour of materials, such as sensitive papers, wrapping papers, cards, etc.; a goniophotometer for studying the polar reflection curves for cinematograph screens and also a mirror arc for use with the Kodascope apparatus for projecting 16 mm. cinematograph films. The British Photographic Research Association shows the latest design of photoelectric density meter as now marketed.

Dr. F. C. Toy and G. B. Harrison have recently succeeded in making a very thorough study of the photo-conductance of silver bromide. By means of models they now show some of the principal facts arising out of their work. Included in the same exhibit are specimens of large single crystals of silver bromide. These were prepared by methods similar to those employed for making single crystals of copper. The samples shown are probably the largest single crystals of silver bromide which have yet been made.

Ilford Ltd. show some examples of the influence of dyes on the spectral sensitivity of photographic materials, together with a very fine example of a clear photograph taken on a misty morning by the use of a plate sensitised to the infra-red and with a so-called 'infra-red filter'.

An instructional exhibit of great interest is shown by the research laboratories of Messrs. Thomas Illingworth, Ltd. It illustrates how the development of the negative must be controlled in order to yield a good print on a given printing paper. For comparison, the original object is shown in its proper lighting by the side of various negatives and prints. The limitations of photographic prints on paper are emphasised by including with the prints a positive transparency. The latter is seen at once to be a much more faithful representation of the original. This was so striking to the writer that he at once went on to see again the pictorial lantern slides in the exhibition. These are arranged for viewing as transparencies, and when so displayed give a demonstration of photographic rendering of tone which is considered by many people to be far more beautiful than that obtained by any other method. It is unfortunate that much of the beauty is lost when the pictures are projected on to a screen.

S. O. R.

Recent Studies of the Foraminifera.

THE Foraminifera constitute a class of Protozoa which provides many problems of great interest for the morphologist, the systematist, and the palæontologist. Their remarkable life history, the beauty and elaboration of their shells, and the records of their occurrence in the rocks from the most ancient times have been the subjects of many elaborate and important treatises in recent times. It is difficult for anyone to follow the progress of our knowledge of the group in all these directions; but as in other groups of animals, it is the work of the systematists which is most usually set aside as suitable only for the perusal of the specialists.

Accurate description and illustration of the various forms of animal life whether species or varieties is the essential basis upon which the construction of reasonable morphological theories must rest, and it is not unreasonable, therefore, to direct attention to the excellent work that is being done in the Foraminifera by Heron-Allen and Earland [1] in Great Britain, and by Hofker [2] in Holland.

The time is past when a study of the external form of the shells was considered sufficient. Nowadays the use of sections for the observation of the canal system in their walls, in the case of the arenaceous forms, the use of skiagraphs, when possible, and the careful search for dimorphism or trimorphism are necessary for the accurate determination of genera and species.

The number of specific names that have been given to members of the Foraminifera is so enormous that there may be some misgiving as to the validity of many of the species. No doubt many of the old names will disappear, but it is always difficult to determine the degree of discontinuity between a new form and an old one which justifies the constitution of a new species, and particularly so in the lower orders of animals where variation is wide and breeding experiments at present impracticable.

The recent investigations of Heron-Allen and Earland, in which the most elaborate methods were used, lend support to the view that among the free unattached Foraminifera there may be a true specific discontinuity.

Globigerina cristata, for example, from the deep sea mud of the South Atlantic seems to be, undoubtedly, a good species. From the smallest immature forms 0·08 mm. in diameter through a long series to the largest mature forms, 0·18 mm., the characteristic features which distinguish it from the other species of the genus can be observed. The same may be said of *Ehrenbergina crassa* and several other species described and figured in these papers.

Among the forms which become attached to foreign objects at the bottom and lead a sedentary life the beautiful symmetries of the shell are lost and variations in growth and many other characters are rampant.

In the widespread and very common *Foraminifer Polytrema*, for example, with its endless varieties of ramification, there seems to be no specific discontinuity, and the same is probably true of the genus *Gypsina*.

This has led to a great deal of confusion in the systematics of the group and to the proposal for the suppression not only of species but even of genera, which is quite startling to some of those who have taken an interest in these forms. Thus Hofker in a recent very fine monograph has declared that *Ramulina herdmani* is identical with *Carpenteria utricularis*

and "Sporadotrema is nothing else than a typical Carpenteria".

Without fully accepting all Hofker's conclusions, it may be said that his work has brought additional and important evidence of the extraordinary variability of these sedentary Foraminifera as compared with that of their allies which remain free throughout life.

This does not necessarily lead to the conclusion that specific discontinuity does not occur in any of the sedentary Foraminifera. That would be an extreme view which is not warranted by the facts. Such species as *Sorosphaera depressa* and *Schizammina labyrinthica* described by Heron-Allen and Earland in these papers seem to be good species. But it does suggest that in some cases such discontinuity has been lost or, perhaps, has not yet been gained, and that their survival depends not on the evolution of specific characters but on their extreme adaptability to the environment by their great variability.

Space does not permit comment on many other interesting features of these papers, but attention may be directed to the account given of the remarkable family the Pegidiidæ which have an extraordinarily thick shell and an unusual system of apertures. In this paper there is a reproduction of Dr. Orbigny's original sketch for a drawing of *Rotalia dubia*, a long-lost species now included in the Pegidiidæ.

S. J. H.

[1] E. Heron-Allen and A. Earland. On the Pegidiidæ, *J. Roy. Micr. Soc.*, 1928. Vol. 48. Some New Foraminifera from the South Atlantic, Parts I., II., and III. *Ibid.*, 1929; 1930. Vols. 49 and 50.

[2] J. Hofker, Foraminifera of the *Siboga* Expedition, Part II.; 1930.

Angiosperm Origins.

G. R. WIELAND has a very interesting discussion of the origin of Angiosperms in the *Proceedings* of the International Congress of Plant Sciences held at Ithaca, vol. 1, pp. 429-456 (George Banta Publishing Company, Menasha, Wisconsin, 1929). Naturally this account contains a particularly interesting recapitulation of the main features of the discoveries in the Cycadeoideæ with which the author's name is now linked through the genus *Wielandiella*, established as the result of Nathorst's fine reconstruction of difficult Swedish and Yorkshire material; but this general account is particularly valuable as it synthesises the available material, in a problem which ranges the whole globe and a considerable part of geological time.

Wieland argues that the Jurassic was a time of leaf and carpellary change in the earlier Angiosperms, just as the Cretaceous was the time of continued stem and floral change in fully characterised Angiosperms. He points out that the abundance of Angiosperms in Cretaceous rocks is due not merely to the increasing complexity in the phylum, but also to the greater thickness of the more and more recent plant beds. From this point of view he advises the botanist not to take too seriously the geologists' suggestion that the Angiosperms originated locally and suddenly; rather this impression may be due to imperfections in the earlier plant record; thus he calculates that of Jurassic times our plant records represent perhaps a tenth of one per cent of the species then existent, and those recorded mainly by dissociated leaves, stems, etc., more rarely by flowers and fruits. Some impressions of interesting new, possibly Dicotyledonous, fruits are recorded from Rhætic plant beds of the Argentine. Wieland states that the fossil series of insects described from these beds "mark the Argentine Rhætic as one of the most important fossil localities in the world".

Wieland concludes that there is every reason to regard the Angiosperms, "so far as actual descent goes, as old, quite as old as pines, and polyphyletic". He points out also that, from studies of fossil forms, it is easy to get a false impression that giant forms predominated in fossil periods, where specialised types make up the bulk of the fossil series. But this conclusion is not justified; the Cordaites varied from types with leaves ten feet long to those with narrow grass-like blades. Wieland suggests that "the contrast between the flowers of *Drimys*, in some species about the size of those of the chickweed, and related flowers a foot across, has surely been paralleled many times in the geologic past", so that many small fleshy forms of megasporophylls were probably grouped into seed cones allied to *Wielandiella* in Rhætic times.

Fluctuations in Fisheries.

ON April 12, 1929, the Conseil Permanent International pour l'Exploration de la Mer held in London a special meeting to discuss the present state of our knowledge concerning fluctuations in the abundance of the various year-classes of food fishes. So much interest is now being taken in this important branch of fishery research that no less than nineteen papers were read at the meeting, a full report of which has recently been published.*

When the Council entered upon its international collaboration thirty years ago, an enormous amount of work had to be done in the systematic determination of the various species, in ascertaining their geographical occurrence and distribution, and in locating their spawning grounds. As this work advanced, and more refined methods of biological analysis were brought to bear upon the steadily accumulating masses of data, it gradually became clear that to think only in terms of species was inadequate, and new concepts of definite tribes or races of the various species had to be evolved in order more clearly to grasp the true state of affairs in Nature. Still further research revealed, moreover, that these newly discovered tribes themselves often occur in several more or less distinct groups, depending upon such factors as age, size, and sexual maturity.

These comparatively recent racial investigations, and especially the study of the varying age-distributions in the stock of our chief species of food fishes, have opened up new vistas of marine investigation. They have explained in many cases the amazing fluctuations in the yield obtained by the fishing industry from year to year, and, more important still, it has even been possible to forecast future fluctuations—an achievement of very considerable practical value.

A paper read by Dr. Harold Thomson outlining his work on the haddock may be taken as typical of this branch of marine research, and indicates the possibilities inherent in the results so far obtained. After discussing the incidence and amplitude of brood survival, Dr. Thomson proceeds to consider the

* Fluctuations in the Abundance of the Various Year-Classes of Food Fishes. Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès Verbaux des Réunions, vol. 65, pp. 188. (Copenhague: Andr. Fred. Høst et Fils, 1930.) 7.25 kr.

possible causes underlying them. The following are suggested:

(a) Variation in the locality of the spawning ground. In the case of the haddock, the main centre of spawning activity may vary in position by so much as almost 2° of latitude. The effect of this movement of location is probably mainly an indirect one in that it influences the primary distribution of the eggs and fry.

(b) The numbers and average age of the spawning fish. The spawning shoals are always composed chiefly of haddock from three to six years old, and therefore include a series of broods differing in themselves in initial numerical strength. As there is an appreciable difference between the spawning locations assumed by younger and older haddock, the outcome may well be that the eggs and fry resulting from the spawning of younger fish predominating in one year will drift in quite a different set of currents from those resulting from the spawning of older fish predominating in another year.

(c) Early food supply. There is reason to suppose that the food requirements of the earlier (fry) stages are highly specialised, and that the necessary food organisms fall short of the demand to a greater or less extent in certain years. This, possibly, is the main cause underlying the not unusual wholesale failure of a brood.

Finally, as a result of careful analysis of the existing composition of the North Sea haddock, Dr. Thomson has been able to formulate the following tentative estimate of the immediate (1929) outlook for the fishery. "As the 1927 brood has proved to be almost a failure, catches may be expected to dwindle below the normal from the late autumn until well into next year (1930). About August of 1930 there should be a marked increase in the catches owing to the upgrowth of the very successful 1928 brood. In 1931 still greater catches should accrue. This is as far as can be seen ahead, for by the autumn of that year the influence of the 1928 brood will be waning and the next determining factor will be the quality, as yet unknown, of the brood of 1929. Estimations are therefore necessarily restricted to about two years ahead in the case of the southern portion of the North Sea. If these general anticipations prove correct an attempt should certainly be made to form seasonal or even monthly forecasts for the main fishing grounds."

Dr. Johan Hjort, in a brief survey of the methods and general principles underlying investigations into fluctuations in the stock of fishes, lays great stress upon the importance of the work. He suggests the setting up of an international biological organisation for the regular observation of age-distribution in the stock of our food fishes and of the relative—in time perhaps even the absolute—numerical strengths of the year-classes. Such a biological service, dealing conjointly with both biological statistics and a biochemical study of the fluctuating conditions in the sea, would in due course throw new light on many problems, and render possible a trustworthy fishery prediction service.

Linnæus and the Production of Artificial Pearls.

LINNÆUS was a great naturalist, but one gathers a fresh idea of his manifold interests in Nature from the series of articles in *Svenska Linné-Sällskapets Årsskrift*, Årg. 13, 1930. One of the most curious of these papers, by Gustaf Drake, recounts an incursion of Linnæus into the artificial pearl trade. In the course of his journey through Lapland, Linnæus paid a visit to a pearl-fishery, where the pearls were derived from fresh-water mussels. Knowing that various species of mollusca, both fresh-water and marine, could produce pearls, he formed the opinion that theoretically they could be formed by any shell, and turned his attention to their artificial production. He carried out several successful experiments, and Beckmann records that in 1765 he was shown by Linnæus himself four or five real pearls lying within the shells of *Mya margaritifera*, with the proud announcement: "*hos uniones ipse artificio meo arcano confeci.*" Before this time, however, word had got abroad of Linnæus's pearl-making secret, and in 1761–62 he was induced to demonstrate his method to Parliament. As a reward he was allowed the right of nominating his own successor, and chose his only son. But he also had a tempting offer from a private person for the monopoly of his pearl-producing method, though he did not accept it.

It is interesting to recall that the manuscripts explaining the pearl-producing method of Linnæus came into the hands of Sir James Smith and to repeat the latter's strong opinion regarding the exploitation of such scientific researches, conveyed in a letter dated Nov. 28, 1821: "The only *pearls* I ever expected from the possession of your illustrious countryman's literary treasures are *pearls of science*, in which I have not been disappointed. I am contented with these, and am happy that Sweden appears satisfied with what I have done for the honour of Linnæus and for the science to which I have devoted myself, in humble imitation of that great man. I believe I am possessed of manuscripts of his own explaining the secret of producing pearls. I have also in his own cabinet of shells specimens of pearls so produced, and of mussel shells in various states upon which experiments have been made. I have no intention of carrying out the scheme—still less of paying £500 for any further information, nor, in short, of entering at all on the subject, for which I have no leisure." Can any of our readers say whether the experimental shells referred to are still in existence, and if so, whether the public has ever had an opportunity of seeing so interesting an exhibit ?

The natural philosophy of Linnæus is the subject of another very interesting contribution in the same *Årsskrift*. The Rev. Dr. Elis Malmeström considers that although Linnæus scarcely formulated a natural philosophy of his own, his ideas moved in the direction of such a philosophy, and in the preface and introductions to his various works he often indicated the direction of his thoughts about the universe, creation, life and its purpose. Three transitional stages of development are observable. In the first, ending about 1735, Linnæus expressed in the first edition of "Systema Naturae" a static idea of Nature which he had gathered from the Bible and especially from the creation myths of the Old Testament. Such an idea is presupposed by the whole of his systematic work, and he never really forsook it. The second period, up to about 1750, saw an endeavour to unify the discrepancies which appeared to be increasing between creed and science. The fixity of species seemed less assured than formerly, but Linnæus stood firm against materialism, and adopted the physico-theology of his day. The third period, from 1750 until his death, marked a strong drift toward theodicy and a teleological view of Nature. He now adopted a natural theology, in which everything worked for the glory of God. Behind his thoughts on natural philosophy lay a religious craving for harmony.

Historic Natural Events.

Sept. 21, 1486. Sweating Sickness in England.—According to Holinshed, "in this year a new kind of sickness invaded suddenly the people of this land passing through the same from the one end to the other. It began about the one and twentieth of September and continued until the latter end of October being so sharp and deadly that the like was never heard of to any man's remembrance before that time. For suddenly a deadly burning sweat so assailed their bodies and distempered their blood with a most ardent heat, that scarce one amongst a hundred that sickened did escape with life."

Sept. 21, 1741. Shower of Gossamer at Selborne.—Gilbert White records ("Natural History of Selborne") that before daybreak "I found the stubbles and clover grounds matted all over with a thick coat of cobweb. . . . When the dogs attempted to hunt, their eyes were so blinded and hoodwinked that they could not proceed, but were obliged to lie down and scrape the encumbrance from their faces with their forefeet. . . . About nine, an appearance very unusual began to demand our attention—a shower of cobwebs falling from very elevated regions, and continuing, without any interruption, till the close of the day. These webs were not single filmy threads, floating in the air in all directions, but perfect flakes, or rags: some near an inch broad, and five or six long, which fell with a degree of velocity, that they were considerably heavier than the atmosphere. On every side, as the observer turned his eyes, he might behold a continual succession of fresh flakes falling into his sight, and twinkling like stars, as they turned their sides towards the sun. How far this wonderful shower extended, it would be difficult to say; but we know that it reached Bradley, Selborne and Alresford, three places which lie in a sort of triangle the shortest of whose sides is about eight miles in extent." The gossamer descended even on the highest part of the downs.

Sept. 23, 1834. The "Padre Ruiz" Hurricane.—This was the most severe hurricane on record in Santo Domingo; it takes its name from the fact that it began during the funeral service over a priest of that name. The loss of life and property was appalling; everything was laid waste, large areas of timber being torn up by the roots. Hundreds of houses were destroyed and many vessels were lost. The stone church of San Antonio was demolished, and its ruins have been left as a monument of the storm. The downpour of rain was so great that a fisherman was drowned in the principal market, as no one dared to go into the street to assist him.

Sept. 23, 1924. Inundation at Leningrad.—At 10 A.M. the waters of the Neva commenced to rise rapidly and by 7.15 P.M. stood 12 feet above their ordinary level. This flood was second only to that of November 1824 and caused enormous damage. The flood was caused by a deep depression over Finland, resulting in westerly winds over the Gulf of Finland, which heaped up the waters and impeded the flow of the Neva. The actual flood was due to sea water.

Sept. 25, 1909. Magnetic Storm.—A magnetic storm, of brief duration but of unusual severity, began abruptly at noon on Sept. 25 and ceased about 15 hours later. The ranges at Greenwich—193′ in declination and 1710γ in horizontal force—have not been equalled there for at least fifty years. An oscillation in declination of 3° within 15 minutes of time was recorded at Kew; at Stonyhurst an oscillation of $2\frac{1}{4}$° within 2 min., and one of 5° within 14 min. at Cheltenham, Maryland. An aurora accompanied the disturbance of the magnets; at South Kensington, in spite of cloudy or overcast skies, the green auroral line was easily seen with a spectroscope. A large sunspot crossed the central meridian on Sept. 23·8, and this was observed spectroscopically to be very active; about twenty-six hours before the commencement of the magnetic storm, the spot was for a time nearly obliterated by an overhanging cloud of brilliant calcium that probably represented a large active prominence.

Sept. 25, 1928. Waterspout off Deal.—An immense waterspout was reported over the sea about $4\frac{1}{2}$ miles off Deal. It was described as having a conical shaped top which was encircled by a large rainbow, with a remarkable background formed by heavy rolling clouds in which the sun was setting. It lasted for about ten minutes.

Sept. 26, 1902. Heavy Rain in Sicily.—On Sept. 25–27 a barometric depression travelled northwards from Tunis and settled over Sicily. It was accompanied by an extraordinary series of thunderstorms, in the course of which more than half the normal year's rainfall fell in five days. The most violent occurred at 7.25 A.M. on Sept. 26; it lasted only about half an hour but in that time several inches of rain fell. The total for the 24 hours at Linguaglossa was 16·7 in., and in five days (Sept. 25–29) 29·1 in. At San Alfio 23·3 in. fell in two days and 30·6 in. in five days. The storm of Sept. 26 was followed by extensive floods. At Modica, where three small streams meet, the flood was the first since 1833 and the worst on record; the water rose 10 to 20 feet above the level of the streets, and 111 persons lost their lives, while enormous damage was done. A rock weighing 90 tons was carried two-thirds of a mile by the force of the water.

Sept. 27, 1911. Tornado in Victoria.—A violent tornado, in the shape of a long inverted cone of cloud, appeared between Leichardt and Derby about 2.30 P.M. and travelled south-eastward, completing a course of 12 miles in about half an hour. Much damage was done by the wind to buildings, cattle, and agricultural machinery, and several persons were injured. The tornado was accompanied by heavy rain and hail, some of the hailstones weighing a pound.

Sept. 27, 1912. Heavy Rain.—At Wynaad in southern India an extraordinary rainstorm broke at 1.45 P.M., unaccompanied by wind but with a good deal of thunder and lightning. The storm lasted an hour, during which time the fall amounted to 9·75 in. The extensive lowlands were flooded to a depth of more than a foot.

Sept. 27-28, 1908. Floods at Hyderabad.—At Hyderabad in the Deccan, India, during the passage of a cyclone, more than 15 in. of rain, nearly half the annual total, fell in 36 hours, causing the river Musi to rise 60 feet. A considerable part of the city was ruined, more than 5000 persons lost their lives, and 100,000 were rendered homeless.

Correction. Sept. 10, 1903. Gale over British Isles. Line 5, *for* 5 mb. (1·4 in.) *read* 5 mb. (0·14 in.).

Societies and Academies.

Paris.

Academy of Sciences, July 28.—**Deslandres**: The *raies ultimes* of the alkalis and alkaline earths.—**Bigourdan**: The observatory of Courtanvaux at Colombes.—**L. Blaringhem**: The influence of the pollen on the movements which precede the opening of the flowers in poppies.—**J. Costantin**: The increase in resistance to disease (of plants) due to altitude. The resistance of cultivated plants to disease is increased when the plant is grown at a high

altitude. The results with potato, sugar cane, and coffee plant are cited.—**Ch. Gravier and P. Mathias**: The reproduction of a phyllopod crustacean of the group Conchostriaceae (*Cyzicus cycladoides*).—**Paul Pascal and Erling Botolfsen**: The synthesis of methane starting with carbon monoxide and steam. In presence of a nickel catalyst, the reaction between carbon monoxide and steam depends upon the temperature. At 275° C. the reaction is $4CO + 2H_2O \rightarrow 3CO_2 + CH_4$, but at 750° C and upwards the well-known reaction $CO + H_2O \rightarrow CO_2 + H_2$ occurs.—**E. Mathias and G. Grenet**: The daily variation of the electric field of the air at the observatory at the coast of Landais. The results agree with those obtained at the summit of the Puy de Dôme and at Val Joyeux in showing daily two maxima and two minima of unequal importance. The amplitude of the daily variation is considerable at the lower station, the ratio of the maximum to the minimum being 3 for the summer, 2·1 for the spring.—**Paul Delens**: The geometry of connected cycles.—**Jean Pierre Robert**: Limited formulæ of mediation.—**S. Sonoda**: Radiation resistance of a small antenna oscillating in half waves.—**L. Brillouin**: The electrons in metals and the rôle of the conditions of Bragg's selective reflection.—**Jean Thibaud and F. Dupré La Tour**: Study of the α and β crystals of the fatty acids.—**J. J. Trillat and A. Nowakowski.**: The orientation of the fatty acids in contact with a liquid phase. It is shown that using the method of the tangent drop, it is possible to follow the various factors which govern the formation of crystals and the orientation of the molecules of fatty acids in contact with various liquids.—**George I. Costeanu**: Batteries with a sodium cathode.—**Guy. Emschwiller**: The absorption of ultra-violet light by the alkyl iodides. Details of quantitative measurements by the photographic method, using the recording microphotometer of Lambert and Chalonge. The substances studied included methyl, ethyl, propyl, butyl, isopropyl, isobutyl, secondary butyl, and tertiary butyl iodides and iodobenzene: these were examined as liquids and as gases.—**Mlle. L. Popovici**: Naphthyl-β-glyoxylic acid and some of its derivatives.—**Albert Saint-Maxen**: The autoxidation of hydroquinone. To a solution of hydroquinone, sodium hydroxide is gradually added. Curves are given showing the light absorbed, the electrical conductivity, and the oxidation velocity as functions of the amount of alkali added.—**Ch. Courtot and V. Oupéroff**: The systematic study of the condensation of the aromatic monoketones with the tertiary aromatic amines, under the action of aluminium chloride.—**Jean Lugeon**: Ionisation and electric field at El Goléa: lightning visible at 800 kilometres: mirages seen from a motor car: condensations in the dunes of the Grand Erg.—**René Girard and Robert Lemesle**: Structural peculiarities of the floral axis of *Ramondia pyrenaica*.—**Mlle. Lucienne George**: Some anatomical peculiarities of *Gnetum*.—**Aug. Chevalier**: The mycocecidia of the gyrophore of *Arachis*.—**Fernand Mercier**: A new water soluble derivative of camphor and of sparteine: sparteine camphosulphonate.—**M. Javillier and Mlle. L. Emerique**: A method of purification of carotene and the vitamin activity of a purified carotene. A carotene purified by five repetitions of a process described, and melting at 185° (the melting point given by Drummond for his pure but physiologically inactive carotene), still possesses powerful vitamin properties.—**Edm. Sergent and H. Ducros-Rougebief**: The preservation in Nature during the winter of *Drosophila*, carriers of yeasts.—**A. Leulier and P. Sédaillan**: The affinity of the diphtheria bacillus for copper. The diphtheria bacillus is not injured by small proportions of copper sulphate and fixes this metal in notable amount.—**Charles Benoit and André Helbronner**: Photochemical therapeutics.

BRUSSELS.

Royal Belgian Academy of Science, Letters, and Arts, Mar. 1.—**Cl. Servais**: The geometry of the tetrahedron (5).—**E. de Wildeman**: Concerning multiplication in the Conjugates.—**Laurent Joyeux**: New contribution to the anatomy and systematics of Asparagus.—**L. Godeaux**: Certain series of Laplace associated with a given Laplace series.—**Radu Badesco**: A functional equation.—**H. R. J. Germay**: The formula of Lagrange.—**R. H. J. Germay**: The application of a method of successive approximations to the solution of the Gauss equation $\sin(z-q)=m \sin^4 z$.—**A. De Waele**: Life conditions of the vinegar eel, *Anguillula aceti*.—**Jacques Van Mieghem**: Study of retarded potentials.—**Raymond Defay**: The thermodynamical study of surface tension. Affinity and adsorption velocity.—**Jean P. Bosquet**: Examples of the reduction of the second variation of an n-tuple integral.—**Raphaël Deladrière**: The parametric or homogeneous form in the calculus of variations.—**H. Van de Walle and V. de Landsberg**: The preparation of symmetrical bromiodoethylene. The nature of the reaction between acetylene and a mixture of bromine and iodine depends on the solvents used for the halogens (water, hydrochloric acid, chloroform). In the separation and determination of the amounts of bromiodoethylene, diiodoethylene, tetrabromethane, chlorobromoethylene, dibromethylene and chloroiodoethylene present, in view of the instability of these compounds on distillation, use was made of the properties of the azeotropic mixtures obtained by distilling with butyl alcohol.—**Marcel Winants**: Application of the method of successive approximations to the integration of certain linear trinomial partial differential equations of any order.

WASHINGTON, D.C.

National Academy of Sciences (Vol. 16, No. 6, June 15).—**E. M. East**: The origin of the plants of maternal type which occur in connexion with interspecific hybridisations.—**Dietrich C. Smith**: Melanophore pulsations in the isolated scales of *Fundulus heteroclitus*. The hydrogen ion concentration seems to be the most important single factor concerned.—**John H. Welsh**: Diurnal rhythm of the distal pigment cells in the eyes of certain crustaceans. Diurnal rhythm parallels changes of activity of animal. It continues even under constant illumination, but proximal pigment does not show same movement. Effects of chloretone and ligation of eye-stalk suggest that movements are controlled directly by blood and indirectly by nervous system.—**G. H. Parker**: The colour changes of the tree toad in relation to nervous and humoral control. The American tree toad is unable to adapt its mottling to the size of pattern on which it finds itself. The pattern becomes sharper or fainter but without modification of detail. Adrenalin makes the pattern light in colour and pituitrin makes it dark. Humoral rather than nervous control is suggested.—**Donald Statler Villars**: Equilibrium constants of reactions involving hydroxyl: a correction.—**G. A. Miller**: Groups of isomorphisms of an Abelian group.—**Arthur B. Brown**: (1) Coalescence of parts of a complex.—(2) An extension of the Alexander duality theorem.—**Richard C. Tolman**: More complete discussion of the time-dependence of the non-static line element for the universe. A theoretical development of the theory described in earlier papers.—**R. A. Millikan and I. S. Bowen**: The significance of recent cosmic-ray experiments. The experiments

discussed are (1) absorption coefficients on high mountains and at great depths in mountain lakes (Millikan and Cameron), (2) absorption of gamma rays in mountain lakes (Millikan and Bowen), (3) gamma ray absorption in the laboratory (Chao), and (4) coincidences in ionisation counters (Bothe and Kolhörster, and Curtis). The results are considered to favour the atom-building hypothesis of the origin of cosmic rays, which seem to be photons rather than electrons. On striking matter, these photons share their energy with an electron, producing beta rays of penetrating power of the same order of magnitude as the cosmic rays themselves.—**C. Hewitt Dix**: Motion on a lattice. A theoretical discussion.—**C. Y. Chao**: The absorption coefficient of hard γ-rays. Thorium-C″ is used as a source of γ-rays (λ4·7 X.U.) and a parallel beam is used. Measurements were made with a Millikan cosmic ray electroscope and also with an ionisation chamber connected with a vacuum electrometer. The ratio of absorption coefficient to number of external electrons per c.c. increased with atomic number of absorbing substance. This may be due to (*a*) scattering by electrons within the nucleus; (*b*) the fact that scattering of a tightly bound electron of atoms of high atomic numbers may be greater than that of a loosely bound electron; (*c*) true absorption due to the photoelectric effect.—**B. F. Skinner**: On the conditions of elicitation of certain eating reflexes. Rats were fed in a sound-proof box in a sound-proof room and the rate of feeding measured; the pieces of food are of uniform size and removal of each piece is recorded electrically. The graph of amount eaten against time is of the form $N = Kt^n$ where N = food eaten at time t and K and n are constants; K varies from animal to animal and day by day, but n is always approximately constant.—**Francis G. Benedict and Cornelia Golay Benedict**: The energy requirements of intense mental effort. Respiratory exchange was measured by a helmet which permits free vision and is without mouthpiece or nose-clip. The subject lies down after a 12-hour fast and remains quiet with as little mental activity as possible. Then he is asked to respond to ocular or auditory stimuli to determine the metabolic changes required by attention or alertness, and finally he is given three or four 15-minute periods of intense mental effort (mental multiplication). There is a noticeable increase in heart rate, increased volume of air passing through lungs, and slight increase in oxygen consumption. The effects are not cumulative, and increase in heat production, even with intense mental effort of this type, is only of the order of 3 or 4 per cent.—**William Hovgaard**: Bending of curved tubes. Formulæ for displacements and stresses previously obtained were tested on pipes from 4½ in. to 12 in. in diameter. Good agreement was obtained while the bends were well within the elastic limit. Plastic flow occurs along well-defined longitudinal zones.

Official Publications Received.

BRITISH.

Forest Department, Trinidad and Tobago. Notes on the Silviculture of the more Important Timber Trees of Trinidad and Tobago, with Information on the Formation of Woods. By R. C. Marshall. Pp. 50+6 plates. (Trinidad: Government Printing Office.) 2*s*.

Joint Board of Research for Mental Diseases, City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1930. Pp. 11. (Birmingham.)

Imperial Institute of Agricultural Research, Pusa. Bulletin No. 203: The Description of a New Fluke found in the Indian House-Crow (*Corvus splendens*). By V. R. Phadke and Amarnath Gulati. Pp. 8+1 plate. (Calcutta: Government of India Central Publication Branch.) 8 annas; 4*d*.

Records of the Geological Survey of India. Vol. 63, Part 1. Pp. 187+4 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 16: Technological Report on Banilla Cotton, 1924-30. By Dr. A. James Turner. Pp. ii+12. (Bombay.) 6 annas.

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series, No. 1: A Preliminary Account of Three Rice Stem Borers. By H. T. Pagden. Pp. iv+30. (Kuala Lumpur.) 50 cents.

Department of Agriculture, Ceylon. Bulletin No. 87: The Cultivation and Commercial Possibilities of the Robusta Types of Coffee. By T. H. Holland. Pp. 19. (Peradeniya.) 40 cents.

Indian Lac Association for Research. Reports of the Committee and of the Director, Indian Lac Research Institute, Nankum, Ranchi, for the Year 1st April 1929 to 31st March 1930. Pp. ii+51. (Nankum.)

The Indian Forest Records. Entomological Series, Vol. 14, Parts 5-8. Part 5: The Indian Species of Palorus Muls (Coleoptera: Tenebrionidae) and some associated Beetles, by K. G. Blair; Part 6: Two New Species of Coleoptera from India, by E. Fleutiaux; Part 7: Some New Indian Cerambycidae, by J. C. M. Gardner; Part 8: Some Records of Indo-Malayan Psyllidae, by F. Laing. Pp. 44. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 2*s*.

Canada. Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1928. (No. 710.) Pp. ii+57+2 plates. (Ottawa: F. A. Acland.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 17: The Distribution of Gene Ratios for Rare Mutations. By Dr. R. A. Fisher. Pp. 205-219. 1*s*. 6*d*. Vol. 50, Part 2, No. 18: The Definite Integrals of Interpolation Theory. By Dr. E. T. Copson. Pp. 220-224. 9*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Cordwainers' Technical College, Eagle Court, St. John's Street, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1930-31. Pp. 43. (London.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 6: Studies in the Sampling of Cotton for the Determination of Fibre-Properties. Part 1: Introductory and Experimental; Part 2: Frequency Curves for various Fibre-Properties. By Ram Saran Koshal and Dr. A. James Turner. Pp. ii+46. (Bombay.) 1 rupee.

Department of Public Instruction, Technical Educational Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1929. Pp. 7. (Sydney, N.S.W.: Alfred James Kent.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 7, July. Abstracts Nos. 1291-1495. Pp. 237-274. (London: H.M. Stationery Office.) 9*d*. net.

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 23: The Bacon Industry; Interim Report by the Pig Industry Council. Pp. 8. (London: Ministry of Agriculture and Fisheries.)

Indian Journal of Physics, Vol. 5, Part 1, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 1. Conducted by Sir C. V. Raman. Pp. 112. (Calcutta.) 2.4 rupees; 3*s*.

Survey of India. Geodetic Report, Vol. 5, from 1st October 1928 to 30th September 1929. Pp. xiv+156+29 charts. (Dehra Dun.) 3 rupees; 5*s*. 3*d*.

The Hundred and Eighth Report of the Commissioners of Crown Lands, dated 25th June 1930. Pp. 35. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 61, Part 1, March. Pp. v+215+38 plates. (Wellington, N.Z.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31st, 1929. (No. 51.) Pp. 100+9 plates. (Adelaide: Harrison Weir.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1316 (Ae. 453): Charts for Aircraft Performance Reduction. By H. L. Stevens and A. E. Woodward Nutt. (T. 2949.) Pp. 19+3 plates. (London: H.M. Stationery Office.) 1*s*. net.

Report on Damage to Plumbing Work caused by Frost. Prepared by a Conference convened by the Science Standing Committee of the Royal Institute of British Architects. Pp. 8. (London.) 3*d*.

British Museum (Natural History): Department of Botany. Exhibition of a Selection from the Historical Collections. (Fifth International Botanical Congress, 1930.) Pp. 23. (London.)

The Linnean Society of London. Exhibition of a Selection from the Linnean Collections. (Fifth International Botanical Congress, 1930.) Pp. 12. (London.)

East African Agricultural Research Station, Amani. First Annual Report, 1928-29. (Colonial No. 50.) Pp. 20. 6*d*. net. Second Annual Report, 1929-30. (Colonial No. 51.) Pp. 36. 1*s*. net. (London: H.M. Stationery Office.)

Report of the Third Imperial Entomological Conference, 17-27th June 1930. Pp. 59. (London: Imperial Institute of Entomology.) 2*s*. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, August. Pp. 475-565+xxxviii. (London.)

Hull Municipal Publications. No. 75: Guide to the Birds in the Hull Municipal Museum. By T. Sheppard. Second edition. Pp. 91. (Hull.) 4*d*.

FOREIGN.

Field Museum of Natural History. Report Series, Vol. 8, No. 1: Annual Report of the Director to the Board of Trustees for the Year 1929. (Publication 271.) Pp. 265+20 plates. Zoological Series, Vol. 17, No. 6: Reptiles of Marshall Field North Arabian Desert Expeditions, 1927-1928. By Karl P. Schmidt. (Publication 273.) Pp. 221-230+plate 2. Anthropological Series, Vol. 17, No. 2: Ethnology of the Mayas of Southern and Central British Honduras. By J. Eric Thompson. (Publication 274.) Pp. 23-213+24 plates. Geology Memoirs, Vol. 1, No. 1: Studies of Fossil Mammals of South America. A Partial Skeleton of Homalodontotherium from the Santa Cruz Beds of Patagonia, by Prof. William Berryman Scott; New Carnivorous Marsupials from the Deseado Formation of Patagonia, by Prof. William J. Sinclair; Results of the Marshall Field Paleontological Expeditions to Argentina and Bolivia, 1922-1927, Elmer S. Riggs, in charge. Pp. 39+8 plates. (Chicago.)

United States Department of the Interior: Geological Survey. Water-Supply Paper 615: Surface Water Supply of Hawaii, July 1, 1924, to June 30, 1925. Pp. iv+155. 20 cents. Water-Supply Paper 616: Geology and Water Resources of the Kau District, Hawaii (including parts of Kilauea and Mauna Loa Volcanoes). By Harold T. Stearns and William O. Clark; with a Chapter on Ground Water in the Hawaiian Islands, by Oscar E. Meinzer. Pp. ix+194+33 plates. 85 cents. Water-Supply Paper 629: Surface Water Supply of the United States, 1926. Part 9: Colorado River Basin. Pp. v+188. 20 cents. Water-Supply Paper 632: Surface Water Supply of the United States, 1926. Part 12: North Pacific Slope Drainage Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. v+154. 20 cents. Professional Paper 156: Revision of the Lower Eocene Wilcox Flora of the Southeastern States, with Descriptions of New Species, chiefly from Tennessee and Kentucky. By Edward Wilber Berry. Pp. iv+196+50 plates. 75 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 99: A Note on Two Marssonina Diseases on Willows. By Dr. R. M. Nattrass. Pp. ii+19+18 plates. (Cairo: Government Press.) 0 P.T.

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 7: An Equation of State for Gas Mixtures. 2: A Study of the Methods of Combination of the Constants of the Beattie-Bridgeman Equation of State. By James A. Beattie and Shikao Ikehara. Pp. 127-170. Vol. 64, No. 8: The Anonymous La Conquista del Peru (Seville, April 1534) and the Libro Vltimo del Svmmario delle Indie Occidentali (Venice, October 1534). Edited, with an Introduction and a Bibliography, by Alexander Pogo. Pp. 177-286. 1.75 dollars. (Boston, Mass.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 254: Zeeman Effect of Neon. By Kiyoshi Murakawa and Tatsuro Iwama. Pp. 203-291. 20 sen. No. 256: Studies on the Coagulation of von Weimarn's Au$_F$ Sols, II. By Eiichi Iwase. Pp. 11. 20 sen. Nos. 257-259: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 5: Die Einflusse von Titanoxyd, Zirkoniumoxyd und Ceroxyd auf den Kobalt-Kupferkatalysator, von Shinjiro Kodama; On the Promoter Action in the Catalytic Oxidation of Methane with Steam, by Bennosuke Kubota and Tatsuo Yamanaka; The Separation and Determination of Gallium, 2: The Separation of Gallium and Aluminium from each other, and the Determination of these Elements, by Sunao Ato. Pp. 13-47. (Tōkyō: Iwanami Shoten.) 55 sen.

United States Department of Agriculture. Technical Bulletin No. 198: Relative Insecticidal Value of Commercial Grades of Pyrethrum. By C. C. McDonnell, W. S. Abbott, W. M. Davidson, G. L. Keenan and O. A. Nelson. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Treasury Department: United States Coast Guard. Bulletin No. 18: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1929. Pp. iv+141+17 plates. (Washington, D.C.: Government Printing Office.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1928. By R. S. Wimpenny. Pp. x+86+4 plates. (Cairo: Government Press.) 5 P.T.

The Peking Society of Natural History. Bulletin, Vol. 4, Part 4: Yenching Science Conference Papers. Pp. 101. (Peking.) 1.50 dollars.

U.S. Department of Agriculture. Leaflet No. 59: Hints on Coyote and Wolf Trapping. By Stanley P. Young. Pp. 8. 5 cents. Circular No. 130: Traps for the Japanese Beetle. By E. R. Van Leeuwen and F. W. Metzger. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.)

Société des Nations: Institut International de Coopération Intellectuelle. Coordination des Bibliothèques: Guide des services nationaux de renseignements du prêt et des échanges internationaux. Pp. 50. (Paris.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 7: The Carver's Art of the Indians of Northwestern California. By Isabel T. Kelly. Pp. 343-360+plates 108-119. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 40 cents.

University of California Publications in Zoology. Vol. 32, No. 4: Osteology of the California Road-Runner Recent and Pleistocene. By Leigh Marian Larson. Pp. 409-428. 25 cents. Vol. 32, No. 5: Notes on the Range and Life-History of the Pacific Freshwater Turtle, *Clemmys marmorata*. By Tracey I. Storer. Pp. 429-441. 25 cents. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 255: Isotope Effect in the Spectrum of Neon, I. By Hantaro Nagaoka and Tadao Mishima. Pp. 293-316+plates 34-38. (Tōkyō: Iwanami Shoten.) 60 sen.

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 70: Das kritische Massenverhaltnisse bei der Bewegung um L_4 und L_5 im Problème Restreint. Von Elis Strömgren. Pp. 14. (København: Bianco Lunos Bogtrykkeri A.-S.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 8, Août. Pp. 489-544. (Prague: Regia Societas Scientiarum Bohemica.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 29, Part 1: Die biologischen Gruppen der Rhynchitinen, Attelabinen und Apoderinen. Von Hiromichi Kôno. Pp. 86+4 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Imperial Academy. Vol. 6, No. 7, July. Pp. xxiii-xxiv+243-295. (Tokyo.)

Memoirs of the Geological Survey of China. Series A, No. 6: The Geology of the Kalgan Area. By Prof. George B. Barbour. (Contributions from the Department of Geology, Columbia University, Vol. 42, No. 2.) Pp. xi+148+14 plates. (Peking.)

CATALOGUES.

Cambridge Alternating Current Instruments for Supply Frequencies. (List No. 161.) Pp. 28. The Grassot Fluxmeter. (List No. 178.) Pp. 8. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

MONDAY, SEPTEMBER 22.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 2.30.—W. J. Rees and J. H. Chesters: The Application of Tensile Tests to the Study of the Bonding of Refractory Materials.—C. R. F. Thelfall: Grog.—H. T. S. Swallow: The Influence of Atmosphere on the Load-bearing Capacities of Firebricks.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 2.30.—F. L. Brady and E. H. Coleman: Influence of Firing Conditions on the Soluble Salt Content of Burnt Brick.—J. Williamson: Continuous Kilns for Burning Clay.—W. Emery: Red Roofing Tile Kiln Report.

TUESDAY, SEPTEMBER 23.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30.—W. Hugill: The Structure of Diatomaceous Earths in Relation to their Uses.—R. J. Sarjant: Works Tests on Refractories and Service Conditions.—W. Hugill and W. J. Rees: Effect of Repeated Burning on the Structure and Properties of Lime-bonded Silica Bricks. Parts II. and III.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30.—Ambrose W. Cross: British Bricks for British Roads.—G. A. Hodson: The Manufacture of Bricks for Road Paving in U.S.A. and Holland.—J. Bentley, jun.: A Few Observations on the Causes of a Particular Type of Crack encountered in the Manufacture of Plastic Machine-made Roofing Tiles.—W. Emery: Blue Brick Kiln Report.

INSTITUTE OF MARINE ENGINEERS, at 6.—Lieut.-Comdr. Sir August B. T. Cayzer: Presidential Address.

WEDNESDAY, SEPTEMBER 24.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30 A.M.—Council and General Business Meeting of Refractory Materials Section.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 11.30.—Council and General Business Meeting of Building Section. The following papers will be communicated by title:—W. J. Rees and W. Hugill: The Effect of Iron Oxide and a Reducing Agent on the Rate of Inversion of Quartz.—W. J. Rees: Note on the Effect of Iron Oxide in Quartz Inversion.—J. W. Mellor: A Study of Pan Grinding.

THURSDAY, SEPTEMBER 25.

INSTITUTION OF LOCOMOTIVE ENGINEERS, at 6.—H. Kelway Bamber: Presidential Address.

SATURDAY, SEPTEMBER 27.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Autumn Meeting).—Visits to St. Paul's Cathedral and the Natural History Museum.

THURSDAY, OCTOBER 2.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (in the Chemical Department, The University, Bristol), at 7.30.—Prof. J. W. Hinchley: Air and Water.

FRIDAY, OCTOBER 3.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Crispin: The Development of the Bridge.

SATURDAY, OCTOBER 4.

ROYAL SANITARY INSTITUTE (in the Assembly Room, Town Hall, Hereford), at 10 A.M.—Councillor Mrs. Luard: The Place of Women in Local Government.—G. H. Jack: The Preservation of the Countryside.—Councillor J. R. Barker: The Health Authority and the Milk Supply.

CONGRESS.

SEPTEMBER 29 TO OCTOBER 1.

FARADAY SOCIETY (in Laboratory of Physical Chemistry, Cambridge).—Discussion on Colloid Science applied to Biology.

Monday, Sept. 29, 2 to 4 and 4.30 to 7.—Equilibrium in Protein Systems. In Chair—Sir William Hardy, who will introduce the Discussion.

Prof. A. V. Hill: Membrane-Phenomena in Living Matter—Equilibrium or Steady State.

Dr. R. A. Gortner: The State of Water in Colloidal and Living Systems.

Prof. E. J. Bigwood: Distribution of Diffusible Ions in Gels.

Prof. W. Pauli: The Behaviour of Proteins towards other Colloids and towards Electrolytes.

Prof. F. F. Nord: The Biological Significance of the Physical Influence of Gases on Colloids.

Tuesday, Sept. 30, 10 A.M. to 11.15 A.M., 11.30 A.M. to 1 P.M., 2.30 to 4, and 4.30 to 7; and

Wednesday, Oct. 1, 10 A.M. to 1 P.M.—In Chair—Sir F. Gowland Hopkins, who will introduce the Discussion.

Dr. Honor B. Fell and Dr. Wilmer, followed by Kinematograph Studies of Living Cells by Dr. Canti: The Structure, Behaviour and Physiological Characteristics of Vertebrate Cells cultivated *in vitro*.

Prof. E. Faure-Fremiet: The Kinetics of Living Matter.

Prof. R. A. Peters: Surface Structure in the Integration of Cell Activity.

Prof. O. Warburg: Surface Reactions in Living Cells.

Prof. H. Pfeiffer: Isoelectric Point of Cells and Tissues.

Dr. A. von Muralt and Dr. J. Edsall: Double Refraction in Protein Systems.

Dr. J. H. Quastel: The Mechanism of Bacterial Action.

Other speakers will be: Prof. E. F. Burton, Prof. J. Duclaux, Prof. H. Euler, Prof. H. Freundlich, Prof. H. R. Kruyt, Prof. H. Lundegardh, Dr. P. Lecomte du Nouy, Prof. W. J. V. Osterhout, Prof. Wo. Ostwald, Prof. and Mme. Jean Roche, Dr. Straub, and Prof. T. Svedberg.

SATURDAY, SEPTEMBER 27, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

What's in a Name?

DURING the early days of September the section on Nomenclature of the International Congress of Zoology has discussed at Padua, with live interest and some acrimony, if we may judge from our recollection of the meetings three years ago at Budapest, questions about the naming of animals; and at the same time the British Association for the Advancement of Science has devoted two presidential addresses to a kindred problem. Clearly here is a matter which demands consideration.

It is a happy coincidence that two leading official authorities in the systematic classification of animals and plants, Dr. W. T. Calman, keeper of zoology in the British Natural History Museum, and Dr. A. W. Hill, director of the Royal Botanic Gardens, Kew, should each from his own point of view direct attention to the problems of taxonomy. Although one address supplements the other, both experts meet on common ground in deploring the fact that there is a strong tendency to deprecate the value of taxonomy and to ignore its claims to a fair share of the attentions of scientific workers. "The anatomist, the physiologist, the field naturalist, the student of one or other of the innumerable specialisations of biological science, has always been inclined to regard with distaste, if not with contempt, the work of those whose business it is to denominate, classify and catalogue the infinite variety of living things", says Dr. Calman; and Dr. Hill, echoing the same idea, laments that "we seem somewhat to have failed to attract a sufficiency of able recruits".

What's in a name, that the task of naming should be shunned by potential workers? Names are not what they were. When Linnæus put on a firm footing the binomial system of designating species, he catalogued about 4370 animals. Now the number of described species has been estimated at something in the neighbourhood of three-quarters of a million. The botanists show even less sign of vegetating in this fruitful field, for the recently issued seventh supplement of the "Index Kewensis" contained some 33,000 new specific names. This does not mean that the variety of plant and animal life on the earth is increasing at this extraordinary rate, but it does mean that the technique of naming has become more delicate, that finer distinctions are drawn between species —in other words, that the species of to-day is a different thing from the species of the Linnæan conception.

The result is obvious in the recent developments of nomenclature. In the animal world the old Linnæan binomial is giving way before a trinomial designation, and geographical races are backed by varieties. Botanists have their own specific finesse: their Linnæons are supplemented by Jordanons, the 'compound species' by the 'micro-species' (the latter the units of which the former is made up), and 'hybrid swarms' complicate the story. Now a name should be more than a simple appellation; it should be a symbol of a relationship, and the scheme of names should indicate the system of natural evolution. Whether the new manner of naming properly interprets the variety of form in the plant and animal worlds is a matter which we shall examine in due course, but it has had two harmful effects upon the progress of knowledge. Its complexities and its almost super-meticulous discriminations have put to flight the amateur naturalist, whose kind has in the past taken so great a part in the advance of British science, and it has created groups of specialists, who, retreating within the protective shell of their specialism, tend to see the world of life with narrow vision and to be satisfied with the creation of 'species' irrespective of environment or any other vital influence. Many new species founded upon minute differences and created for single specimens extracted from the herbarium or the museum stores, are cases in point.

The degree of segregation of function to which specialisation has been carried in other branches of science as well as in the taxonomic is a sign of the times. As Dr. Calman puts it, "the Poet of the Breakfast Table, laughing gently at the narrow specialism of the Scarabee, can scarcely have foreseen the day when a university in his own country would have upon its teaching staff an officer named in the university calendar as a 'Drosophilist'". This general movement often ignores the basic necessity of taxonomy, yet it becomes clearer and clearer that specific structure is linked with specific habits and functions, so that the foundation of sound description in whatever line is proper determination of species.

Has the science of classification, then, reached the stage of perfected description of species? It is often said by workers in other fields that the business of naming is a back number; that except in a few odd corners, the inhabitants of the earth have been sufficiently catalogued. The straits to which some systematists are put to define their species, and the perpetual creation and demolition of so-called new forms, give colour to the complaint. If naming is to tell anything of the history of the evolution of forms, it is indeed apparent that in some respects it must revise its methods, or perhaps one should rather say, check the exuberance of some of its devotees. It must be realised that the minute description of all the structural features of an individual or group of individuals is not the definition of a species. The single museum or herbarium specimen, divorced from the story of its habitat and growth, should be regarded as a new type only in extreme cases. Above all, study must be pushed from the laboratory into the field, and analyses of the range of variation normal in an individual, of temporary modifications in form induced by peculiarities of soil, climate, or environment generally, must build a sounder basis for descriptions of phylogenetic significance.

When all this has been done, there may still be something lacking. It has been assumed from the time of Linnæus that form defines the animal or plant. But this convention ignores the many-sidedness of the living organism, and there may be living characters which reveal specific grouping. If we are not prepared to admit physiological species as well as morphological species, at any rate we must admit that stable and well-defined characteristics may elude morphological analysis. Dr. Hill gives some interesting illustrations of the blind spot in morphology. The botanist is unable to separate two forms of the leguminous *Butea frondosa*, but the Indian lac insect feeds on one and will not touch the other. The South African Pentzias are widely distributed on the plains; but while some are eaten greedily by sheep, others are entirely avoided, and still others, usually left untouched, cause unmistakable symptoms of nervous depression when grazed. Yet no morphological difference of any value can be detected between these three forms. In another direction the common mistletoe illustrates the same problem. There is a form of mistletoe which grows on deciduous trees, another associated with fir trees, and another with pine trees; but the seeds of the pine form will not grow on fir or on apple trees, nor will the others sprout except on their own type of host. Morphological identity may conceal physiological diversity. It is significant that morphology alone cannot necessarily solve the problem of relationships. Physiology and chemistry must join hands with structural analysis before the ultimate variations or adaptations can be interpreted.

These points need not be laboured. They make

evident, however, that taxonomy has not yet reached the final analysis. It is not a back number, but in a new spirit it demands from many angles fresh study of characters and groupings. There are still problems to be solved, interesting in themselves, of service in the advance of pure knowledge, and of vital economic value; and the solution of these problems demands not only the best knowledge of the schools, but also the ingenuity of fertile and unhampered minds.

At home and abroad more scientific research workers are required, and more posts adequately endowed for them to occupy. The addresses of the presidents of the Zoological and Botanical Sections of the British Association ought to stimulate interest and recruitment in a branch of scientific work which for the moment and for no very good reason has fallen somewhat out of favour.

Haloes.

Probleme der kosmischen Physik. Herausgegeben von Prof. Dr. Christian Jensen und Prof. Dr. Arnold Schwassman. Band 12: *Die Haloerscheinungen.* Von Prof. Dr. Rudolf Meyer. Pp. viii + 168 + 2 Tafeln. (Hamburg: Henri Grand, 1929.) 11 gold marks.

THOSE who are interested in the optical phenomena of the earth's atmosphere have reason to be grateful to the editors of this valuable series of monographs, for, at no long interval after "Die Dämmerungserscheinungen", has appeared this volume dealing with the luminous rings, arcs, and patches, always beautiful and sometimes remarkably impressive, which are due to refraction and reflection of light by ice crystals suspended in the atmosphere. That these phenomena, which usually receive the general designation of halo, were due to ice crystals was suggested more than two centuries ago, and though the classical memoir by Bravais in 1847 admirably surveyed the knowledge of the time and, for certain phenomena, elaborated explanations which have required no essential modification, there are a number of matters which remain obscure at the present day. The halo of 22° and the associated parhelia (mock suns or sundogs) are the most frequently observed of halo phenomena and are well known to even the casual observer; but there are several other less common manifestations, the occurrence or form of some of which depends on the altitude of the sun (or moon), and there is as yet no unanimity of opinion as to the precise mode of origin of certain forms. On the other hand, the general theory of haloes indicates the possibility of other and as yet unrecorded forms.

The first principal section of the volume under notice is devoted to a general description of the chief halo forms (reference being made to some of the remarkable 'halo-complexes' which have been observed) and to a discussion of observational data, from polar as well as from other latitudes, with intent to reveal the frequency of occurrence of individual or associated forms of halo, and the geographical, annual, daily, and secular variation in frequency. It may be noted in passing that haloes occur more frequently than may be generally suspected, there being on the average one observation about every three days at places in middle latitudes. Certain observational series appear to indicate that there may be a restricted inverse relationship between the frequency of haloes and that of sunspots, but the evidence from other series is conflicting. It is very evident that the non-comparability of sets of observations is responsible for the inconclusive or divergent results of several of the statistical studies which have been made from time to time. The observational data are not published according to a uniform scheme, and the observations are made with varying degrees of intensiveness, the waxing and waning of individual or general interest in the phenomena being reflected in the observations.

The first section of the work concludes with a discussion of the relationships with cloud and cloudiness, and with the general weather situation. There is some evidence that in Holland the ordinary mock suns and the circum-zenithal arc, both of which are attributed to crystals floating with the principal axis vertical, occur definitely more frequently behind than in front of a depression: that is, presumably more frequently in old than in new cirrus cloud. The age-long belief in the value of haloes as prognostics of stormy or cold weather seems to receive no support when subjected to critical investigation, but it must be admitted that the number of really critical investigations of this matter is insufficient.

Hexagonal ice crystals of elementary form—columnar or laminar prisms, alone or in association, and with or without pyramidal caps—are regarded as the refracting and reflecting agents necessary to the production of haloes, and it is obvious that all physical circumstances which in any way determine the form and behaviour of ice crystals in the atmosphere, usually at the cirrus level, are relevant to any complete study of the phenomena. The dependence of form of crystal on temperature and on the rate of crystallisation; the size of effective

crystals; the nature of the motion of the crystals through the air; the effect of the quantities of crystals present; the brightness and polarisation of haloes; diffraction effects; the optical properties of ice; and the all-important rôle of refraction at minimum deviation, are treated in the second section, which deals with the general foundations of halo theory. By the very nature of the problem it is extremely seldom that any direct observation is possible on the form, size, and character of motion of ice crystals which produce a given halo. Much of our knowledge of these matters has been acquired indirectly and by analogy. Experiments with models in the form of typical ice crystals have shown that in general they tend to fall in such a way that the resistance to motion is a maximum. This, an important point in the explanation of the production of certain forms of halo, is in direct opposition to the assumption made by earlier workers. Emphasis is laid on the desirability of investigation of the physical factors determining the form and equilibrium setting of ice crystals, of the question of oscillation as distinct from rotation of crystals, and on the need for quantitative observations on the brightness and polarisation of haloes.

Nearly one-half of the volume is occupied with the discussion of the several forms—the haloes of 22° and 46°, the various arcs of contact associated with these haloes, the various parhelia, the parhelic circle, the circum-zenithal and horizontal arcs, the anthelion, the paranthelia, sun pillars, and others. A detailed survey is given of the circumstances of production of individual forms, of their characteristics and variations, and of the views of the chief workers in this field of inquiry. In this section, as elsewhere, mathematical expressions are not derived or quoted, but where necessary the results of such analysis are quoted and compared with observational data, and there are diagrams both of halo forms and of the paths of light rays through ice crystals. Certain unusual haloes are noticed, but the author does not mention that some ten years ago Besson showed that the very rarely observed haloes of about 8°, 17°, 19°, 24°, and 32° radius may all be attributed to a crystal with pyramidal ends, the pyramidal faces being inclined at 25° 14′ to the principal axis; and that, a little later and independently, Humphreys made the same suggestion but gave, from the results of X-ray analysis of ice, 24° 51′ as the value of the angle.

Useful recommendations on the technique of observation, both visual and photographic, are contained in the final chapter. There is a numbered bibliography of about 250 entries and the reference numbers are employed liberally throughout the text.

The author is heartily to be congratulated for giving us, within rather less space than is occupied by the corresponding section of "Meteorologische Optik" by Pernter and Exner, so complete an account of haloes; for keeping in the forefront the general and particular problems involved, and for succeeding so admirably in his aim to produce a book which will appeal to those outside a small circle of specialists in the subject. One regrets that there is no work in the English language with which Dr. Meyer's monograph may be appropriately compared.

H. W. L. A.

The Art of Geological Map-making.

Methods in Geological Surveying. By Dr. Edward Greenly and Dr. Howel Williams. Pp. xvi + 420. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1930.) 17*s.* 6*d.* net.

THE authors tell us that one of the earliest, if not the first, to suggest the making of a geological map in Britain was one John Aubrey, who lived in the seventeenth century. We are also told that he was described by a contemporary as "a shiftless person, roving and magotie-headed, and sometimes little better than crazed"; whether because or in spite of his suggestion is not stated. One knows, however, that, even in these enlightened days, geological surveyors are often not recognised as such. Their hammerings and apparently aimless wanderings cause wonderment and comment, the latter sometimes caustic.

It seems that, in Great Britain, the functions and, in fact, the very existence of a Geological Survey are not so widely known as is desirable, at least to the general public. The appearance of a book which, among other things, directs attention to this branch of scientific activity is therefore welcome.

The senior author, Dr. Edward Greenly, received his early training as a member of the Scottish staff of the Geological Survey of Great Britain. Afterwards he pursued his detailed survey of Anglesey for twenty-four years, with results well known. Dr. Howel Williams, in addition to his work in Wales, has taken part in pioneer surveying in the United States. Their combined experience well fits them for the task they have undertaken.

The manual is intended for those desiring to know how geological maps are made, and is not concerned with their interpretation. The authors maintain as the principal aim of geological mapping that it should be an end in itself rather than a means

to an end. To us this point of view seems a little over-stressed. Surely the production of a map, however important, must always be a corollary to the geological survey undertaken first of all to gain knowledge, be it scientific or economic, of the geology of a country.

While primarily intended for the use of those who have the advantage of large-scale topographical maps, the book also deals with pioneer and reconnaissance mapping.

Part I. is devoted to introductory and historical matters only. Though full of interest, it is somewhat surprising to find that it occupies one-third of the text. That this is so is less astonishing when, for example, we discover that two and a half pages are solely occupied with the etymology of one word—'chart'. In addition to the evolution of geological cartography, the history and methods of construction of topographical maps are discussed here.

There is much in Part I. to repay the general as well as the geological reader, especially in these days of motoring and cheap maps. Few give a thought to the care and labour involved in their production. It cannot, however, be maintained that much of Part I. is essential to the stated objects of the book.

Part II. consists of a detailed exposition of the methods of mapping employed by the authors and others in Great Britain and elsewhere. It includes notes on the preparation and care of maps, note taking, specimen collecting, and other incidentals. In addition, there are chapters on the use of surveying instruments. The methods elaborated seem to be thoroughly sound, and we cannot offer any major criticisms. Each individual mapper will incorporate his own idiosyncrasies in his own maps, but if he bases his field work on the system here advised he will not go far wrong.

Appendix I. includes an explanation of the frontispiece. This is a poorly reproduced facsimile of one of Dr. Greenly's field maps. Apart from poor reproduction, we should have expected something better after reading the text.

There are also three tables of useful mathematical constants, and the book concludes with an extensive bibliography.

The difficulties of geological surveying are summed up in the statement that while a topographical surveyor maps what he sees, the geologist, as often as not, must map what he cannot see. The authors therefore recommend caution at all times, and attention to detail. They rightly insist that on field maps observations should in all cases be distinguished from inference. There is a not inconsiderable number of geologists who are in the habit of indulging in sporadic bouts of field work, more for the purpose of obtaining results for publication than with any idea of producing a worth-while map. Considerations of time may militate against their acquiring the knowledge of field technique that can only come from prolonged work in the field. To them especially, and also to students in general, the counsel of perfection expounded by the authors is specially recommended.

"Methods in Geological Surveying" contains much that is discursive. If limited to matter essential to its scope, it might have been reduced very considerably in size and, more important, in price. Then, however, there would have been left only the bare bones of a text-book. As it stands the book is eminently readable, and may, we think, be perused with pleasure and profit by all geologists.

Bacterial Housekeeping.

Bacterial Metabolism. By Marjory Stephenson. (Monographs on Biochemistry.) Pp. xii + 320. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 18*s.* net.

THE chemical action of bacteria (and other micro-organisms) has always aroused great interest for two reasons. The weight of material which undergoes change frequently stands in striking disproportion to the weight of the organisms which provoke the change, and the products, in contrast to the few simple end substances formed by the oxidation of food materials in the animal body, are diverse in kind and often complex in nature. The clue to the explanation of these phenomena lies in the fact that bacteria and many other micro-organisms possess, in addition to the aerobic mode of life in which food materials are oxidised by the aid of atmospheric oxygen, the faculty of acquiring the special compounds requisite for growth and the energy for both growth and maintenance by an anaerobic process. In this atmospheric oxygen is not involved, since it consists in producing a rearrangement of the atoms of the food materials so that the resulting compounds, often of a highly complex nature, contain less energy than those from which they have been formed. This process, known generally as fermentation, results, as was first pointed out by Lavoisier, in the transference of oxygen and hydrogen from one atom to another in such a way that one part of the molecule becomes oxidised and another reduced,

the bonds between the carbon atoms being often simultaneously broken, so that a number of smaller molecules are produced.

Peculiar interest also attaches to the autotrophic bacteria, which, as the author points out, are, like green plants, independent of other living beings and are, moreover, independent of the energy of light, since they are able to utilise the energy liberated by oxidation of various inorganic materials (for example, sulphur or a ferrous salt) for the conversion of carbon dioxide into assimilable carbon compounds.

The present work is one for which biochemists have long been waiting and it will be received with gratitude. The predominant interest attached to bacteria as the prime causes of disease has overshadowed the study of their general physiology, and, as the author says in her preface, it is indeed "time that an attempt should be made to arrange the scattered data in order to appraise our knowledge of bacteria as living organisms".

This has been very effectively accomplished, and the successive chapters, which cover the whole field of bacterial metabolism, all show evidence of diligent search and wise selection.

As might be expected, the chapter on respiration is of particular interest and presents an extremely interesting picture of the work of the Cambridge School, in which the author of the book has herself taken such an important part.

It has, of course, not been found possible to deal with equal thoroughness with all the subjects discovered; thus the section on the death-rate, in which reference is made to the large subject of disinfection, might usefully have been expanded.

An appendix is provided dealing with practical methods, and the work concludes with a most valuable bibliography, extending to thirty pages.

ARTHUR HARDEN.

The Comparative Anatomy of the Brain.

The Evolution of the Nervous System in Invertebrates, Vertebrates and Man. By Dr. C. U. Ariëns Kappers. Pp. vii + 335. (Haarlem: De Erven F. Bohn, 1929.) 8·75 g.

WHEN the International Brain Commission met in 1905 at the Royal Society's rooms in London, it recommended the establishment of a central institute for brain research in each of the countries represented. While most of the representatives regarded this resolution as the expression of a pious wish not likely to be realised, the Royal Academy of Sciences in Amsterdam set to work to found such an institute as the Brain Commission recommended and placed Dr. Ariëns Kappers in charge.

It is no exaggeration to claim that this enlightened course made Amsterdam the chief centre for the investigation of the comparative anatomy of the brain, not merely for Holland but also for the whole world. During the War, the issue of three large volumes on the comparative anatomy of the nervous system in vertebrates and invertebrates by Dr. Ariëns Kappers and Dr. Drooglever Fortuyn, providing as they did the most impressive collection of data yet made available on this subject, revealed the great significance of the work accomplished during the first ten years of the Brain Institute's work, and set the seal of success upon the Royal Amsterdam Academy's enterprise.

The first half of the valuable book that has just been issued in English may be regarded as a concise and generously illustrated summary of the large treatise, brought up-to-date. Like all Dr. Ariëns Kappers's writings, it is a simple and lucid statement of the present state of knowledge, in which the often conflicting views of different workers are fairly and fully stated, along with the solid background of Dr. Kappers's own observations. It is a general survey of the facts relating to the nervous system as a whole in invertebrates and vertebrates, and especially the comparative anatomy of the cerebral cortex, striatum, thalamus, cerebellum, medulla oblongata and spinal cord, together with a useful account of the evolution of what Dr. Kappers calls the 'metabolic tissue' of the central nervous system.

This section of the book will be of particular value to students of comparative anatomy and psychology in providing them with a brief and easily understood survey of the whole field of comparative neurology.

The latter part of the book is a comprehensive survey of the literature, and Dr. Ariëns Kappers's original observations, on what he calls the anthropology of the brain, "written in the hope that it may increase the interest in this much neglected field and stimulate further research". It gives a succinct and well-illustrated account, with an excellent bibliography, of the work which has been accomplished in the study of endocranial casts of the extinct members of the human family and of the actual brains of the various living races of mankind.

The volume is a most useful book of reference, with an exceptionally full index.

G. ELLIOT SMITH.

Our Bookshelf.

Northern Rocky Mountain Trees and Shrubs. By Dr. J. E. Kirkwood. Pp. xvii + 340 + 35 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1930.) 35*s*. net.

DR. JOSEPH EDWARD KIRKWOOD, the author of this work, made a life study of the flora of the northern Rocky Mountains, but, unfortunately, he died suddenly in August 1928, whilst the present book was in course of preparation. The title indicates the scope of the work, and the region included embraces the country from the Yellowstone Park, north and north-west through Montana and Idaho and the Canadian Rockies, covering the various ranges and the closely adjacent plains. The limitation of area naturally excludes from this work many of the well-known trees and shrubs of western North America, but in an introduction describing the area and the peculiar distribution of various genera and species, we find that 79 genera and 248 species are found in the region under notice. The introduction is ended by a key to the 27 families concerned. *Salix* is the most prolific genus in species, for some 51 are described.

Beginning with Pinaceæ, the various families with their genera and species are then passed in review. A family description is first given with a key to the genera, then follows a description of a particular genus with keys to the species and good specific descriptions, with excellent illustrations of shoot, leaf, flower, fruit, and seeds. Some eighty-seven figures of this description are included in the 340 pages to which the book runs, whilst there are thirty-five full-plate photographs. The descriptions are in non-technical language and should not create difficulties for the person who has little or no botanical knowledge, but in some quarters difficulties may arise through the splitting up of genera. Thus, for the well-known shrub *Spiræa discolor* Pursh, the name of *Holodiscus ariæfolius* Greene is used. The generic name of *Neillia* gives place to *Opulaster*; *Rubus parviflorus* Nutt. is described as *Bossekia parviflora* Greene, and *Spiræa millefolium* Torr. as *Chamæbatiaria millefolium* Maxim. Where this division of genera occurs it would have been an advantage had the well-known names been bracketed with the ones used.

A Study of the Induction Motor. By Dr. F. T. Chapman. Pp. xvi + 289. (London: Chapman and Hall, Ltd., 1930.) 21*s*. net.

THE induction motor is one of the most useful mechanical slaves that man has ever invented. It is deserving, therefore, of the most careful study, and engineers will welcome a good exposition of the theory. They will find it in this book. Dr. Chapman was the designer of alternating current machinery to Messrs. Greenwood and Battey of Leeds. He was afterwards senior lecturer and superintendent of the testing department at Faraday House, London. He is now an inspector of technical colleges for the Board of Education. His experience therefore qualifies him in every way for writing a treatise on electric motors, and in particular of the induction motor, of which he has always made a special study.

The book contains a great deal of original matter now published for the first time. The student will welcome the author's method of finding the fundamental equations and developing the circle diagram on the assumption that the motor may be replaced by a stator and rotor made from magnetic material of infinite permeability, the air gap being bounded with smooth unbroken surfaces. Afterwards the length of the air gap used in the formulæ is corrected in order to take into account the presence of slot openings and the saturation of the iron.

The author shows that the theory can be readily developed by simply using algebra and geometry. Those who think that there is something specially powerful in vector algebra, which the reviewer does not, can easily convert Dr. Chapman's proofs into that form. Several firms make electric motors only, four or five of which are required for every cine-sonoro (talkie). This book will be of great use for designers.

Photographic Printing Processes. By Capt. Owen Wheeler. Pp. xvi + 260 + 6 plates. (London: Chapman and Hall, Ltd., 1930.) 8*s*. 6*d*. net.

THE average amateur is generally content to confine himself to the practice of one or two photographic printing processes. He is not aware of the many other processes, varied in nature and giving beautiful results, which will repay his attention; to some extent the same is true of the professional photographer. To both these classes this book should make an appeal. Capt. Wheeler embodies largely his own extended experience in the description of processes ranging from print-out, through bromide, carbon and carbro, gum-bichromate and its variants, dye-printing, etc., to colour printing. The details given are such that it should be easy for novices in a particular process to go straight ahead and acquire proficiency. The scientific principles involved are not discussed, and only the simplest chemical terminology is used.

Rasa-Jala-Nidhi: or Ocean of Indian Chemistry, Medicine and Alchemy. Vol. 3. Compiled in Sanskrit by Bhudeb Mookerjee. With English translation by the Author. Pp. xxxvi + 390. (Calcutta: The Author, 41A Grey Street; London: Luzac and Co., or Arthur Probsthain, 1930.) 6 rupees.

MR. MOOKERJI is a medical practitioner who is publishing a series of volumes on the pharmacopœia of drugs prepared from minerals, based on ancient sources. His work is of interest to students of Indian chemistry and medicine, although it is sometimes without apparent logical arrangement and contains a great number of names of plants and materials transcribed without the elucidation necessary for European readers. The present volume deals with the metals, gems, alkalis, salts, poisons, oils, and fermented liquors. The Sanskrit text is given, followed after each section by an English translation.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Observation of the Opposition of Eros.

IN *Astronomische Nachrichten*, No. 5722, is published an article "Zur Beobachtung der Eros-Opposition", by Prof. Hartmann, in which certain recommendations are made to those who will be co-operating on the observations of Eros around the forthcoming opposition.

As chairman of the Solar Parallax Commission of the International Astronomical Union, I desire to state that some of these recommendations cannot receive the support of the Commission. Prof. Hartmann recommends that observations should be limited to the period 1931, Jan. 1 to Feb. 26, and that they should be secured at intervals of four days throughout this period, except that from Jan. 25 to Feb. 6—when the parallax of Eros has practically its maximum value—observations should be secured daily. Southern observers are recommended to obtain daily observations, in addition, on Mar. 14–18, when Eros is near a stationary point. He further recommends that observations should be secured at large east and west hour angles only, and states that observations on the meridian, between a northern and southern observatory in co-operation, are not to be recommended in view of the possibility of observations being frequently secured at one of the co-operating observatories and not at the other. He considers that the advantages of the co-operative and practically simultaneous observations—elimination of the errors of positions of comparison stars and of the ephemeris of Eros—do not outweigh the loss of weight in parallax factor as compared with observations by the east-west method.

The co-operative programme of observations has for its purpose the accurate determination of (1) the solar parallax, (2) the mass of the moon and other related constants. In so far as (1) is concerned, limitation of observations to the period recommended by Prof. Hartmann would undoubtedly provide adequate weight for the derivation of the solar parallax, if weather conditions were satisfactory throughout the period.

It must be remembered, however, that observing conditions at this time of year at most places in the northern hemisphere are not generally satisfactory, and that long spells of cloudy or unsettled weather are possible. By the end of February Eros will have moved too far south to be accessible to most of the co-operating observatories in the northern hemisphere, and if observations have been unduly interfered with by bad weather, it will then be too late to obtain additional material. From this point of view, it is desirable that northern observatories should secure observations before Jan. 1. From the middle of November the parallax of the planet is greater than 20″, increasing to nearly 40″ at the end of December; observations during this period can add appreciable weight to the derivation of the solar parallax. Observers in the southern hemisphere are more fortunate in that Eros is first accessible when its parallax is near its maximum value, and the extent to which observations need be continued as the parallax decreases will be conditioned by the weight of the material already accumulated.

As regards (2), observations over as long a period as possible are required in order to cover a number of lunations and so enable the lunar equation term to be more satisfactorily disentangled from the errors of the ephemeris of Eros. In this connexion, the experience of Mr. Hinks on the discussion of the observations secured at the 1900–1901 opposition (when the maximum parallax was only 28″) may be recalled (*M.N.R.A.S.*, **70**, 63, 1909): "For the parallax determination the observations made after Christmas 1900 had very little weight. But, on the other hand, it will appear that the part of the series most valuable for the determination of the mass of the moon is the latter half, from the middle of December to the end of February. It is fortunate, therefore, that some observers persevered throughout the unfavourable months of January and February, 1901, after those whose main interest was the solar parallax had stopped work." Dr. Jackson (*M.N.R.A.S.*, **90**, 742, June 1930) has recently directed attention to the discordance between the observed and theoretical values of the constant of nutation and the importance in this connexion of a determination of the mass of the moon. It is hoped that all observers will plan their observations with the view of providing material for the determination of the mass of the moon as well as of the solar parallax.

With regard to the co-operative observations between northern and southern observatories, these are not being planned to the exclusion of observations at large hour angles, but will be in addition to them. Observations obtained at one observatory, when conditions are unfavourable at the other, need not be wasted, as such observations can be utilised in connexion with the derivation of the errors of the ephemeris of Eros and of the mass of the moon. On the other hand, the simultaneous observations at the two observatories are ideal for the derivation of the solar parallax, being entirely independent of errors of comparison star places and of the ephemeris of Eros.

H. SPENCER JONES
(Chairman, Solar Parallax Commission, I.A.U.).

Royal Observatory,
Cape of Good Hope,
Aug. 29.

A Simple Lecture Demonstration of Lattice-'Planes' in Two Dimensions.

STUDENTS frequently find some difficulty in picturing lattice-planes in X-ray crystallography, and in their elucidation, apart from isometric drawings and models of crystal forms and lattices, recourse is usually made to drawings of a two-dimensional lattice. I venture to hope that the following simple demonstration may be of service to those who have to lecture on this subject.

The device is an adaptation of the lecture-demonstration of optical diffraction patterns projected on a screen across the lecture theatre—a demonstration which is not so often shown as it deserves to be. By means of a condensing lens, the light from an arc is focused in front of a narrow slit, so that the length of the slit is filled with light, and a thin pencil of light passes beyond the slit to the diffracting object, placed (say) one foot away from the slit. In these circumstances, beautiful diffraction patterns of wires, straight-edges, needle-points, etc., can be readily observed by the audience on a screen placed several yards away. It is often advantageous to tilt the screen and so broaden the fringes.

If, in this arrangement, the diffracting object is replaced by an ordinary square-mesh wire gauze arranged normally to the incident light, it becomes

an effective lecture-demonstration of lattice-' planes ' in two dimensions. Assuming one set of wires of the gauze to be vertical and parallel to the slit, only the vertical wires cast sharp shadows on the screen, the horizontal wires being ineffective because each point of the slit casts its own shadow, as it were, of each point of the gauze. We thus see on the screen a series of vertical line-shadows, with their accompany-

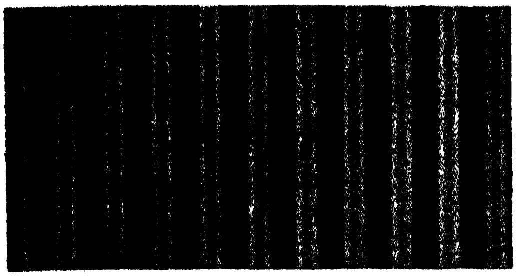


FIG. 1.—(1·0)-' Planes '.

ing diffraction patterns, often very beautiful, especially at distances of several yards. These vertical lines (Fig. 1) represent the (1·0)-rows (' planes ') of the two-dimensional lattice, in which the points of intersection of the vertical and the horizontal wires are the *units* of the lattice. If we turn the slit through 45°, the diagonally elongated shadows of the units give rise to well-defined linear shadows on the screen, representative of the (1·1)-' planes ' in the lattice (Fig. 2). For various intermediate positions of the slit, quite a number of such well-defined, inclined shadows of the units can readily be seen on the screen, running parallel to one another. Moreover, the intensity and distance apart of the shadows increase, almost without exception, with the number of units per unit length in the relevant ' plane '. Fig. 3 reproduces the pattern which corresponds to the (3·1)-' plane ' of the gauze, and I have succeeded in photographing several others, but the three figures here shown will suffice to illustrate the generality and effectiveness of the demonstration.

Only the simpler figures are suitable for demonstration to a seated audience, but by viewing the screen

FIG. 2.—(1·1)-' Planes '.

close up, I have had no difficulty in observing and identifying the figures corresponding to the following ' planes ': (1·0), (7·1), (6·1), (5·1), (4·1), (3·1), (2·1), (1·1), (3·2), (5·3), (4·3), (5·4), (6·5). Other weak figures have been observed, but not identified with certainty. For all the gauzes I have examined, the figure corresponding to the (2·1)-' plane ' is exceptional in its behaviour. Instead of giving bold black shadows, it gives fine-line and weak shadows, correctly spaced, and generally accompanied by a weaker component on either side of each of the main shadows. I have not succeeded in explaining why the (2·1)-' plane ' behaves in this way.

The experiment can be performed with gauzes of different size of mesh, but the most satisfactory results have been obtained with a gauze with wires about 1/3 mm. thick, and of spacing about 1·3 mm. The spacing of such gauzes usually differs in perpendicular directions by several per cent, and with the one used in taking the photographs here reproduced the angle corresponding to the (1·1)-row was calculated to be 42° 35′ (instead of 45°); the actual amount through which the slit, mounted on a circular scale, had to be rotated from the vertical to obtain this figure most clearly was found to be 42° 39′—a very satisfactory agreement. Perforated zinc or copper gauze, with hexagonal pattern, can also be effectively used in the demonstration, and generally shows a periodicity in the patterns and intensities obtained, owing to the periodic grouping in the spacing of the perforations. Good results are also given by the use of positive or negative plates obtained by photographing point-row lattices or squared paper with prominent black lines on a white background, especially when a permanent set of ' grids ' is required for demonstration purposes, as different types of lattice can readily be drawn and photographed. In general, however, ordinary square wire gauze is a convenient and ready-at-hand lattice, sufficient for most purposes.

FIG. 3.—(3·1)-' Planes '.

The accompanying photographs were obtained by exposing bromide paper on the screen, placed about six feet beyond the gauze, and taking bromide paper positive contact prints of these negatives, using a ' Lumino-phor-Leuchtfolie ' as the source of contact illumination.

In conclusion, it may be of interest to direct attention to an interesting optical effect obtained with squared paper—black lines on a white surface. On looking at this surface perpendicularly, and moving the eye to different parts of the surface, the intersections of the black lines appear to have white centres, and one gets an impression of two perpendicular sets of white diagonal lines over the surface—the (1·1)-' planes ' of the lattice. The effect is more pronounced by observing the squared paper (card is preferable) at grazing incidence, and in the appropriate orientation of the card, when one has no difficulty in observing ' white lines ' crossing the card in the directions of the (1·1)-, (2·1)-, and (3·1)-' planes '.

ROBERT W. LAWSON.

Physics Laboratory,
University of Sheffield,
Sept. 1.

Chromosome Behaviour of Triploid Œnothera.

IN two recent issues of NATURE, Darlington [1] and Gates [2] have entered into a discussion of synapsis in triploid Œnotheras. The root of controversy lies in the novel observation and interpretation of Catcheside [3] that a continuous ring of 21 chromosomes was formed in a triploid plant. Having been engaged for the past two years in an investigation dealing with the genetics and cytology of triploid Œnotheras, I

have naturally focused my attention on all published accounts of polyploidy, particularly those which deal with chromosome behaviour in triploids. At the suggestion and under the guidance of Prof. G. H. Shull I undertook the studies of triploid Œnotheras, the origin of which he has described in a recent paper.[4] Fifteen triploids were turned over to me in the fall of 1928 and their cytology was studied. I have since then made cytological analyses of buds of triploids in the summers of 1929 and 1930. The triploids studied in the last two years have all been derived from pure *Œ. Lamarckiana*. As the chromosome behaviour in triploid Œnotheras has become an issue of lively interest, I report here such observations as are pertinent to the fundamental point under discussion. My observations were based on paraffin sections stained with Heidenhain's iron-hæmatoxylin and on smear preparations of pollen mother cells stained with iron-Brazilin.[5] My microscopic preparations have been examined both by Prof. E. G. Conklin, under whose supervision I have acquired my cytological technique, and by Prof. Shull.

In microsporogenesis of triploids, it can be frequently observed that rows of pollen mother cells in different phases of mitosis occur in the same bud. Not infrequently also, pollen mother cells in various stages of cell divisions are found in a single anther segment. This condition enables one to trace with accuracy the various phases of meiosis. Microscopic slides, particularly the paraffin sections, are now available which show the stages from early presynizesis up to the reconstitution of daughter nuclei. I have observed that the threads issuing from the synizetic knot are single in Nature, as evidenced by the presence on them of a single row of chromomeres. In the second contraction stage the pachytene threads also remain single and later the chromosomes are formed as single segmented bodies invariably connected end to end, and undoubtedly conjugation has occurred in telosynaptic fashion. This arrangement of chromosomes is in many instances, especially the Y-shaped (trivalent) chromosomes, in agreement with the earlier account of Hakansson,[6] and it confirms some of the observations which were made by Darlington [1] on Catcheside's slides.

In my triploids are shown two or more chains open or closed to form rings, Y-shaped trivalents, unpaired chromosomes, and single pairs of chromosomes in the form of rings. These ring pairs generally encircle the long axis of the chain. All prophase spiremes seem to be characterised by the presence of trivalents which are formed in various shapes, the predominating one being Y-shaped. The open chains are often branched at one end with from 1 to 2 chromosomes in a branch. In no case could it be observed or even inferred that the 21 chromosomes were all united in a single circle. Paraffin sections and uncut cells of smear preparations gave essentially identical results. The various types of chromosome rings and configurations persist in the formation of multipolar or bipolar spindles at meiotic metaphase. At metaphase plate they aline themselves in the characteristic zigzag manner of other Œnotheras, and the plate shows two or more circles or chains interlacing with one another. In anaphase the chromosomes seem to orient themselves at haphazard with respect to the poles to which they move. In this chromosome separation two members composing the trivalent move to one pole and the third to the other.

It is not within the scope of this short account to discuss the interpretations of the chromosomal configurations here described. Suffice it to put on record at this time that the chromosome associations, especially the trivalent forms, are quite characteristic of meiosis in Œnothera triploids. A fuller preliminary account of these investigations is appearing in the *American Naturalist*.

JOSÉ M. CAPINPIN.

Biological Laboratory,
Princeton University,
Aug. 1.

Darlington, C. D.: NATURE, May 17, 1930.
Gates, R. R.: NATURE, June 7, 1930.
Catcheside, D. G.: *Trans. Roy. Soc. Edin.*, **56**, part 2; 1930.
Shull, G. H.: *Proc. Nat. Acad. of Sci.*, **15**; 1929.
Capinpin, J. M.: *Science*, **72**; 1930.
Håkansson, A.: *Hereditas*, **8**; 1926.

Moving Striations in Positive Column in Rare Gases.

IT is now well known that the visually observed uniform positive column in rare gases is in reality discontinuous, consisting apparently of a series of uniformly spaced moving striations which travel from anode to cathode.

I have pointed out the following facts in connexion with this phenomenon:

1. The light emitted does not exhibit the Doppler effect even when observing the fastest flashes moving up to 10^6 cm./sec. at the lower pressures (*Proc. Camb. Phil. Soc.*, Jan. 1925).

2. At any particular gas pressure there are at least four types of 'flash' which change one to another in a definite manner (*Proc. Leeds Phil. Soc.*, 1930) with changing current, being all independent of external inductance and capacity.

3. For one type of flash the velocity in the body of the tube is approximately proportional to the reciprocal of the pressure and is little dependent on current and tube potential (see, however, 2).

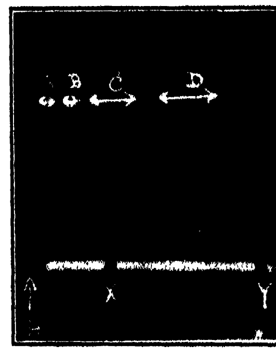


FIG. 1.

4. The current variations in the circuit are roughly about one per cent of the whole—an interesting wave form being associated with this current variation.

I have now formed the opinion that there is a good deal to be said for supposing this phenomenon to be due to a regular sequence of dark spaces travelling at constant speed in a uniform positive column away from the anode. It is clear that such a hypothesis would be in conformity with 1 and 4 above.

An additional experiment which I have just performed attempts to follow the 'flashes' right up to the cathode—which was a dull emitting lime-coated filament placed on the axis of a quartz tube.

The photograph here reproduced (Fig. 1) is of the discharge in argon. The intense white line XY is the uniform positive column photographed directly, punctuated at X and Y by two obstacles 10 cm. apart for reference purposes. On the left at H is an isolated button of light, the negative glow surrounding the cathode. The Faraday dark space is just to the right of H, the anode being out of sight on the extreme right.

Above XY is the photograph on the same plate of the same discharge viewed in a mirror rotating with axis parallel to the tube.

The inclined white streaks are the hitherto named moving striations. Their steepness is a measure of their speed. It will be observed that in the region

above XY—away from the external electrodes—their speed is constant, as shown by the constancy of D wherever taken in this region. Nearing the cathode, however, the separation shrinks to C, then to B, the striations approach closer to each other, lose speed, but, it is noticed, never cross the Faraday dark space, the edge of which they approach in an asymptotic manner. It is important to notice that at the instant one striation has merged its identity in the edge of the Faraday dark space its successor is a distance behind of B equal to A, the Faraday dark space width.

The following table shows the approximate equality of these two distances at different gas pressures :

Photograph number.	Faraday dark space length (A in photo).	Travelling dark space length (B in photo)	Travelling dark space length in body of tube (D in photo).	Pressure in Pirani gauge.
7	0·44	0·54	1·76	20·4
18	0·67	0·67	3·30	18·0
14	1·27	1·34	3·34	10·5
12	1·39	1·39	3·90	9·7

The numbers in the pressure column are the voltmeter balance readings in the usual Pirani gauge circuit and are only included to indicate the trend of pressures employed. R. WHIDDINGTON.

Physics Laboratories,
University of Leeds, Aug. 30.

Aucuba or Yellow Mosaic of the Tomato: A Note on Metabolism.

THE metabolism of tomato plants infected with aucuba mosaic disease is being studied at the Cheshunt Experimental Station, and a number of interesting results have been obtained. The following appear to be fairly well established under the conditions of our experiments :

1. In the early stages of infection, the removal of starch from the leaves of a plant placed in the dark is greatly accelerated except at the points of infection, which show a marked local inhibition of starch removal, often surrounded as a transient phase by a zone of accelerated removal. At this stage starch formation in the light does not appear to be affected. The local inhibition is followed at a later stage, often about fourteen days, by the removal of starch over a larger area of the inoculated leaf, slight yellowing of the chlorophyll, and a failure to form starch over this area in the light.

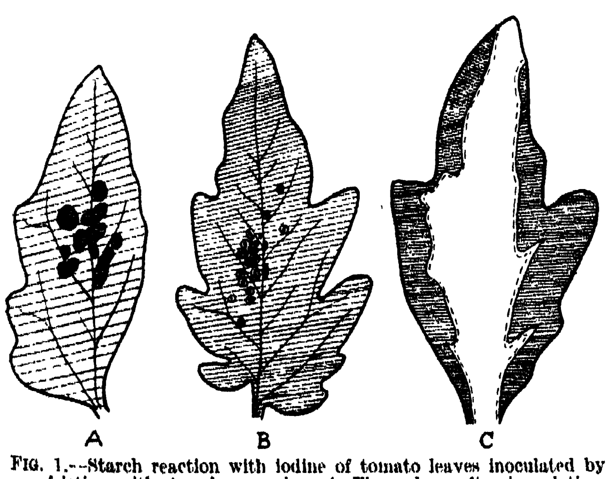


FIG. 1.—Starch reaction with iodine of tomato leaves inoculated by friction with Aucuba mosaic. *A*. Three days after inoculation, kept in greenhouse, tested 9.30 A.M. *B*. Four days after inoculation, kept in dark fifteen hours before testing. *C*. Fourteen days after inoculation, kept in greenhouse, tested 2 P.M.

2. The acidity of an aqueous extract of infected leaves sampled at dawn, that is immediately after loss of starch, is greater than that from healthy leaves.

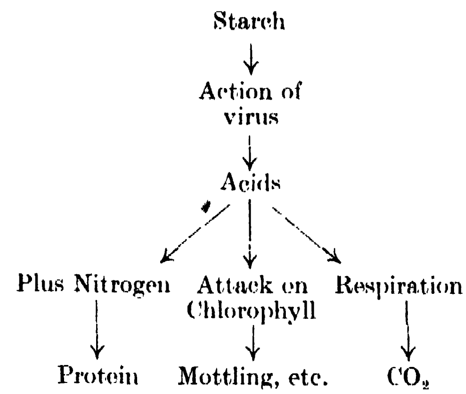
3. Local absence of starch in the leaves, even during the day, appears to precede the appearance of mosaic symptoms.

4. The freshly discoloured chlorophyll appears to react with copper salts, regenerating a green colour.

5. At a later stage of infection, some days or weeks after typical mottling has appeared, a marked accumulation of starch is found in parts of the infected leaves and complete absence in other parts.

6. No definite evidence has yet been obtained as to the relative respiration rates of infected and healthy leaves.

While not desiring to attach undue importance to these results, we venture to suggest the following sequence of metabolism :



This view agrees with all the observed facts as we know them, such, for example, as the different type of winter and summer symptoms, the effect of nitrogen, darkness, and other factors on infected plants.

While much of the work must be repeated under more critical conditions, the above results appear of sufficient interest to be recorded at this stage.

BERNARD D. BOLAS.
W. F. BEWLEY.
Experimental and Research Station,
Cheshunt, Herts,
Aug. 27.

Photographic Sensitisers for the Infra-Red.

A STATEMENT which has been circulated recently (compare NATURE, Aug. 9, p. 218) that the late developments in the technique of infra-red photography have come largely from the needs of the motion picture industry is not accurate, and I think it is worth while to have the record correct.

The making of sensitising dyes for the extreme red seemed to have reached a limit about 1907 with the discovery of dicyanine, and no great progress was made until Adams and Haller at the Bureau of Chemistry in Washington discovered kryptocyanine in 1919. The Bureau of Chemistry was at that time working on sensitising dyes with the general view of making improvements in the preparation of dyes for photographic purposes. Kryptocyanine was utilised by W. H. Wright for his photographs of the Yosemite Valley from Mount Hamilton and later for his photographs of Mars. Its first use in the motion picture industry was by J. A. Ball, who used it for sensitising motion picture film for making imitation night scenes.

Kryptocyanine was not of much value in spectroscopy, its sensitising power being limited to the region below 8000 A., in which region dicyanine was already known to be effective.

Improvements in methods of sensitising with kryptocyanine have now made aerial photography possible with it, and the photograph of Mount Ranier at a distance of 227 miles referred to in the note in NATURE was made on kryptocyanine sensitised film.

In a preparation of kryptocyanine, Dr. H. T. Clarke in 1925 found another dye to be present, which was separated and found to have sensitising power for the extreme infra-red. The name of neocyanine was given to this dye, and it is by the use of neocyanine that the advances in spectroscopy have been made. The discovery of neocyanine had thus nothing to do with the demands of the motion picture industry. It was an accidental discovery resulting from the manufacture of kryptocyanine, which was being used chiefly in miscellaneous scientific work. The maximum sensitising power of neocyanine is at 8300 A.; its sensitising power begins to fall off rapidly at 9000 A., but with long exposure through screens, spectra can be photographed beyond 11,000 A. Since its discovery, improvements have been made in the use of the dye, and modifications of it have been made which are much better for sensitising than that originally produced. A great deal of research has also been done in the hope of finding other sensitisers for the infra-red, both before and since the discovery of neocyanine, but up to the present, no dye has been found which is more effective for the infra-red region than neocyanine. C. E. KENNETH MEES.

Kodak Research Laboratories,
Rochester, N.Y., Aug. 25.

Vitamin Content of Marine Plankton.

THE appearance of the letter in NATURE of Sept. 13, by J. C. Drummond and E. R. Gunther, on the vitamin content of marine plankton, simultaneously with the résumé on p. 423 of the same issue, of the paper by G. Belloc, R. Fabre, and H. Simonnet on the study of plankton sterols, stresses the importance of a knowledge of the vertical distribution of plankton animals in the sea. It is a general rule that most of the plankton animals in Plymouth waters in sunny weather during April, May, and June live at depths below 10 to 15 metres, thus presumably avoiding the layers in which irradiation is likely to take place. In July, however, a definite change comes over the plankton, certain species previously only to be found in the deeper layers becoming abundant right up to the surface itself; this condition persists throughout July, August, and perhaps September. This seems significant in view of Belloc, Fabre, and Simonnet's findings that the sterols collected in July were found to be biologically active, whereas those collected in April only acquired biological activity after irradiation.

F. S. RUSSELL.

Marine Biological Association,
Plymouth.

Mortality amongst Plants.

ON the Cretaceous plateau that occupies so much of East Devon (800 ft.-900 ft.) beech trees flourish in considerable numbers. The roads crossing the upland are separated from the adjoining enclosures by massive earth banks that are quite remarkable for their breadth and solidity, some being upwards of twelve feet in breadth and six to eight feet in height. On these banks beech trees usually grow, and in some instances form a continuous avenue. Between the roads and the banks are shallow ditches, and in the late spring the bottoms of these ditches are completely green with the first true leaves of seedling beech. None of these come to maturity, as they are browsed off by rabbits. Even in the enclosed 'rough lands' beech seedlings exist in abundance, but only where some protective environment occurs does the seedling achieve maturity. The mortality must be enormous.

The seedlings of *Pinus sylvestris* offer a complete contrast. Extensive plantations of this tree exist all over the upland plateau, the woods frequently surrounding waste common land. The seeds find their way to the open commons and the seedling plants practically all reach maturity, so that in a very short space of time a piece of open common land becomes a Scots pine wood. It is obvious that in this case the resinous excretion of the plant preserves it from the attacks of the hordes of rabbits inhabiting the district.

Seedling oaks are rarely seen in any quantity, however prolific the autumn crop of acorns may have been. The oak in this district is principally a tree of the lowland, and in the autumn the droves of pigs from the numerous farmsteads effectually clean up the supply of dropped acorns around the enclosures, and very often in the country lanes also.

G. T. HARRIS.

Buckerell, E. Devon.

Noise Associated with Lightning.

THE thunderstorm which burst upon Petersfield on the night of Aug. 29-30 was accompanied by an unusual effect on the electric lighting system in a house on Bell Hill, distant $1\frac{1}{4}$ miles from Stoner Hill, where the same storm was observed by Capt. C. J. P. Cave (NATURE, Sept. 13).

The lightning was first noticed shortly after 9 P.M., and flashed incessantly every ten to thirty seconds, but was not at its nearest to Bell Hill until 1 A.M. to 2 A.M., when, to judge from the interval of $\frac{1}{3}$-$\frac{1}{2}$ second between the flash and the thunder, a storm centre was within 500 feet.

At the time of observation there were no lights burning in the house. Simultaneously with the nearest lightning flashes, an electric light bulb, hanging from the ceiling, emitted a bluish green light, which flickered and quivered in correspondence with the lightning. This was accompanied by a click in a small pear switch of the lamp in question. Thunder followed the click, after an interval. Other bulbs in the same circuit appear to have been unaffected, which may perhaps be due to the better insulation of their switches. It was next found that the current had failed, and we afterwards learnt that the supply throughout the whole of Petersfield was interrupted at approximately 12.50 A.M. owing to a surge on the high tension line.

It is suggested that a current of electricity, induced in the mains, jumped the switch and illuminated the lamp.

M. H. D. GUNTHER.
E. R. GUNTHER.

White House,
Bell Hill, Petersfield.

A Cypriote Threshing Sledge.

IN your notice of Mr. Hornell's description of the Cypriote 'dukani' or 'tribulum' in the Research Items in NATURE of Aug. 23, it is stated that "In some parts of Spain and the Canary Islands it is in use without the flints as the straw is required whole". A specimen that I saw at work near Burgos was well provided with flints, which like those in Cyprus are of Miocene age. It is known as a 'trillo'.

JOHN W. EVANS.

62 London Wall,
London, E.C.2,
Sept. 15.

Recent Hydro-Electric Developments in Northern Italy.

By Dr. BRYSSON CUNNINGHAM.

IN a preceding article (Sept. 6, p. 371), attention was directed to an essential difference in principle governing systems of hydro-electric development in the Alps and in the Apennines, distinguished in general terms as stations of high and of low altitude. Although my tour in Italy was confined to the northern provinces, and an opportunity was not forthcoming for inspecting developments actually among the Apennines, yet the installations visited within the Alpine region did, as a matter of fact, present certain characteristics of low altitude stations; that is to say, they were in some cases more dependent for supplies of water on rainfall and river flow than on the melting of ice and snow in glaciers.

The first installation inspected was that which constitutes the main source of energy of the Società per l'Utilizzazione delle Forze Idrauliche del Veneto, itself a branch of the great Società Adriatica di Elettricità, which is one of the largest in Italy and among the most important in Europe. It supplies current to a region of considerable extent, covering the whole of north-eastern Italy comprised in the provinces of the three Venetias and Emilia, and stretching from the shores of Lake Garda to the confines of Yugoslavia. The undertaking derives its principal water supplies jointly from the River Piave and Lake Santa Croce, and develops power in a series of five stages from summit level at Lake Santa Croce to the outfalls at Castelletto and Caneva, where the discharge from these stations finally passes into the River Meschio, which conveys it to the sea. The power generated is transmitted at tensions of 70 to 120 kilovolts to the towns and cities of the districts served.

Lake Santa Croce, with its surface area of 8 square kilometres and its content of 120 million cubic metres of water, is one of the most capacious natural storage reservoirs in Italy. Together with one or two smaller sheets of water among the lower slopes of the Venetian Alps some 40 miles or so to the north of Venice, it lies adjacent to the upper basin of the River Piave, and there are indications that at some remote epoch it constituted part of the course of the river in its passage from the Carnic Alps to the Adriatic. The formation of a moraine across the head of the lake has apparently resulted in blocking the passage, and the waters of the Piave are now diverted in a south-westerly direction from a point in the river some five miles above the town of Belluno. Since this diversion took place, instead of feeding the lake as in times past, the Piave has been receiving the overflow from the latter in periods of flood.

Advantage has been taken of these circumstances to effect a joint service. At or about the point of diversion above alluded to, the level of which is some 1280 feet above sea-level, the bed of the Piave has been intersected by an earthwork embankment and masonry dam, to be seen in Fig. 1, with a combined length of rather more than half a mile. The dam provides an overflow crest for a length of about 300 yards, with a set of automatic adjustable weirs for relief in times of heavy flood. The water intercepted by the dam and weir is diverted into a canal on the eastern side of the river, which, partly in tunnel and partly in the open, conveys it a distance of six miles to the northern extremity of Lake Santa Croce, there to augment the natural drainage into the lake and to raise the surface to a level which, when the works in hand are completed, will be 1266 feet above sea-level and will permit, by a lowering of the level to 1180 feet, of the utilisation of a supply of 120 million cubic metres of water for power purposes. To this end, a long earthen embankment with clay hearting is in process of formation at the northern end of the lake.

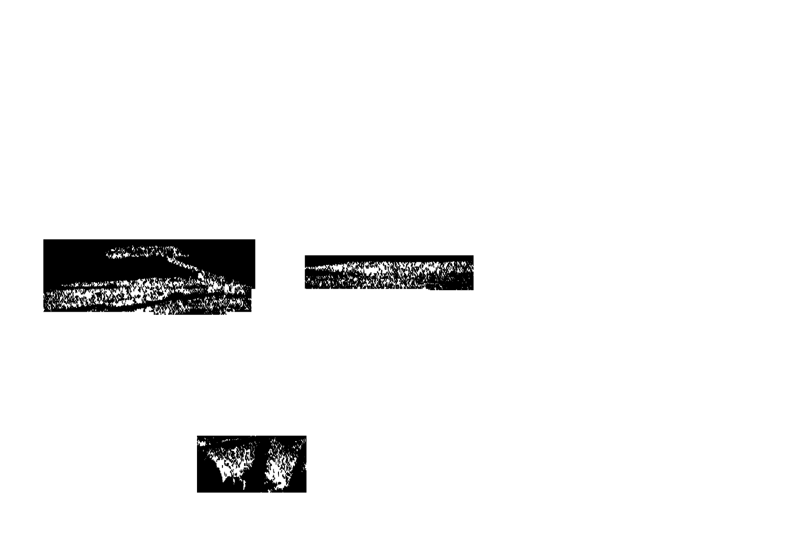


FIG. 1.—Piave and Santa Croce hydro-electric installation; dam and intake at the Piave. By courtesy of the Società per l'Utilizzazione delle Forze Idrauliche del Veneto.

At the south end of the lake, the water passes into a tunnel which has a connexion with the lake at the level of 1059 feet above sea-level. The tunnel is nearly 1¾ miles in length and it transmits the supply to the five pressure tubes, 8 ft. 6 in. in diameter, which enter the power house at Fadalto, where five groups of turbo-alternators, each with a capacity of 24,500 horse power, are installed. There are also two other pressure tubes belonging to an earlier installation, serving two groups of generators of 4000 horse power each. A view of

the power houses and pressure tubes is given in Fig. 2. In its complete development the new power station at Fadalto will possess a sixth unit of 24,500 horse power, making a total of 155,000 horse power generation under a maximum head of 348 feet.

The water discharged from the tail race at Fadalto passes into another natural lake of much smaller size—Lago Morto, or Dead Lake—which is utilised as a storage reservoir for the next stage of descent. The Dead Lake can provide 3 million cubic metres of water in the course of lowering its surface by 13 feet from 905 feet to 892 feet above sea-level. Leaving Lago Morto by a tunnel which is 2 miles in length, the water passes onwards to the power station at Nove, where there are four pressure tubes, 8 ft. 6 in. in diameter, connected up with three groups of generators of 22,000 horse power each and two groups of 8000 horse power each, making a total capacity of 82,000 horse power for the station under a working head of 321 feet.

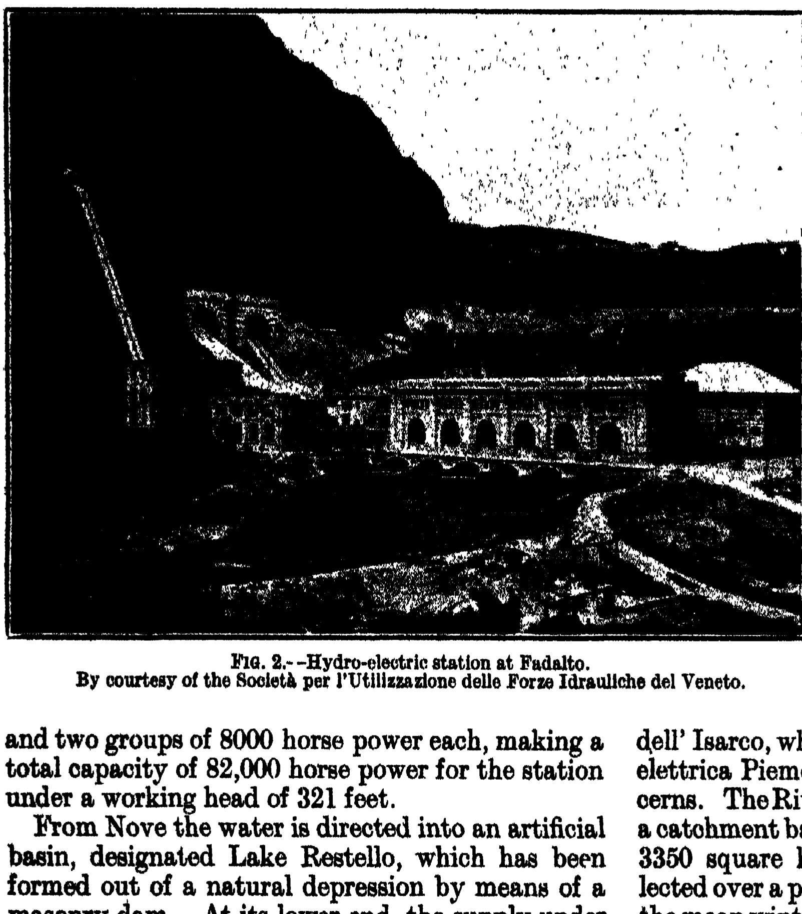


FIG. 2.—Hydro-electric station at Fadalto.
By courtesy of the Società per l'Utilizzazione delle Forze Idrauliche del Veneto.

From Nove the water is directed into an artificial basin, designated Lake Restello, which has been formed out of a natural depression by means of a masonry dam. At its lower end, the supply under a head of 46 ft. reaches the station of San Floriano, where there is a small installation generating some 5000 horse power.

Leaving San Floriano, the water, after passing through the little lake of Negrisiola, enters a long canal which, partly in the open and partly in tunnel, conveys it a distance of 5 miles to Castelletto and 9 miles to Caneva, the two terminal stations of the development, from each of which the discharge passes into the River Meschio, where, as a final duty, it serves to irrigate a district containing 36 million hectares. The stations at Castelletto and Caneva develop 5000 and 60,000 horse power respectively. Thus it will be seen that the series of stations from Fadalto to Caneva serve at the present time to produce no less than 280,000 horse power, and with the extensions in view the total will shortly exceed 300,000 horse power.

The whole undertaking, comprising some 25 miles of waterway in canal, tunnel, river, and lake, with dams, shafts, buildings, and machinery, is a remarkable example of resourcefulness and technical skill in overcoming natural obstacles and constructional difficulties, such as beset in a rugged country the realisation of schemes for turning the forces of Nature to useful ends. The benefit to Italy of such undertakings is of the highest importance: every water horse power realised is the equivalent of about 6 tons of coal per annum, and the Piave-Santa Croce installation alone is capable of rendering unnecessary the annual importation of more than a million and a half tons of coal.

The supply of water being to a certain extent seasonal, there is inevitably a falling-off in production during certain winter months, and, accordingly, the Società Adriatica di Elettricità has to fall back on a thermic generating station as an auxiliary for such periods as the hydraulic supply is insufficient. This station is installed at the new industrial port of Marghera, Venice, and in its present form is capable of producing 86,000 horse power, with provision for future expansion as the need for additional current production manifests itself.

The second station visited was even more northerly than Santa Croce; it is right in the heart of the Dolomites, but here again the local conditions have conduced to the utilisation of a water supply derived from reasonably continuous river flow. The station belongs to the Società Idroelettrica dell' Isarco, which is linked up with the Società Idroelettrica Piemonte, one of the leading Italian concerns. The River Isarco, a tributary of the Adige, has a catchment basin above the town of Bolzano of some 3350 square kilometres. Hydrographic data collected over a period of about twenty years show that the mean winter flow (Nov. 1 to Mar. 31) ranges from 30 to 60 cubic metres per second; that the mean summer flow (April to November) ranges from 72 to 90 cubic metres per second, and that the average for the year lies between 56·8 cubic metres and 72·6 cubic metres. As the mean annual flow only occasionally (3 years in 19) falls below 60 cubic metres, it has been considered permissible to estimate that in conjunction with a working head of 163·50 metres at Cardano, where the generating station is located, a volume of electric energy amounting to 586 million kwh. is capable of realisation, and this over a period of 7400 hours per annum reduces in round figures to 500 million kwh., of which 210 million kwh. are continuous.

The river is bridled by means of a massive dam or embankment, ten miles north-east of Cardano and a little more from Bolzano, containing a set of three large sluices and a smaller sluice. The main sluices have openings 15 metres wide, the small sluice an opening 4 metres wide. Through the intake at the embankment, the water of the Isarco enters an accumulation and sedimentation basin with a serviceable capacity of 290,000 cubic metres, excavated in fairly level ground on the right bank of the river and provided with discharge outlets into the river capable of emptying it completely.

In the station itself are installed five generating groups of 45,000 horse power each and three groups of 14,700 horse power each, making an aggregate of about 270,000 horse power. The maximum demand, or peak load, will absorb the full capacity of four principal groups, leaving the fifth in reserve for the present. The whole of the energy, except the 25 million kwh. generated by the smaller units, which will be supplied to the State railway for the electrified line from Bolzano to Brennero, will be transmitted at a tension of 240,000 volts to the transformer station of Cislago, near Milan, and thence distributed throughout the provinces of Lombardy and Piedmont.

The exceptionally great power of the installation and the unusually high tension of the transmission lines make the Cardano station of the Società Idroelettrica dell' Isarco one of the most notable stations in Europe. It is also remarkable as being the first plant in Europe working at so high a tension. This outstanding enterprise was brought into commission during 1929, but at the time of my visit to the station, at the end of May last, there was still enough finishing work to be done to occupy several months.

The last station in my itinerary in Italy was the new Ponale installation in connexion with the utilisation of the waters of Lake Ledro, which lies rather less than 4 miles north-west of the head of Lake Garda, near Riva. The Ponale is the natural discharge of the overflow from the first lake into the second and there is a fall of 1800 feet between the two. Advantage had been taken of this fact by the municipality of Riva to construct a plant adjacent to the outfall at Ponale so early as 1894. The plant was of small calibre and with gradual accretions only reached 2000 horse power in 1915. The capabilities of the location were obviously very much greater and after the War considerable attention was given to the matter, the problem being whether to enlarge the existing station or to design an entirely new installation on lines of greater convenience and service.

Lake Ledro has an area of 2·1 square kilometres, with a catchment basin of 105 square kilometres. Its surface level is 654 metres above sea level, and it is fed by two subaqueous influents and two torrential streams. Its greatest depth is 48 metres and it has a content of 75 millions of cubic metres of water. It is obviously of glacial origin, and is blocked at the eastern end by a frontal moraine. It acts, therefore, as a suitable seasonal reservoir.

The matter was settled by the action of the combined municipality of Rovereto and Riva, which with expert advice decided upon an installation with a power station at Riva, and the works were commenced in November 1924. Discarding the old power station, a new conduit for the water has been formed by means of a tunnel 6 kilometres in length and 2·9 metres in diameter, running from a point near Mezzolago to an outlet near Riva, where the water enters two pressure tubes of 1·15 metres diameter for transmission to the power house at the edge of Lake Garda below. A view of the power house and pressure tubes is given in Fig. 3.

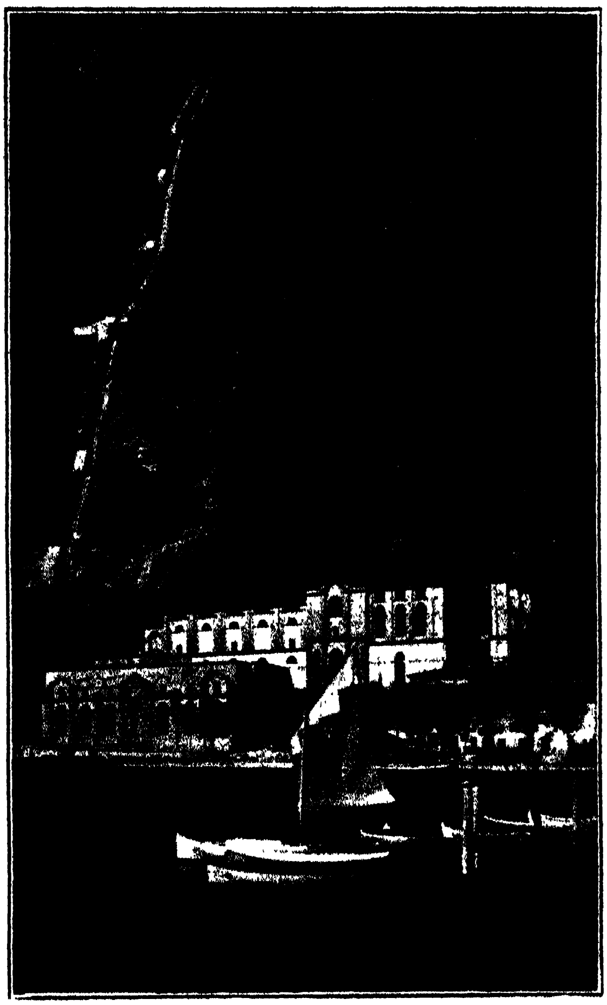


Fig. 3.—Hydro-electric station of the Ponale Installation at Riva, Lake Garda. By courtesy of the Consorzio Industriale delle Città di Rovereto e Riva.

The power generating plant consists at present of two sets of Pelton water wheels, each with an output of 30,000 horse power, coupled to alternators of 21,000 kva. capacity. A third wheel of 45,000 horse power coupled with an alternator of 35,700 kva. is in course of installation and nearing completion. There is provision for a fourth unit.

The foregoing descriptions of plant and installations, which, despite their individual importance, form but a small portion of the activities of the Italian nation in regard to hydro-electric generation, will enable some idea to be formed of the projects which are now in hand and are playing so important a part in the industrial and commercial development of the country.

Present-Day Problems in Taxonomic and Economic Botany.*

By Dr. A. W. Hill, C.M.G., F.R.S.

Taxonomic workers have tended to fall into one of two categories, for to some a 'species' has covered a wide range of forms grouped around a mean type, while others have taken a more restricted view and their species have represented far smaller and more sharply defined classificatory units. Both methods have been of value; the broader view has had its advantage very often in relation to questions of geographical distribution, while the narrower one has caused us to inquire into questions relating to the origin of species themselves and the significance of so-called 'varieties'. They have also had their drawbacks, since in one case many matters relating to the influence of habitat, general conditions, etc., have not been fully appreciated, while in the other the possibilities of hybridisation, segregation, and adaptation have usually received little or no recognition.

The intensive study of the flora of a region, or of particular genera, such, for example, as *Rubus*, *Taraxacum*, or *Hieracium*, has led in some cases, I feel, to the adoption of a very narrow outlook, which has tended to detract from the importance of taxonomic work in the eyes of the younger botanists. In the past, no attempt was made to study effects of light and shade or other environmental conditions, or to make cultural experiments to test the validity or otherwise of the find. Such experiments may involve controlled cultivation, genetical research, and very careful tabulation of statistics before full light can be shed on the true nature of what may have been regarded as a large 'compound-species' or a host of small, closely allied 'micro-species'.

Until I had the opportunity of visiting New Zealand I was not very greatly exercised about the problems underlying the species question, and was content, like others, to describe a new species from a single specimen. The extraordinary prevalence of hybridisation, however, in the New Zealand flora, seen under the able guidance of Dr. Leonard Cockayne, quickly made me realise how rash it would be to think of describing any New Zealand plant as belonging to a new species with only a single specimen before one. Here, then, is a large and vital problem which, to my mind, very greatly widens the interest and importance of our herbarium studies, since problems relating to the possible hybrid origin of the plants we are dealing with demand careful study in the field, with visits to the countries where the plants are native.

A somewhat parallel case, though of a different order, is afforded by the common mistletoe, *Viscum album*. Tubeuf gives an account of the races of *Viscum album* which are definitely associated with particular host plants. Three definite physiological races, however, are clearly marked: (1) the form which is found on deciduous trees, (2) that associated with the silver fir, *Abies pectinata* and other species of *Abies*, and (3) the form parasitic on *Pinus sylvestris*, *P. Laricio*, and *P. montana*. The races are so far distinct that seeds of the 'pine form', for example, will not grow on the apple or fir, and vice versa. Physiologically, therefore, they are distinct, though morphologically they cannot be separated. A case like this suggests that we may be witnessing the advent of three species from one, and that eventually morphological differences may also become evident.

The vegetation of South Africa supplies some taxonomic physiological problems of a like nature, which up to the present have not been satisfactorily solved. These relate to the difficulty of differentiating between two or more forms of the same species which, though distinct physiologically, cannot be separated on any structural characters. Several such physiological strains are now known in South African species of *Pentzia* and *Salsola*. There are two strains of *Salsola glabrescens*, which grow side by side. One of these plants, with purplish-red young twigs, is closely grazed, while the other, in which the young twigs always appear to be pale-coloured, remains untouched by cattle or sheep until there is nothing else to eat. It would be of great interest, therefore, could we discover how the animals are able to distinguish the palatable from the unpalatable form, since we might then become as acute as they appear to be in appreciating the significance of fine distinctions.

Then again, there are puzzling problems connected with the character of certain species on different types of soil in South Africa: for a species may be a useful pasture plant on, say, a red loamy soil, yet when the same species, growing on tufaceous limestone, is eaten by stock, a heavy mortality may result.

It is also very remarkable that the Indian lac insect (*Coccus lacca*) has directed our attention to the existence of two physiological forms of *Schleichera trijuga* (Sapindaceæ), and to two forms of *Butea frondosa* (Leguminosæ), upon one of which it feeds while the other it does not touch; yet the botanist is unable to separate them in either case!

As it is so desirable that the importance and value of taxonomic work in its widest sense should be better appreciated in our schools and universities, I think it is worth while to say something as to what is now implied by taxonomy in the light of modern developments, in the hope that taxonomy, combined with ecology, may again occupy a prominent place in the studies of our developing botanists.

It is true, of course, that the taxonomist must know his plants and must be able, with careful training, to use to the full his powers of observation and deduction, so that he can appreciate small differences, weigh evidence, and draw up descriptions in comparison with allied species, etc.; but he will not go very far if he stops there.

* From the presidential address to Section K (Botany) of the British Association, delivered at Bristol on Sept. 4.

That we are appreciating now the problems surrounding every species which we are able to examine critically, through studying it in the field, and if need be under cultivation, is a healthy sign; for it is, I think, clear that the taxonomist, in undertaking experimental and field studies, will be able to throw much light on the 'origin of species', and on the meaning and importance of the so-called 'variations' which such experimental study reveals.

This seeking after truth by means of experiment is not exactly a new development, though it may be claimed that the conception and planning, during the past few years, of new lines of inquiry has raised the status of these experiments to the definite plane of research. Isolated experiments to test the persistence of individual forms, varieties, or species have been made since Linnæus's day, but it is only in recent years that they have been carried out under careful control.

The classical experiments of Gaston Bonnier are well known. Daniel and F. Krasan have also published papers recording the direct influence of the environment on plant characters, but it is when we come to the work of Turesson in Sweden and Clements and Hall in America that the importance of transplant work to taxonomists, geneticists, and ecologists can be fully understood. The value of Turesson's work may be said to be that he has been able to come to conclusions as to the different types of variation shown by the plant he has observed, both growing wild and under cultivation, and has been able to demonstrate that in some cases they are of a heritable nature, while in others they are merely fluctuations.

These new lines of research, which bring together ecology, genetics, and taxonomy, are now being actively pursued at Potterne. Thanks to the kindness and keen interest of Mr. E. M. Marsden-Jones, the experiments are being made by him in his garden at Potterne, near Devizes, in co-operation with Dr. W. B. Turrill. Four large raised beds have been made side by side, and each has been filled with a distinct type of soil—clay, chalky clay, calcareous sand, and non-calcareous sand. On each type of soil twenty-five individuals of each of six species are now being grown, all being of known genetic origin. Climatic conditions are being recorded, and full records of all features connected with the growth and behaviour of all the plants on the different soils are being kept. The species transplanted are *Centaurea nemoralis* Jord., *Silene vulgaris* Garcke, *S. maritima* L., *Anthyllis vulneraria* L., and *Plantago major* L., while during this year *Fragaria vesca* L. has been added. It is interesting to find that the most obvious changes are taking place in *Silene vulgaris*, *S. maritima*, and *Plantago major*.

Centaurea nemoralis does not at present appear to be plastic; *Silene vulgaris* is slowly plastic under certain edaphic conditions; *S. maritima* is decidedly more plastic than its congener; *Anthyllis vulneraria* is not plastic, and is not capable of survival under a wide range of edaphic conditions, and *Plantago major* is exceedingly plastic.

In addition to what the taxonomist is seeking to discover from this intensive study of plants by means of 'transplant experiments', he is also anxious to elucidate the problems associated with certain 'critical' British and European genera, such as *Silene*, *Centaurea*, *Rubus*, *Taraxacum*, and *Hieracium*, in which botanists have described a multiplicity of species.

In the case of *Rubus* also it seems likely that carefully controlled experiments would possibly reveal the fact that habitat or hybridisation, rather than a 'fixed' type, was the *raison d'être* of several 'species'. Whatever research may reveal in these genera, it has been shown in *Centaurea* that at least three described 'species' are of hybrid nature, for exact counterparts of *Centaurea jungens* Gugl., *C. pratensis* Thuill., and *C. Drucei* C. E. Britt. have been artificially produced at Potterne.

An important development, arising out of the more intensive study of wild species and possible hybrids and the associated genetical work and controlled cultivation which is so pregnant of far-reaching results, is the need of greatly extended herbarium records and field notes. For genetical work to be of permanent value it is essential that ample material of the parent plants and their offspring should be preserved for reference; and in the case of assumed wild hybrids, representative specimens of the parents and of all the linking forms are required. I am glad to say that at Kew we have now established special 'herbaria' for genetical specimens and for hybrids, where specimens forming as complete a set as possible are kept together, apart from the general herbarium collection. We have also formed a collection of fruits and seeds, which it is hoped in course of time will be as comprehensive and complete as is the collection of the vegetative and floral specimens in the general herbarium.

Now let me turn to some problems on the economic side. In the first place, I would direct attention to the interesting observations made by Dr. A. B. Stout and others on the flower behaviour of Avocados, *Persea gratissima* Gaert. (Lauraceæ). These afford an excellent example of the assistance that the botanist can render to the grower and of the practical application of a remarkable botanical phenomenon of great scientific interest.

The Avocado pear bears hermaphrodite flowers, but they exhibit a daily rhythmic alternation of sexes reaching maturity for the entire plant. This synchronous dichogamy apparently reaches a perfection of phsyiological regulation to ensure cross-pollination unknown in any other group of plants. All the flowers that may be open at any one time, on trees of the same clonal variety, are in either the female or the male condition. If the trees belong to one of the varieties placed in 'Class A' by Stout, of which the Taylor variety is taken as an example, the flowers when they first open in the morning are found to be functioning as females with a receptive stigma, but the anthers are not yet mature. About midday these female flowers close, for none but flowers in the female state are open on the trees, and another set of flowers then opens in the early afternoon, normally

without any overlapping, so that there are never on any tree of 'Class A' flowers in the male and flowers in the female condition open at one and the same time. These afternoon flowers are found to be in the male condition with the stigma withered; the anthers are in an upright position, with their valves open and shedding their pollen.

Careful investigation of trees of 'Class A' has shown that the flowers, when they first open, function as females for some four hours in the forenoon; they then close about midday, remain closed all night and all the following morning, and reopen on the afternoon of the second day in the male condition. Self-pollination of individual flowers is thus rendered impossible by this sex-alternation, and since there is normally a definite time interval, about midday, when no flowers on trees of the same 'Class' are open, cross-pollination on the same tree or between different trees of the same clonal variety can rarely occur.

This rhythmic phenomenon is all the more remarkable because there is an entire reversal of the process just described in other clonal varieties and individual seedlings, which Stout places in his 'Class B'. In trees belonging to 'Class B' the flowers are in the *male* condition when those of 'Class A' have their stigmas receptive, and are *female* when the pollen of 'Class A' trees is being shed. These reciprocating changes in sex thus provide the opportunity for mutual cross-pollination between the trees of 'Class A' and those of 'Class B'. The practical application of this discovery scarcely needs pointing out, but it is clear that an orchard planted with trees of only one variety is not likely to yield a rich harvest of fruit!

With regard to pistachio nuts, which are grown as a crop in California, the problem facing the plant breeder, if he is to satisfy the grower, is to produce varieties bearing nuts which crack naturally. If varieties are produced the nuts of which have to be cracked by hand, they are of no value commercially, since the labour cost involved in cracking by hand in the United States is prohibitive if the nuts are to be sold at a profit! Fortunately, scientific research has now produced the desired article, and those who delight in pistachio ices, etc., can rest assured that they are coloured and flavoured by the genuine article and not by some synthetic product.

Limes, again, the staple industry of Dominica, present a curious and difficult problem. The wither-tip disease has made it imperative to carry out experiments with the object of producing races or varieties immune to the disease.

There seems good prospect of success attending these efforts. Dominica, however, is very hilly, and the lime bushes are grown on such steep hillsides that hand-picking of the fruit would be well-nigh impossible. The lime of commerce has the useful habit of shedding its fruit when ripe, so that the Dominican peasant merely has to go and collect the fruit under the trees or bushes. The problem before the plant breeder, therefore, is to produce a lime which not only is immune to disease but will also shed its fruit when ripe. Unless this second essential can be attained, the new variety is of little or no commercial value.

Dr. Walter T. Swingle's researches on the pollination of the date palm (*Phœnix dactylifera* L.) are of great interest: "Each species of *Phœnix* seems to have determined its peculiar action in ripening the fruit of the date palm. The amazing thing is that the pollen of the huge Canary Island palm used on the date palm produces a small seed, quite different from the ordinary date seed, and small or medium-sized fruit that ripens late, whereas the tiny palm *P. Roebelinii*, which has the smallest seeds of any *Phœnix*, when used to pollinate the date palm, causes the formation of large seeds, and makes large dates which ripen extremely late." The economic importance and scientific interest of these discoveries need no comment.

Systematic botanists in the past have, I think, been rather too apt to regard the 'species' they have described as fairly definite units, recognising and recording from time to time 'varieties', but, as I have said earlier, frequently without sufficient material to enable them to say what such varieties really represent, or how constant and definite they may be. In some cases they may be the so-called 'Jordanons', while in others, no doubt, as we are beginning more fully to realise, they are the resultants of hybridisation. For the majority of plants the occurrence of such 'varietal' forms appears to be of little more than purely scientific interest, and they may be passed by with only a casual comment.

When, however, almost any plant comes into the limelight of applied botany and is found to be of some economic value, then the importance and significance of varietal differences at once become apparent. A few cases may be cited in illustration:

Para rubber (*Hevea brasiliensis*) is considered to be a good botanical species, but a careful examination of the trees now being grown in plantations in the East reveals a number of forms, very similar as regards their morphological characters, but showing marked physiological differences, especially with regard to the yield of latex.

A similar problem, where the systematic botanist requires the assistance of his economic colleague, has recently been investigated in Australia by Messrs. Penfold and Morrison. This concerns the oil yielded by *Eucalyptus dives* Schæur. *E. dives* is a species easy of botanical determination, and is of economic value for its oil, which has a piperitone content of about 45–50 per cent, which is used for the manufacture of thymol and menthol. Oil has been obtained yielding only 5–15 per cent of piperitone—morphologically, however, the trees were true *E. dives*—while others contain oil with less than 5 per cent piperitone and 45–75 per cent cineol. It might be thought that ecological conditions are concerned in these striking differences—for a typical form and three distinct physiological varieties have been recognised by their oil characters—but the type form with 40–50 per cent piperitone has been found growing alongside the variety B, containing only 10–20 per cent piperitone with 25–50 per cent cineol. Here, then, is an

interesting piece of investigation which brings the botanist into alliance with the chemist. A similar problem exists with regard to camphor, where, as is well known, two, and perhaps more, physiological varieties exist in the species *Cinnamonium Camphora*, which botanists are unable to separate.

Then again, the tung oil trees, *Aleurites Fordii* and *A. montana*, the seed of which yields a very valuable drying oil, are now being introduced through Kew and the Imperial Institute to all suitable Dominions and Colonies. In these trees the flowers are borne in clusters, and each flower-cluster usually consists of a large number of male flowers surrounding a single female flower. It was noticed that certain trees bore two or three female flowers in each inflorescence. Selected seed from this 'multiple-cluster' type appears to transmit this characteristic, and trees showing this favourable variation may thus be expected to crop more heavily and yield more oil than trees with only one female flower in the cluster.

The problem, therefore, which may arise is analogous to that which confronts us with Para rubber in the matter of latex-yield or with cacao as regards permanent poor-yielders and permanent heavy-yielders. Cases such as these, and there are many others of a like nature, afford an apt illustration that economic and systematic botany can provide romances, possibly of more scientific interest to the botanist than to the commercial planter, but of so great material importance to the latter that the botanist looks to the man of affairs for the financial assistance to help him to discover their solution.

This brief summary will suffice to show that we are living in an era of progress and development, and that we are alive to the opportunities offered of widening our outlook and our interests in the domains of taxonomic and economic botany. As I have hinted earlier, our studies in taxonomic botany, to be living and of practical value, need to be transported from time to time from the herbarium to the field. In this way only can we realise fully the extent and character of variations, the effects of soils and climates, and the prevalence and significance of physiological races.

By the widening of our horizon through travel and by means of vegetational studies in the field, I feel myself on sure ground in maintaining that we are thereby more efficient, more enlightened, and more useful taxonomists, both in the pure and applied directions, than if our studies were strictly confined to the examination of the dried and mounted specimens in a herbarium.

Vast and enthralling as is the prospect, we seem somewhat to have failed to attract a sufficiency of able recruits. If this is so, then we must needs look for the reason. We may and, in fact, I think we are apt to say, like the 'children sitting in the market-place', 'We have piped unto you and ye have not danced'; but with whom does the fault lie? May it not be, as regards taxonomic botany, that we have piped on a wrong note, that we have 'in fact 'mourned' in a minor key, and have failed to pitch our tune on the high note of enterprise and endeavour?

Need I say I refer to the millstone of nomenclature, which encumbers and weighs down the neck of the systematic botanist. The theme itself, 'taxonomic botany' in its widest sense, is full of charm and interest, but it has been so obscured that many have failed to be attracted by the grandeur and harmonies of its melody. Much of our failure to attract disciples is due, I fear, to the misplaced activities of those whom I might call our taxonomic 'Scribes and Pharisees', who have tended to substitute the shadow for the substance. It remains for us to point the way and bring the labourers into the vineyard.

We are hampered to-day in our pursuit of scientific research by the all-important and interdependent problems of recruitment and remuneration. With regard to recruitment—and naturally I am speaking only with regard to botanical science—are we fully satisfied with the efforts, laudable as they are, that are being made in our schools and universities, for training the rising generation in biological science? A good deal has been said recently about the advantages and disadvantages of early specialisation in science in the schools, at the expense of a more 'liberal' education. We realise that the last years at school are the time for laying the foundations of a sound education, and it is certainly a debatable matter whether the now prevalent severe competition (I might almost say scramble) for scholarships at the universities is not, after all, detrimental to the recruitment of those who should develop into the scientific naturalists for home and overseas appointments.

There is no question that the scientific training now given in many of the schools of Great Britain is of a very high order, and that it is given with the most splendid enthusiasm. But nevertheless may we not, owing to competition between school and school, be unduly forcing the pace and producing a superficial scientific precocity in our youth which will not stand the strain?

Science should not be looked upon as a task, but as a guiding tendency, for it is only by regarding it in this way that we can expect to produce the men with a true interest in and enthusiasm for scientific research. The flowering stage, so to speak, has been achieved before the roots and leaves have developed sufficiently to bear the fruit, and our young plants, raised from seed which may have fallen on stony places, will be found prematurely to wither away.

Then again there is a danger of the groundings of science being neglected at the universities, since there is a tendency to assume that the standard of school science teaching is that of the scholarship holder. There are, however, many who turn to science after they have had the good fortune of receiving a classical education, and I could mention botanists who only discovered their natural inclination and aptitude was towards science after they had entered the university.

There is still need to point out that the services which science can render, and for which there is so great a demand, cannot be obtained without making due provision for the cost.

News and Views.

Hearty congratulations are extended to Prof. W. Mitchinson Hicks, who celebrated his eightieth birthday on Tuesday last, Sept. 23. Born at Launceston, he was educated at a private school in Devonport, proceeding thence to St. John's College, Cambridge, being placed seventh wrangler in 1873. Prof. Hicks was principal of and professor of physics in the University of Sheffield from 1883 until 1905. At the Ipswich meeting of the British Association in 1895 he was president of Section A (Mathematics and Physics). The Royal Society awarded him a Royal medal in 1912, during the presidency of Sir Archibald Geikie, for his researches in mathematical physics, and especially for his investigations on the theory of spectroscopy. Among researches specially associated with his name may be mentioned those on hydrodynamics, and particularly on vortex motion, published in the *Philosophical Transactions*. Prof. Hicks was elected a fellow of the Royal Society in 1885, and has served on the council on several occasions.

Friday next, Oct. 3, will be the hundredth anniversary of the birth of Albert Günther, one of the most distinguished naturalists in England in the second half of last century and for twenty years keeper of the Department of Zoology in the British Museum. To mark the centenary, his son, Dr. R. T. Gunther, of Oxford, has prepared a bibliography of his father's writings, which has been published as a supplementary number of the *Annals and Magazine of Natural History* (August). A brief biographical sketch is prefixed, followed by a tabular analysis showing the wide zoological and geographical range of the subjects dealt with. Apart from the personal interest, the list of books and papers will be of great use to zoological bibliographers, since it catalogues not only the works well known to all students of the groups dealt with, but also numerous short notes in such periodicals as the *Field* which are sometimes difficult to trace. The first paper on the list is an article on animal poisons, published in 1853. The last item is the "Appendix to the History of the Collections in the Natural History Departments of the British Museum", issued in 1912, giving the general history of the Department of Zoology from 1856, the year before Günther entered the Museum, to 1895, when he retired on reaching the age limit. His death on Feb. 1, 1914, spared him the sorrow of witnessing the conflict between his native land and that of his adoption. It is to be hoped that Dr. R. T. Gunther may find occasion to expand his sketch of the life of one to whom more than to any other single individual is due the present position of the zoological departments of the British Museum.

A joint discussion on the relation between past pluvial and glacial periods was held between the Sections of Geology, Geography, and Anthropology at the recent Bristol meeting of the British Association, with Prof. H. J. Fleure in the chair. Prof. J. W. Gregory, who was probably the first observer to correlate equatorial pluvial with European glacial periods, devoted his remarks in the discussion to the emphasising of difficulties in taking correlations beyond the broadest outlines. Misses Gardner and Caton Thompson from work in the Fayum, Mr. Leakey from work in Kenya, and Mr. Armstrong from work in Rhodesia, all stated that they had been led to the conclusion that there were in the Pleistocene two pluvial maxima separated by a period of relative aridity. Dr. Sandford (from Egypt) had not been able to find evidence of a mid-Pleistocene arid period. European workers indicated that there was a tendency to look upon the Mindel ice age as a major phenomenon and upon the Riss and Würm phases as episodes of a second major glaciation. Prof. Sölch (Heidelberg) said that he thought Central European opinion was trending towards the idea of the subdivision of the Pleistocene ice age mentioned above, and urged British workers to bear in mind that orographical changes (an uplift of perhaps 500 metres) were among the phenomena of the later Pleistocene ice age. He gave as the general opinion of Central European glaciologists the view that the Hotting breccia belonged to the Mindel-Riss interglacial period. Dr. C. E. P. Brooks gave Dr. G. C. Simpson's view of the succession of conditions in the ice age, and then stated some of his reasons for not accepting the idea of a long arctic interglacial in the middle of the ice age. He showed that a weakening of the monsoon, and consequent aridity, would be the inevitable result of heavy glaciation on the Central Asiatic Highlands. Prof. Barbour showed that in China in the Pleistocene a pluvial period separated two more or less arid periods characterised by loess. Mr. L. A. Cammiade's observations in South India agreed with those of Prof. Barbour in China.

The National Radio Exhibition which was held at Olympia on Sept. 19-27 was nearly twice as large as that held last year. The radio industry is apparently one of the few industries which are practically unaffected by the world trade depression. There are no unemployed on the register of skilled workmen in the radio trades and they are steadily absorbing unskilled labour. Since Madame Melba broadcast from Chelmsford about ten years ago, the progress made in perfecting the transmitting and receiving sets has been extraordinarily rapid. This is due to the fact that from the start it was recognised that progress could only be made when based on scientific principles deduced from careful physical researches. The tendency towards a standardisation of types was very apparent in this exhibition. The prices varied from about £30 for a good 'all-electric' set down to about 30*s*. for a serviceable radio set. In the making of 'all-electric' sets the manufacturers have proceeded on very similar lines of development. Good Continental reception necessitates a four-valve set, arranged preferably with a small outdoor aerial. Ability to receive at least twenty stations can be guaranteed. The lowering of the royalty charged for valves has led to the use of a greater number of them. The European stations have wave frequencies varying between 155 and 1400 kilocycles per second, and the

'all-electric' sets as a rule can be adjusted so as to receive any within this range. But few of them can be adjusted for the short-wave emissions, varying from 3748 (Rome, Prato Smeraldo) to 18,821 (Java, Bandoeng). This is no real drawback to dwellers in Europe. The British Broadcasting Corporation has put forward a scheme for an Empire broadcasting service. This will be discussed at the forthcoming Imperial Conference. It will be of interest to learn whether any of the Dominions wishes to join in this scheme.

The summer meeting of the Newcomen Society took place at Liverpool on Sept. 15–17, thus enabling members to visit the exhibition in St. George's Hall, and the exhibition and pageant in Wavertree Playground in connexion with the centenary celebrations of the Liverpool and Manchester Railway. One day, however, was devoted to visits to certain small factories at Prescot where tools are still made by hand, and to Rainhill, the site of the famous locomotive trials of 1829. Though marine chronometers are made by various London firms, much of the mechanism is made in a small workshop in Prescot by two workmen who have inherited a business a hundred years old and possess the requisite skill and experience. In other shops were seen hand file cutting, hand broach making, and the manufacture by hand of high-class pliers and wirecutters. In file making, the steel blank in the soft state is held down on a lead block by two straps pulled down tight by the foot of the file cutter. The tools necessary are the chisel and hammer, both of special shape so as to render the action of the cutter natural. Skill is easily and quickly acquired and the teeth on a file seven or eight inches long can be cut in less than ten minutes. It is the burr raised by one cut which forms the guide to the tool for the next cut and enables the work to be done so quickly and accurately. In broach making similar dexterity was shown. The broaches being made varied in size from fine needles to lead pencils, but all were tapered and five-sided. The broach was held in a pair of pliers and laid in a groove in a bone block while being filed, and the accuracy with which the pliers were turned a fifth of a circle at each stroke of the file was not the least surprising part of the work. In the making of pliers and cutters, there were operations of an equally interesting character, and it was not a little remarkable to find these hand industries still able to hold their own in the days of mass production.

On Sunday, Sept. 21, M. Laurent-Eynac, the French Minister for Air, unveiled a statue to Clement Ader, one of the pioneers of flight, at Muret in the Haute Garonne. Ader's experiments were carried out in the nineties of last century. Through the writings of Mouillard he studied the flight of birds in Algeria, and in 1890 built an aeroplane of bat-like form and fitted with a steam engine, which on Oct. 9, 1890, is said to have flown a distance of 150 feet. He then built a larger machine on the same lines, to which he gave the name the 'Avion', which was tried in the presence of the French military authorities, but without success, in October 1897. Ader's experiments in France, it will be seen, were contemporary with those of Lilienthal in Germany, of Pilcher and Maxim in England, and of Chanute and Langley in the United States.

The relics of Andrée's expedition of 1897 which were found last August on White Island (or Giles Land) by a Norwegian expedition have arrived in Norway on their way to Sweden. The *Times* has published a preliminary report of the Swedish experts who have examined the remains and diaries. There were three men in the balloon when it left Danes Island, Spitsbergen : S. A. Andrée, N. Strindberg, and K. Frankel. The bodies and diaries of all have been found. The balloon came down on the ice on July 14, 1897, three days after leaving and the day after the last message was sent by carrier pigeon. This was in about lat. 83° N., long. 30° E. Instead of striking south for Spitsbergen, the men appear to have sledged eastward. They got into eddies in the drifting pack-ice and had great difficulty in making progress. By Aug. 10 they were in lat. 81° 55′ N., long. 29° E. At times the drift was even north-west. Eventually they were carried on the only part of White Island where a landing is possible, the greater part being ice-covered. There they landed on the south-west early in October 1897. Andrée's notes continue until the end of September, and Strindberg's until Oct. 17. A number of instruments, photographs, and scientific observations have also been found.

In the twenty-fifth report of the Committee on Photographs of Geological Interest, presented at Bristol to Section C of the British Association, 141 new photographs are recorded, bringing the total of the collection to 8287. From the well-known Reader series of negatives 39 are contributed to the present additions. The Isle of Wight landslip of 1928 is illustrated by photographs by Mr. J. F. Jackson. Prof. S. H. Reynolds contributes sets from Torquay, Snowdon, South London, and Portraine. The submerged forest of Swansea Bay and the raised beach of Hope's Nose, Torquay, are illustrated by Dr. A. E. Trueman and Mr. L. N. Wheaton. River action in South Wales is portrayed by a set from Dr. T. F. Sibly, and Mr. W. F. Chubb has presented a fine view of the Severn Bore. Lundy Island is the subject of a series by Mr. A. O. Rowden. Copies of individual photographs can generally be obtained directly from the photographer concerned, to whom application should be made for further particulars. Addresses are given in the report. The Committee has already published three sets of geological photographs, and these have been widely used in teaching throughout the world. It will therefore be of very special interest to geologists to know that two new sets of 25 photographs each are expected to be available by the end of the present year. For information concerning these new issues application should be made to the honorary secretary of the Committee, Prof. S. H. Reynolds, The University, Bristol.

Progress in the application of scientific methods in the production of raw cotton is well exemplified in the recent issue of the *Empire Cotton Growing Review*

(vol. 8, No. 3), in which questions of breeding, ginning technique and cotton quality, and blackarm disease come under discussion. The chief interest, however, is focused in a résumé of the progress of the cotton industry under successive German and British rule in Tanganyika Territory. Under German administration, experience proved the vital importance of planting on suitable soil and of growing the right kind of cotton, owing to the ravages of diseases and pests on such types as Egyptian and Ceravonica. Lighter soils give better results than the heavier ones, and production is greatly assisted by proper rotation of crops. Under British rule the output has increased rapidly. Production by plantation labour is uneconomic under ordinary conditions, and the policy now is that of definitely encouraging the native smallholder. Under this régime, native production has risen from forty-three per cent in 1922 to from sixty-three to seventy-four per cent of the whole in the succeeding years. It is estimated that during the last nine years more than one million sterling has passed into the hands of the cotton-growing native of the country. Cotton production is much influenced adversely by various factors, of which several may operate at once. Local demand for food crops or other agricultural products, inadequate transport, and unfavourable climatic conditions are but a few of the problems which demand attention, and the solution of which means so much to the economic well-being of the mandated territory.

As a converter of electric energy into heat the electric fire has an efficiency of one hundred per cent. It is desirable to know how much of the energy is converted into radiant heat and how this heat is distributed. In the *Journal of the Institution of Electrical Engineers* for September, Prof. Parker Smith gives the results of experiments on ordinary electric fires which were made to determine their radiant efficiency. This nearly always lies between 55 and 70 per cent, the rest of the heat being carried away by convection. He made tests on five modern types of gas fire and found that the radiant efficiency was from 40 to 50 per cent, the bulk of the remaining heat escaping as flue heat and the rest being carried away by convection air currents. In a room heated by an electric fire, the temperature for comfort of the air should not be less than about 55° F., hence the fire itself needs to produce air convection currents in addition to those produced by objects in the room receiving direct radiant heat. The principal difficulty in connexion with electric heating is the question of ventilation. Means must be provided for admitting fresh air, while the warmed air should escape near the ceiling. Ceiling-panel heating is sometimes employed, but in this case the convection heating is less than with floor and wall panels. If the temperature of the heating elements is raised by over-running, the heat carried away by the convection currents increases more rapidly than the radiation heating. It would seem that ordinary electric fires run at approximately the right temperature, but more attention should be paid to designing proper ventilation for the rooms in which they are placed.

FOR some years the advisability of having an extended high tension system of electric supply has been considered in Northern Ireland and Mr. J. M. Kennedy has been asked to report on the scheme. In the *Electrician* for Sept. 5 a résumé is given of his report and of a supplementary one issued on Aug. 29. The scheme links up the principal centres of population in Londonderry, Tyrone, and Fermanagh with the generating station of the Londonderry corporation. It would also link up with networks projected at Dungannon and in Antrim. The western area has been divided into eight districts and it is proposed to connect them by 33,000-volt lines. The report shows that considerable economies can be effected in this way. The capital cost would be about a million pounds, which is about one-fifth that of the Shannon scheme. Several Irish engineers are agitating that before the final decision of the Northern Government be taken, the possibility of effecting still greater economies by having an all-Ireland electricity programme be considered. We think that it would be for the mutual benefit of the north and the south to have an all-Irish grid. As the power available at the Shannon power station is limited and nothing has yet been done in constructing the northern grid, the time seems opportune for discussing the larger scheme. In a few years' time the water power of the Liffey will probably be harnessed and the falls on the Erne in the north-west of Ireland could be utilised. The water power from the Erne would be particularly helpful to both governments. Mr. Kennedy mentions in his report that it would be a comparatively simple matter to connect the northern system with the Free State grid at Newry. The *Irish Electrician* points out that it would be to the mutual advantage of Dublin and Belfast. An agreement between the two governments would be necessary.

So far back as 1880 Sir William Siemens made experiments on the effect of illuminating plants by electric light. He found that with a few hours' illumination he could make tulip buds blossom, and he suggested that in the future gardeners might become independent of sunlight and regulate the growth of the plants entirely as they wished. In 1920 Jacobsen, a Norwegian engineer, observed that the position of the electric power cables underground could be told at once by the strips of green grass above them. These two fundamental observations form the basis of the procedure in electro-horticulture, which is being carried out in the Experimentalfaltet—a little 'science town' near Stockholm. In the *Electrical Times* for Sept. 4, Charlotte Gast gives an account of the satisfactory results already obtained by Sven Oden and Gustaf Lind. The work is mainly to expose different kinds of plants to light coming from incandescent lamps. As in November 1929 Stockholm had only 23 hours of sunshine, the results were sharply defined. The plants subjected to the electric light were much the more flourishing. Conclusions have not yet been obtained as to the best length of time for the exposure. Cucumbers, which ordinarily require five weeks to produce marketable fruit, can be ripened in three weeks with the use for a few hours

daily of artificial light. The experiments made on the heating of the soil by electric cables have given promising results. It has been proved definitely that it does pay to heat the soil in greenhouses for the cultivation of melons and cucumbers. Nine hundred Swedish gardeners and florists are using soil-heating equipment. A usual price in Sweden for a night electric load for gardening is a farthing a unit. If this could be supplied at a cheaper rate, as in Norway, where there is a special commercial night-rate of a tenth of a penny per unit, Swedish growers could force early spring vegetables and compete successfully with market gardeners situated much farther south.

THE partial absorption of X-ray quanta observed photographically by Dr. B. B. Ray, which was the subject of two letters in NATURE of Sept. 13, p. 398, is one of the large group of atomic phenomena which involve quantised transfers of energy. All have three partially distinct aspects--the magnitude of the energy interchange, the probability that it shall occur, and the relation between the initial and final directions of motion of the reacting particles. There is good evidence from Dr. Ray's measurements, as well as from others made with an ionisation chamber by Prof. Bergen Davis and his collaborators, that the energy change in this case is a decrease, or, more rarely, an increase, in the energy of the X-ray quantum, by an amount determined by the X-ray spectra of the atom traversed. In a further letter which we have received from Dr. Ray, which we are unable to find space to print in full, he has pointed out that certain experiments which might be held to disprove the existence of this effect have been performed under conditions which he would expect to yield only a feeble modified radiation. The chief ground for this statement is the important one that the modified quantum is believed by him to proceed almost, if not exactly, in the original direction of the unmodified quantum, a hypothesis which, he shows, fits in very reasonably with the observations. No estimate appears to have been made as yet of the probability of transfer of energy in this way, but it is evidently not unduly small, and sufficient data probably exist to permit of a rough calculation. Should the reality of this effect continue to be admitted, as seems likely, it will undoubtedly open up a convenient method for investigating certain types of soft X-rays indirectly, much as the Raman effect is now applied to the study of the infra-red spectrum.

ALTHOUGH it has been said that there are already too many scientific periodicals in existence, we have no hesitation in offering a cordial welcome to *Oceania*, a new publication which is devoted to the study of the native peoples of Australia, New Guinea, and the islands of the Pacific. It is issued on behalf of the Australian National Research Council under the editorship of Prof. A. Radcliffe-Brown as the organ of the Anthropological Research Fund, which was established three years ago by a grant from the Rockefeller Foundation and an amount equal to the grant contributed by Australia. It is not intended that *Oceania* should be a mere record of observation. Its policy will be based on the view that the study of the culture of a people can be carried out only by specially trained scientific workers in the field, whose object is not only to record facts, but also to discover their interpretation, that is, their meaning and function. Thus, in the first issue, Miss Camilla H. Wedgwood on war in Melanesia, Prof. A. Radcliffe-Brown on social organisation in Australian tribes, Dr. Raymond Firth on a dart contest in Tikopia, and Miss Ursula McConnel on the Wik-Munkan tribe of Cape York Peninsula, each dwells on the functional aspect, in the respective societies, of the facts which they record and analyse. Beside the four papers mentioned, *Oceania* includes in its contents reports of the proceedings of societies, notes and news, and reviews of books dealing with the area covered by the Anthropological Research Fund. As a record of the researches now being undertaken by Australia, largely owing to the initiative and organising ability of Prof. Radcliffe-Brown, *Oceania* will be of enduring value to students of social anthropology.

IN the recently issued year-book for 1929 of the Carnegie Institution of Washington, Dr. Sylvanus G. Morley publishes his usual annual review of the activities of the Institution in excavation among the Maya ruins of Central America. The excavations at Chichen Itzá and Uaxactun continue to constitute the major operations, but this year a medical survey of the modern Maya living in the neighbourhood of these ancient cities was instituted. This survey already shows promise of producing much information of value to the anthropologist. The chief interest of Dr. Morley's report this year, however, does not lie in the account of the excavations and their result. At the close of the report he makes the pregnant suggestion that the time has now come for excavation in Central America to be more highly organised. He points out that there are now four major expeditions regularly in the field: those of the Carnegie Institution, the British Museum, the Field Museum, and that of the Government of Mexico, which is carrying out investigations in the northern Maya area and the southern part of the republic. In addition, universities, museums, and individuals are engaged on the work of excavation and exploration from time to time. He therefore suggests that a committee should be formed composed of representatives of the bodies interested and engaging in this work. The duties of the committee would be to survey the present state of knowledge, to formulate the problems suggested as the result of this survey, and then, in order to avoid overlapping and waste of effort, to allocate the investigation of these problems to the institutions willing and best fitted to take up the work.

A RÉSUMÉ is given in the *Bell Laboratories Record* for August of the scientific experiments which were carried out by that corporation's acoustical research department for the Noise Abatement Commission of New York City. Complaints had been made that the average city-dweller is continually submerged in an ocean of sound made up by the horns of motor cars, squeaking brakes, rumbling trucks, roaring subway

trains, the rapid fire of riveting machines, and the noise of radio loud-speakers. To find out which were the worst offenders, about ten thousand outdoor observations were made from a truck of the Health Department by the Bell engineers. It was found that trucks, motor cars, elevated trains, tramways, and other agencies of transportation were the principal offenders. Next came the noises made during building operations, often of greater intensity but much less widespread in their effects. It is hoped that the measurements made will enable the special committees which have been appointed to reduce the noise evil. It is stated that this appreciably decreases the vitality and efficiency of the citizens of New York. The figures obtained during the survey are of interest. The most intense noises were furnished by building operations. In one case a riveter produced a noise level of 99 above audibility, the arbitrary unit chosen being in decibels. The use of explosives in the subway excavations of the Bronx produced a noise of 98 decibels. The ever-present roar of street traffic, however, was found to vary between 50 and 80 decibels. A subway express passing a local station produces a level of 96 decibels, a steamship whistle slightly less, and elevated trains a level of 90 decibels.

THE Annual Report for 1929–30 of the executive committee of the Central Library for Students marks the close of the Library under the management which has controlled it since its foundation fourteen years ago. A new constitution has been adopted, the Library has become the National Central Library, and future reports will be issued by the new committee. The purpose of the Library is generally to supply, to serious readers, books which they are unable to obtain for themselves or at their local libraries, and that means as a rule the more expensive books, or books dealing with highly specialised subjects, for which there could be no local demand. Unfortunately, the committee points out, lack of funds prevents the purchase of those very books, and borrowing libraries have been protesting that they cannot obtain the books specially wanted. Unfortunately also the unrestricted grant of £5000 a year recommended by the Public Libraries Committee has been reduced by His Majesty's Treasury to a grant of £3000 allocated for three specific purposes, which do not include the purchase of books. During the year the volumes in the Library have increased from 45,177 to 59,606, of which 3506 have been purchased and 10,923 have been presented. Of the utility of the Library there can be no doubt, but the committee is far from satisfied with the service it has been able to give to meet the most pressing needs of readers.

WE have received vol. 2 of the Collected Papers of the Rowett Research Institute, edited by the director, Dr. J. B. Orr. The first volume was published in 1925; the present covers the ensuing five years and includes the majority of the papers published during this period by the workers at the Institute, but excluding those published by members of the staff working in other parts of the Empire. The volume contains seventy-one papers and runs to 588 pages. Broadly speaking, all deal with the subject of animal nutrition, including the food supply and also certain diseases; a few are concerned with the subject of human nutrition. In a prefatory note Dr. Orr mentions that the Duthie Experimental Stock Farm should be completely established during the present year; that the Imperial Bureau of Animal Nutrition has been established in connexion with the Reid Library to serve as a clearing-house for information on nutrition; and that a residence for temporary workers and visitors is to be built in the vicinity of the Institute. The co-operation of the Institute in work in different parts of the Empire is in increasing demand, and is an indication of the growing value of the research work carried out by the members of the staff and their collaborators.

UNDER arrangements made at the beginning of this year, the Sociological Society was united with the newer organisation of Le Play House, to form an Institute of Sociology, pure and applied. The Institute will continue and extend the work for which both the Society and the House have become well known, namely, study and research in sociology and the development of civic and regional surveys. During the present year a number of preliminary and experimental surveys have been conducted at home (for example, Chichester) and abroad, and detailed civic surveys at Chester and Brynmawr have been directed or assisted. Le Play House was founded by Mr. and Mrs. Victor Branford. Both the founders have since died, and their property has been left in trust to further the objects of the Institute and forms the nucleus of an endowment which, it is hoped, will be added to from other sources. The annual conference will be held in the Duveen Gallery at the Imperial Institute on Saturday and Sunday, Nov. 1 and 2. The sessions will take the form of lectures and discussions on sociological and survey topics. The annual exhibition will be open, in the same gallery, on Oct. 20–Nov. 3 inclusive, and will include representative examples of survey materials from various parts of Great Britain.

WE much regret to announce the death, which occurred on Sept. 18, at the age of seventy-eight years, of Prof. H. B. Dixon, C.B.E., F.R.S., honorary professor of chemistry in the University of Manchester.

THE inaugural sessional address of the School of Pharmacy of the Pharmaceutical Society of Great Britain will be delivered this year on Oct. 1, by Dr. Arthur W. Hill, Director of the Royal Botanic Gardens, Kew. The Pereira Medal of the Society will be presented also on this occasion.

A SMALL brochure has been issued by The British Drug Houses, Ltd., London, N.1, describing in handy form the medical products issued by this firm. A brief description of each substance is followed by notes of the indications for its use, of its methods of administration and modes of issue. Among the newer products mentioned, we noted carotene, which has been shown to act as a potent source of vitamin A in animal experiments; digitalis leaf tablets, physiologically standardised to contain a definite fraction of an inter-

national unit; and sodium morrhuate, which is now being used for the injection treatment of varicose veins. A therapeutic index of diseases is also included. We have also received from the same firm a leaflet describing the applications and uses of the acriflavine group of antiseptics; illustrative cases are quoted and a selected bibliography is appended. These antiseptics have a wide use in the treatment of wounds and a great variety of septic conditions.

"METHODS and Problems of Medical Education", 17th Series, has been issued by the Rockefeller Foundation, N.Y. This volume deals with departments and institutes of anatomy, histology, and embryology in all parts of the world, including Lima, Batavia, and Manila. It is profusely illustrated with plans and views, and gives details of the accommodation, staffing, courses of instruction and research work, and budgets of a number of the leading schools of the world.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An organising secretary of the Land Utilisation Survey of Britain —Dr. L. Dudley Stamp, c/o The London School of Economics, Houghton Street, W.C.2 (Sept. 29). An engineer in the Offices of the Divisional Road Engineers —Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Oct. 1). A graduate assistant in electrical engineering at the Wolverhampton and Staffordshire Technical College — Clerk to the Governors, Education Office, North St., Wolverhampton (Oct. 4). A lecturer in experimental psychology at the Otago University, Dunedin—High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 10). Assistant executive engineers for the Indian Service of Engineers, and assistant executive engineers for the Indian Railway Service of Engineers —The Secretary, Services and General Department, India Office, Whitehall, S.W.1 (Oct. 31). A teacher in mechanical power plants equipment for evening classes at the Central Polytechnic, Croydon—Education Officer, Education Office, Katharine St., Croydon. A temporary full-time lecturer in mechanical engineering at the Municipal Technical School (The Gamble Institute), St. Helens — Secretary for Education, Education Office, St. Helens. An evening lecturer in geography at the West Ham Municipal College—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15. Assistant engineers for the Public Works Department of the Federated Malay States—The Crown Agents for the Colonies (quoting M/1990), 4 Millbank, S.W.1.

Our Astronomical Column.

Pluto.—The first observation of Pluto after its conjunction with the sun was obtained by Prof. M. Wolf at Konigstuhl on Aug. 29 (on two plates taken with the reflector); the approximate position is R A. 7^h $27{\cdot}9^m$, N. Decl. 21° 54′, which is in accord with the ephemeris in *Lick Bulletin*, No. 427. The period adopted in that *Bulletin* is 249·1661 years. Many other computers have found similar periods, so that the orbit is now known within narrow limits. The *Bulletin* gives approximate ephemerides for every year back to 1890, in the hope that further images may be found. Prof. Wolf has found an image that may be Pluto on a plate exposed on 1914 Jan. 23^d 7^h 33 0^m Konigstuhl M.T.; R.A. (1914·0) 5^h 57^m $54{\cdot}93^s$, N. Decl. (1914·0) 17° 37′ 23·0″; the Lick ephemeris, reduced to the same equinox, gives 5^h 58^m 1^s, 17° 38′. As some approximations were used in preparing the ephemeris for past years, the discordance is not excessive.

Prof. T. Banachiewicz gives a full description in *Cracow Circ.* No. 26 (see also *U.A.I. Circ.* No. 296) of the work carried out at Cracow on the orbit of Pluto. It will be remembered that the ephemerides calculated there led to the detection of an image of Pluto on an Uccle plate of Jan. 27, 1927; that in turn led to the detection of the images of 1919 (Mt. Wilson) and 1921 and 1927 (Yerkes). Individual observations of Pluto in 1930 give residuals that occasionally attain 3″. These residuals explain the very erroneous orbits that were first published. Prof. Banachiewicz shows that by using a large number of observations made in 1930 an orbit can be deduced that is similar to those that were obtained with the aid of the observations made in 1919, etc.

The following additional observations have been received from Prof. Wolf: they are for 1930·0.

1930 Aug. 30^d	2^h	$36{\cdot}5^m$ U.T.	R.A.	7^h	27^m	$57{\cdot}97^s$	N. Decl.	21°	53′	55·9″
Sept. 5	2	35·0		7	28	26·88		21	53	16 7

The star places are from the Abbadia Catalogue.

Orbits of Binary Stars.—*Bull.* No. 195 of the Astronomical Institute of the Netherlands contains several determinations of orbits by G. P. Kuiper. The orbit of the close pair β232 is now determined for the first time. Since its discovery in 1876, 240° of the orbit has been described. The period found is 91·2 years, periastron 1914·9, *a* 0·368″, *e* 0·326. Using Eddington's mass-luminosity curve, the masses are 0·95 and 0·91 of the sun, the absolute magnitudes 4·5 and 4·7, parallax 0·0148″.

OΣ77 is a pair with equal magnitudes in which there is liability of confusing the two components when they emerge from periastron; Jackson and van den Bos adopted different identifications and found periods of 95·2 and 51·6 years respectively. The ten years that have since elapsed decide against the short period. Mr. Kuiper finds the period 122·6 years, periastron 1883·4, *a* 0·472″, *e* 0·170; the hypothetical mass of each star is 1·13 sun, absolute magnitude of each 3·97, parallax 0·0146″.

OΣ82 is in the Hyades, and the brighter star is a spectroscopic binary; Prof. Hussey gave the period of the visual pair as ninety-eight years, using observations up to 1900; subsequent observations show that this is too short, and the new period is 487 years. The parallax appears to be close to 0·02″, and the sum of the three masses is between two and three times that of the sun.

The fourth system studied is a fivefold one. It is shown that the double star Σ1999 is probably in physical connexion with the triple system ξ Scorpii, from which it is distant 281″; the common parallax is estimated as 0·04″; the masses of the components of the triple system are given as 1·50, 1·39, and 0·95 of the sun; those of the binary are stated to be equal to each other, but their values are not given; the two systems are about 7000 astronomical units apart in the direction normal to the line of sight. The shift of the second system relatively to the first is only 0·25″ in sixty-four years, whereas the proper motion of ξ Scorpii in that period is 4·7″.

Research Items.

Growth - Changes in Physical Correlation. — Dr. Joseph Bergson, in *Human Biology*, vol. 1, No. 4, publishes the result of a study of the relation of height, weight, and chest measurement in the human male from birth to maturity in accordance with Pearsonian biometric methods. His object is to show that, as conjectured, the alternate stimulus and retardation known to be exhibited during growth are incidental to an all-pervading interdependence of one structure and another. He finds that intercorrelations between height and weight, weight and chest circumference, and height and chest circumference all show significant variation with age. The correlations between height and weight show in their trend on age alternate maximum and minimum points in the neighbourhood of ages 1·5 years, 3 years, 6 years, 11 years, 14 years, and 21 years. The correlations between weight and chest measurement and height and chest measurement, as well as between height and weight, show a maximum point in the neighbourhood of 14 years. Each of the other statistical functions, means, standard deviations, and coefficients of variation, also shows in its trend with age a maximum point in the neighbourhood of 14 years. This is taken to be associated with adolescence and a subsequent decline is regarded as a "post-pubescent decline". The relative size of the correlation coefficient after about 10 years is highest for weight-chest circumference and smallest for height-chest circumference. Between the ages of about 6 years and 10 years the height-weight correlation coefficient is higher than the weight-chest circumference coefficient, while the latter and height-chest circumference retain the relative position they occupy after 10 years.

Archæology of the Mediterranean Lands.—Excavations continue to furnish further links in the history of the Mediterranean region. A distinguished visitor to Section H (Anthropology) of the British Association at Bristol was Dr. Miloje M. Vassitz, of Belgrade. His excavations on the now famous site at Vinča yielded in 1930 important evidence of commercial relations between Vinča and the south-east, the Ægean, Asia Minor, and Cyprus. Remains of wattle and daub buildings with a floor consisting of horizontal beams overlaid with mud plaster, the surface of which had been fired, were reminiscent of floors discovered at Tcherna-Voda on the Danube in Bulgaria, and also in south-west Russia. Obsidian implements suggest a link between Vinča and the Bükk district, as does one type of decoration on the pottery. The most important find of the year, however, was a type of pottery related to Minyan ware. This would confirm Dr. Vassitz's dating of the beginning of Vinča culture as early Troy II., since Minyan ware belongs to the Middle Minoan and Middle Helladic periods. Details of the work are being published in *Man*. Prof. J. L. Myres read a report from Mr. W. A. Heurtley on a Neolithic and Early Bronze Age site on the south side of the Haliakmon in western Macedonia. Mr. Heurtley's excavations have added an important piece of evidence as to the earliest incursion of northerners into Greece, largely based on pottery finds. A complete skeleton, buried in a crouched position, was found and awaits examination by an anthropologist. Since this skeleton is probably that of one of the invaders, great interest will attach to its characters. Miss M. A. Murray, working in Minorca on the clearance of the temenos round megalithic structures, which consist of an upright stone slab with a horizontal slab placed tablewise on the top, discovered painted Iberian ware of a type associated with eastern Spain and southern France.

A Dart Match in Tikopia.—Dr. Raymond Firth describes in *Oceania*, vol. 1, No. 1, the game of dart throwing as played in Tikopia, an island lying between Banks and Vera Cruz islands in the Pacific. This game was a popular sport in old Polynesia, and records of it, varying in details, are preserved among the Maori, in Samoa, Niué, and Fiji, where it drew the interest of the whole community. In Tikopia, matches are watched with most intense interest by crowds which include women and children. Though primarily a public diversion, it is also closely connected with the social organisation and religious belief of the people. The game is played on a *marae*, a long, narrow platform of ground, about 130 yards long by six to seven yards in width, which is cleared of all vegetation. The *tika* or dart has a head of hard wood about five inches long, which curves gently from base to point and is highly polished to make it glide gently over the ground when the dart is thrown. It fits by a tang into the socket of a reed shaft about three feet long. When thrown with a low trajectory, it flies for about fifty yards and then, on striking the ground, glides along for another seventy or eighty yards. Additional impetus is gained by a protective ring of coconut fibre on the forefinger, which fits into a notch in the base of the shaft. The game is played by two sides of twelve to twenty players each—known, figuratively only, as "the Bachelors" and "the Married Men". Actually the sides are drawn, irrespective of their married status, primarily from two clans. The composition of the sides, rules, order and methods of playing are traditional, dating back to the times when men were gods, and thus as the 'sport of the gods' the game is taboo, especially on certain occasions, as for example, when the object is to seek efficacy for the land. In the scoring, only the dart thrown farthest on either side counts; and a complicated system of scoring points and cancellation of points scored makes a complete victory by one side a rare occurrence.

Adaptations of the Kangaroo Mouse.—In 1891 C. Hart Merriam described "one of the most remarkable of the many new and interesting mammals that have been discovered in North America during the past few years" the kangaroo mouse, *Microdipodops megacephalus*. It is of no economic importance, one way or the other, for it lives largely upon seeds, but its adaptations are well marked, as E. Raymond Hall and Jean M. Linsdale show in the most complete account that has been written of this rare creature (*Jour. of Mammalogy*, vol. 10, p. 298; 1929). The eyes are large and black, and suggest nocturnal habits—the only occasion on which any individual was known to bite was when it was endeavouring to escape from a strong light. Stiff projecting hairs occur on the sides of the hind feet, and the hind feet and lower legs are greatly lengthened—a young mouse repeatedly jumped out of a can without touching its sides, although the sides were seventeen inches high and the can only ten inches in diameter. The auditory bullæ are greatly inflated and reach their maximum relative size in kangaroo mice, yet the ear pinnæ are extremely small, consistent with the burrowing habits of the species. The mice are found only in the Great Basin region at altitudes ranging from 4000 ft. to 6000 ft., but the distribution is far from uniform, because fine sandy soil associated with vegetation appears to offer the only suitable habitat.

Clyde Muds.—An investigation into the Clyde muds with a new sampling apparatus was undertaken by Mr. H. B. Moore ("Muds of the Clyde Sea Area

I, Phosphate and Nitrogen Contents", *Journal of the Marine Biological Association of the United Kingdom*, vol. 16, No. 2, March 1930). The instrument is described in a separate paper in the same number of the *Journal* by Mr. Moore and Mr. R. G. Neill ("An Instrument for Sampling Marine Muds"). A column of mud from 12 in. to 16 in. can be taken, the depth ranging from 10 fm. to 70 fm. The sampler is worked by hand and consists of a heavy brass body containing a glass tube open at both ends when descending. This falls under its own weight and drives deeply into the mud, which partially fills the tube. A valve at the top closes when the sampler stops, and by this, and by its own friction against the glass, the mud is held in the tube while the sampler is hoisted. This has been in use at the Millport Laboratory for some months and is very satisfactory, serving for collecting the mud fauna and for chemical analysis. The phosphate and nitrogen contents of the mud at thirty-three stations in the Clyde Sea area were determined at 5 cm. stages, down to 20 and sometimes 30 cm. below the surface. The phosphomolybdic method was used in estimating the phosphates and the Kjeldahl method for the total nitrogen. Whilst no general relation was found between phosphate or nitrogen values and the depth of water, the phosphate values in depths of less than 40 metres all lie close together and fall off with increasing depth in the mud, usually showing a rise at the 10 to 15 centimetre level, and the nitrogen values usually fall with increasing depth in the mud. Stations with strong tides usually show low phosphate and nitrogen values.

Japanese Sipunculids.- Dr. Hayao Satô in his "Report of the Biological Survey of Mutsu Bay, 15. Sipunculoidea" (*Science Reports of the Tôhoku Imperial University*, Fourth Series (Biology), Sendai, Japan, Vol. 5, No. 1, April 1930) records nine species, four of which are new to science. Critical notes, keys, and good figures are given and there is an extensive bibliography. The new species *Phascolion ikedai* lives in a state of commensalism with the madreporarian coral *Stephanoceris carthausi*. This had already been discovered by Ikeda, who observed them in the Sagami Sea, but although noting that the *Phascolion* was new he did not name it. This is the only species of *Phascolion* hitherto known to live as a commensal with a coral, although several cases are recorded for *Aspidophora*. A polychæte belonging to the genus *Syllis*, more than 40 mm. long and 1 mm. broad, usually lives with the *Phascolion* in the coral.

Fish Breeding in Aquaria.—Goldfish breeding is always popular. In the *Aquarian Review* for July (vol. i. No. 12), the president of the British Aquarists' Association, Dr. H. B. Jones, gives useful instructions and hints to would-be breeders. The eggs should be hatched out quickly with a slightly raised temperature and much attention must be given to the food—infusoria at first, later sifted daphniæ. In the same number Mr. L. B. Katterns begins a series of articles dealing with the breeding of tropical fish, the first giving instructions for equipment and general requirements. Here again temperature is necessarily of great importance, and the author states that it is easier to keep the aquarium heated to an even temperature than to keep a cold-water aquarium cool during hot weather.

Eruption of Komagatake (Japan) in 1929.— Near the south end of Hokkaido, the northern island of Japan, is an inlet, Volcano Bay, opening to the east The volcano, Usu-san, of which there was a great eruption in 1910, lies near the northern shore. On the opposite side is the volcano Komagatake, 3740 feet in height, of which the most violent eruption known occurred in 1640 and the latest on June 17, 1929. This has been closely studied by Mr. H. Tsuya and seven colleagues, and the results are described in a valuable series of papers published in a recent *Bulletin* of the Earthquake Research Institute (vol. 8, pp. 237-319; 1930). The eruption began at 0·30 A.M. with an earthquake and rumbling noises. The activity gradually increased until about 10 A.M., when there was a great explosion, after which it subsided. On June 22–23, a microseismometer, a pair of tiltmeters, and a pair of gravity-variometers were erected in a hut about five miles north of the crater. From June 23 to July 10, 377 earthquakes were recorded, the amplitude being usually less than 1 mm., so that few were sensible to human beings. The foci seem to have been close to the surface. The tilt-curves show several abnormal tilts which were clearly connected with changes in the pressure-gradient and also with pulsations of the ground preceding small outbursts. After the eruption, the levelling was repeated along two lines on the north and west bases of the mountain. This showed that the ground had sunk, the curves of equal depression being parts of ellipses with their centres at the crater. The greatest subsidence measured 2 ft. 9 in. There was no trace of change in the gravitational field large enough to be recorded by the instruments employed.

Nuclear Disintegration of Boron.- In two papers in the *Zeitschrift für Physik* for July 21, W. Bothe and H. Franz have given an account of a fairly complete investigation of the ejection of protons from boron nuclei, under the influence of α-particles from polonium and radium-C′. The protons were registered by one of the new forms of electrical counters which is sensitive to single α-particles and H-particles, but is practically unaffected by β-rays and γ-rays. At least three groups of protons are produced, the fastest two being fairly homogeneous, with maximum ranges of 33 cm. and 74 cm. in air when set free by the polonium α-particles. The energy of the protons decreases as the angle between their direction of motion and that of the incident α-particle increases, although their number does not vary much with direction, whilst a decrease in the energy of the individual α-particles has a greater effect on the number of protons than on their range. A very recent investigation, to which reference is made by Dr. Bothe in a footnote, has also established that a hard γ-radiation is emitted when certain light elements are bombarded with α-particles.

Analysis of Groups of Alpha-Rays.—Sir Ernest Rutherford, Mr. F. A. B. Ward, and Dr. Wynn-Williams have contributed a paper to the September number of the *Proceedings of the Royal Society* on a method for analysing groups of α-rays, in which the ionisation produced by each particle is amplified linearly by valves until it can be measured by a relatively insensitive galvanometer. This form of counter can be used either with a single ionising chamber or with a double differential chamber, the latter type in particular being most useful for the study of complex beams, revealing immediately, for example, the previously unknown short range α-particles emitted in the dual disintegration of radium-C. These new rays are not homogeneous, and consist of two groups, a main one of range 4·1 cm., and a subsidiary one of range 3·9 cm., a result which is in accord with the complexity of the 4·8 cm. particles from thorium-C, which had already been established by magnetic analysis and again verified in the present investigation, and with the complexity of the 5·5 cm. particles from actinium-C. The 8·6 cm. particles from thorium-C′, the 7·0 cm. particles from radium-C′, and the 3·9 cm. particles from

polonium are, however, homogeneous within the limits of the resolving power of the counter, and it thus seems possible that the complex α-ray spectra are associated with radioactive elements of odd atomic number, a prediction which is being tested by an analysis of the rays from protoactinium. Fuller details of the apparatus are to be published subsequently.

Mobility of Ions in Pure Gases.—An investigation of the motion of ions in gas at high pressure, in which the modern technique for the purification of materials for electrical measurements at low pressures has been used, is described by A. M. Tyndall and C. F. Powell in the September number of the *Proceedings of the Royal Society*. The results are very surprising in the remarkable dependence found in the properties of the positive ions on the presence of minute traces of impurities. It has been known for a long time that the mobility of the negative carriers is largely affected by impurity, but it has now been shown that when the amount of the latter has been reduced to the stage when the negative carriers are almost unaffected, the positive ions still do not attain their maximum possible speeds in the field. To ensure that the measured mobility of an ion is the true mobility of a positive ion in its own gas, it is necessary that the residual impurity should be reduced to the order of a few parts in a million, the total pressure being 100 mm. or more, and the opinion is expressed that no significance can be attached to the values of the mobility of the positive ion previously obtained in any gas. These experiments are being elaborated with a system of alternating fields of square wave-form, in place of the sinusoidal wave-form, which is less suited for accurate determination of the mobility, but it has already been established definitely that the true value of the mobility of the positive helium ion in helium is considerably greater than had been supposed, and of the same order as the value deduced from classical kinetic theory.

Impact Resistance of Steel Castings.—The May number of the *Canadian Journal of Research* contains a paper by R. W. Moffat, of the University of Manitoba, on the effect of low temperatures on the resistance of steel castings to impact. This subject is of importance from the known increased frequency of failures of machine parts in severe winters. Many studies of this effect have been carried out by previous workers, but we miss from the references given in the paper any mention of the interesting work of Robin, published as a Carnegie Memoir of the Iron and Steel Institute in 1911, which clearly showed the greater resistance to impact at low temperatures due to the use of nickel as an alloying element. The present series of experiments is concerned with castings, and shows that plain carbon steels may have a resistance to impact at $-31°$ C. of only from one-quarter to one-half of that at ordinary temperatures. By heat treatment this resistance is increased very considerably. The impact value falls off with increasing carbon. Vanadium or nickel or a combination of the two metals increases the resistance to impact. Castings with 2-3 per cent of nickel have about the same resistance at low temperatures as those with 0·18-0·22 per cent of vanadium. Normalising at 870°-900° C., followed by reheating to 620°-700° C. and cooling in still air is recommended.

The Melting Point of Iron.—Amongst the black-body radiators used by Dr. C. H. M. Jenkins and Dr. M. L. V. Gayler in an investigation of the applicability of optical methods of pyrometry to the measurement of metallurgical temperatures (*Proceedings of the Royal Society*, vol. 129, p. 91) was a very simple and ingenious one consisting of a bubble blown in the molten metal. The bubble was formed on the end of a narrow tube of refractory material, which served in addition as a viewing tube, and was found to behave quite satisfactorily in iron, but not in gold or palladium. The final result given for the melting point of iron of very high purity is 1527° ± 3° C., the local standard of reference being the melting point of palladium, 1555° ± 2° C. The optical pyrometer used was of the disappearing-filament type.

Tri-organo Thallium Compounds.—The only organo-thallium compounds previously known were of the type R_2TlOH, but in the July number of the *Journal of the American Chemical Society*, H. P. A. Groll describes the preparation of thallium triethyl, $Tl(C_2H_5)_3$, from thallium diethyl chloride and lithium ethyl, in absence of oxygen and moisture.

Explosion Rates.—Although several attempts have been made to account for the high speed of propagation of gaseous explosions, the detailed microscopic molecular mechanism of propagation from one layer of gas to the next has not received much attention. In the August number of the *Journal of the American Chemical Society*, B. Lewis has attempted to calculate the velocity of propagation of gaseous explosions on the basis of the theory of reaction chains. A single interaction between two molecules may generate a product which reacts with the next suitable molecule it encounters, the process continuing in like manner from layer to layer by reason of regenerated active products through a large number of steps or a chain of reaction. By means of a special hypothesis as to the division of the energy of reaction among the rather arbitrarily selected numbers of degrees of freedom of the molecules, Lewis finds that the energy on the carrier finally reaches a maximum limit which remains constant, and by equating this to $\frac{1}{2}Mv^2$, where M is the mass of the carrier, the value of v, the velocity, is found. The agreement in several typical cases is good.

High Frequency Steel Furnaces.—The paper on high frequency steel furnaces by D. F. Campbell, which was read on Sept. 16 at the autumn meeting in Czechoslovakia of the Iron and Steel Institute, contains much valuable information. The melting of steel in an ironless induction furnace has long been known as an efficient and economical method of making tool steel. But this is only a very limited application of its uses. At present the largest furnaces in use have a capacity of 20–25 cwt. and have an output of 20 tons per day. For making tool steel, 5-cwt. furnaces melting one charge per hour are commonly used. They are very appreciably cheaper to operate than gas or coal fired crucible furnaces and the necessary labour is less costly and easier to obtain. The quality of the steels produced in this way, especially those containing complex alloys, is much better and more homogeneous. The remelting of low carbon stainless alloys of the chromium series without any 'pick up' of carbon is of value. In small furnaces of extra high frequency (about 20,000) the melting of hard materials of the tungsten-chromium-cobalt-carbide group, which are being cast in form moulds, at a temperature of between 2000° to 2300° C., can be carried out. A comparison is made between a steelworks equipped with six 75-ton open-hearth furnaces, producing 6000 tons a week, and ten 6-ton high frequency units giving the same output and casting direct into ingot moulds. It is shown that the capital cost of the latter equipment is considerably less and that it has many advantages. Improvements in the design of motor-generator sets for producing the high frequency currents have led to an overall efficiency of between 85 and 90 per cent being obtained.

Eleventh International Zoological Congress.

THE Eleventh International Congress of Zoologists, which met in Padua on Sept. 3–11, under the presidency of Prof. Paolo Enriques, attracted more than six hundred members, representing thirty countries. The British delegates were Dr. F. A. Bather and Dr. G. C. Robson (representing H.M. Government), Dr. K. Jordan, Dr. H. W. Parker, Lieut.-Col. J. Stephenson (Indian Government), and Prof. A. Willey. In the Aula Magna of the University, surrounded by memorials of Galileo, Morgagni, Vesalius, Falloppio, Casseri, and Vallisnieri (nor should we here forget Linacre and Harvey), the Congress was formally opened by H. E. Alfredo Rocco, Minister of Grace, Justice, and Culture, as representative of the Government and as president of the Italian Committee for International Intellectual Co-operation. He expressed the deep practical interest felt by the Italian Government in zoological studies, alluded to the contributions of Italians from Leonardo da Vinci to the present day, and mentioned the Zoological Station of Naples and the Biological Institute of Messina as schools open to the students of the whole world.

Prof. Enriques, in an eloquent address, laid particular stress on the Fascist organisation of the Congress: the vast concepts and ideals of zoology, he said, led the mind up to that rarefied atmosphere in which the spirit of Giotto hovered when, under the eyes of Dante, he traced the poem of the Gospel on the walls of the neighbouring chapel; inspired by like ideals, every Italian sought to be worthy of his country's past and to base new works on the ancient traditions; but such a national ideal could not develop without the friendly co-operation of all civilised countries, and in that belief he tendered an affectionate welcome to the zoologists of every tongue. Among those who replied was the veteran Richard Hertwig, who alluded to the story of St. Antony of Padua preaching to the fishes, and to the Paduan studies of Paracelsus and Goethe. "There is much talk", he said, "of a United States of Europe: that does not satisfy zoologists; we wish to see all the States of the world united in the interests of civilisation and of science."

The scientific communications were presented to fifteen sections and to general meetings. Since they numbered more than two hundred and fifty, it is scarcely possible to mention more than a few of those dealing with wider questions. In an opening discourse on "Genetics and Evolution", Prof. Caullery maintained that the mutants made known by geneticists are not really new formations but combinations of pre-existing genotypes; that, though they may exist where they first appear, they would be eliminated by natural selection and would not give rise to new species distinguished by the criterion of interspecific sterility. It is difficult, he said, to regard evolution as due to successive mutations.

"Biogeography and Evolution" was the theme of Prof. G. Colosi, who, in most explanations of the known facts, finds difficulties (as of contradictory physiographic changes) that are obviated by Rosa's theory of hologenesis. This assumes a world-wide extension of the original life-forms, with parallel orthogenesis, so that the same or similar species arose in widely-separate regions; thus land-bridges or sea-connexions are unnecessary. Dealing with the distribution of populations, from insect epidemics to the races of man, Prof. F. Bodenheimer attributed the chief influence to climatic conditions. On the other hand, Dr. Boettger's account of "Artbildung unter dem Einfluss des Menschen", exemplified by the snails *Agriolimax lævis* and *Potamopyrgus crystallinus*, seems to prove nothing more than the distribution of mutants by human agency. His title would have been more applicable to Prof. Ghigi's account of crossings in pheasants and guinea-fowls with the formation of alleged new species, themselves fertile but sterile when crossed; Ghigi finds that sterility and fertility are sex-linked characters, and regards hybridisation as an important factor in evolution.

Birds also were the subject of Prof. O. Riddle's experiments on the relation of metabolism to sex; metabolism is influenced by temperature more in males than in females, and the amount of hæmoglobin is also affected; the sexes and their corresponding metabolic types are both reversible. Other papers on sexual characters were contributed by A. Arcangeli, A. Banta, E. Caroli, J. de Mallasz, and E. Padoa, and on hybrids by F. Cavazza and G. Montalenti, while F. Poche discussed the possibility of a third sex.

Returning to problems of evolution, one notes Prof. Enriques' studies in Radiolaria because they show similar minute characters repeated through generically differing forms, much as the varieties of wheat are paralleled in rye. Dr. Robson's researches on the origin and descent of Octopoda lead him to attribute much to orthogenesis. In connexion with Cephalopods, the important paper on their nervous system by E. Seroni should be mentioned. Prof. A. Sewertzoff announced an evolutionary principle as "the substitution of functions", which means the replacement of an organ by a totally different organ that performs a function which is analogous or biologically equivalent to that of the suppressed organ. In the reduction of organs, Sewertzoff claims that those parts disappear first which are the last to be formed embryologically.

Other papers with a general bearing might be cited did space permit, but the practical side of zoology demands mention, since a whole section was devoted to silkworm culture. The address by Prof. Pigorini, director of the Bacological Station at Padua, did indeed deal with important embryological questions. Among the papers here were two by Prof. Matsumura on the silkworms of Japan. A visit to the Station proved of exceptional interest, and the preparations of larvæ by Dr. Amelia Tonon were much admired. Here also may be recalled the R. Stazione di Polticultura near Rovigo, where experiments are conducted on numerous breeds of gallinaceous and other birds.

This last was visited during an excursion which included an inspection of Count Arrigoni's ornithological collection with welcome refreshment at his villa, Cà Oddo, and a banquet at Rovigo, where the Minister of Agriculture spoke. Another excursion was to the Royal Villa at Strà, where the company of four hundred was entertained by Count Giusti, Mayor of Padua, to such effect that "grave and reverend signiors" were seen to join in the subsequent fox-trots. On Sunday there was a delightful trip to Venice and the islands of its lagoon. A ball in the fine rooms of the Casino Pedrocchi and a final dinner offered by the local committee in the great and ancient Sala della Ragione were among other general entertainments. Special invitations were extended by certain ladies of Padua to all ladies attending the Congress.

Some of the general meetings were held in a new Aula of Pathological Anatomy, formally opened by Prof. Cagnetti, while sections met in the various aulæ of the new university buildings. In the Zoological Institute a room was provided for exhibits by members, and hard by was an exhibition of books and apparatus. Here Koristka of Milan showed a new

"Stand A" for monocular microscopes and "Stand U" capable of taking various forms of binocular with either single or double objectives; Reichert of Vienna exhibited microscopes, microtomes, projection and photographic apparatus; Zeiss of Jena had a particularly interesting show of projection apparatus; A. C. Zambelli of Turin showed thermostats for embryological research and microscope observation *in vivo*. Allusion may here be made to the cinema film of young orang-utans shown by Prof. G. Brandes of Dresden, and the remarkable results displayed by Prof. Storch of Graz in his cinema studies of small crustacea under the microscope. In the Library of the University, Profs. Ageno and Ducceschi had arranged an exhibit of old books relating to biological science; an excellent illustrated catalogue was provided.

At the concluding session of the Congress reports were presented from the Commissions on Parasitology and on Nomenclature. It was decided that in future the Congress should be held at intervals of five years. In view of the large number of such meetings, the decision is probably wise, but it is to be hoped that care will be taken not to clash with other congresses in allied sciences. The International Institute of Intellectual Co-operation might be asked to act as a co-ordinating body. These congresses would be more useful if papers dealing with relatively special and trivial points were eliminated, especially when the results have already been published. Attention should be concentrated on general problems, towards the discussion of which authorities in various branches might contribute; and on such forms of co-operation as biological surveys, studies of migration, and especially action requiring government assistance. At present the Commission on Nomenclature seems to be the body that continually does really practical international work, however restricted its field may be. What the Permanent Committee of the Congress does between whiles, not even its members seem to know.

The preceding remarks are not intended to reflect in any way on the organisation of the Padua Congress, for which high praise is due to the energy of Prof. Enriques and the labours of the general secretary, Dr. Fausta Bertolini, with her lively and courteous staff of students of both sexes. Padua preserves the intimate and homely character of an ancient university city, and all its inhabitants united in so warm a welcome that the chief characteristic of the Congress now past was its friendly and homely character; and that, after all, is the chief value of these international gatherings.

The Liverpool and Manchester Railway Centenary Celebrations.

THE Centenary Celebrations of the opening of the Liverpool and Manchester Railway were opened on Sept. 13 in St. George's Hall, Liverpool, by the American Ambassador, General Dawes, and were brought to a conclusion on Sept. 20 by a final performance of the great Pageant of Transport which had been shown night by night in Wavertree Playground.

Enacted on a stage 300 feet long and by some 3500 performers, the Pageant of Transport was designed to show the various methods of transport by animals, sledges, carts, wagons and coaches, and by the early railways. The final scene recalled the events of Sept. 15, 1830, when the Duke of Wellington, Sir Robert Peel, Mr. Huskisson, and other notable persons set out in the first of a procession of eight trains from Liverpool to Manchester. A replica of the original train had been constructed, and it was drawn by a replica of the engine *Northumbrian* which in 1830 was driven by George Stephenson himself. In the Wavertree Playground - a large open space kept solely for games - was also an exhibition of old and modern locomotives, together with examples of up-to-date carriages and wagons. It need scarcely be said that a copy of the *Rocket* was to be seen, while the *Lion*, an engine built for the Liverpool and Manchester Railway in 1838, but now the property of the Liverpool Engineering Society, was under steam and worked "a train of 1830" carrying passengers around a circular track.

While the pageant and exhibition and the shows at Wavertree provided for the popular taste, an exhibition of historic material, models, etc., in St. George's Hall provided food for the student and specialist and fascination for boys and girls. The celebrations have been held under the auspices of the corporations of Liverpool and Manchester and with the support of the London, Midland and Scottish Railway. The responsibilty for the exhibition in St. George's Hall lay with a committee of which Mr. Robert Gladstone was chairman, and its success was largely due to his energy and foresight. While there were scores of model locomotives and a splendid model railway to be seen, the chief features of interest consisted of a series of exhibits illustrating the work of the pioneers, Cugnot, Trevithick, Murray, Blenkinsop, Hedley, Hackworth, Stephenson, and others, and another series relating particularly to the history of the Liverpool and Manchester Railway, much of the material for which came from the Liverpool Public Library.

There was much to recall the famous locomotive trials at Rainhill in 1829, between the *Rocket*, *Sans Pareil*, *Novelty*, and *Perseverance*, and one of the original cylinders of the *Novelty*, recently procured from an old works near Rainhill Station, was on view. The fellow cylinder for many years has been in the Science Museum. Of especial interest to serious students of railway history was the exhibition of a recently discovered letter from Robert Daglish referring to locomotive engines he made in 1812 and 1816. Hitherto nothing has been known of these Lancashire engines, and inquiries at the colliery at which they worked have already brought some interesting facts to light.

A Handbook and Programme of the Centenary Celebrations was available, as were also a catalogue of the exhibition and a bibliography of the printed and illustrated material on the Liverpool and Manchester Railway in the Liverpool Reference Library. The London, Midland and Scottish Railway issued "One Hundred Years of Railways", written by Mr. Dendy Marshall; while Prof. G. S. Veitch's book, "The Struggle for the Liverpool and Manchester Railway", was published just before the celebrations.

Of other events connected with the celebrations mention may be made of the commemoration service in the Cathedral, the unveiling of a memorial tablet on the first railway station in Manchester, the performance of a pageant of the industries of Liverpool by the workers of the railway, and the public lectures in Picton Hall arranged by the Liverpool Corporation. At least two additions will be made to the nation's historic machines as a result of the celebration, as the cylinder of the *Novelty* is to be placed on permanent exhibition in Rainhill Station, and the locomotive *Lion* is to be placed on a pedestal in Lime Street Station, Liverpool.

Sinanthropus.

AT a joint meeting of the Sections of Geology and Anthropology of the British Association at Bristol, Prof. G. B. Barbour, of the Department of Geology, Yenching University, gave a very interesting lecture on "The Geological Background of Peking Man (*Sinanthropus*)." Chou-kou-tien, where *Sinanthropus* was discovered in an abandoned limestone quarry, overlooking the re-entrant margin of the Yellow River delta plain, lies 37 miles south-west of Peiping (Peking), on a branch of the Peking-Hankow railway. The fossiliferous deposit was first reported by J. Gunnar Andersson in 1921, and in the following year Otto Zdansky discovered mammalian material, reporting in 1926 that it contained hominid teeth. In 1928 B. Bohlin, C. C. Young, and W. C. Pei found an adult right ramus, with three molars *in situ*, together with part of another jaw and many skull fragments. In 1929 W. C. Pei, a young geologist on the staff of Yenching University, discovered first fragments of a skull, since reconstructed, and later an uncrushed adult skull. This latter discovery occurred at 4 P.M. on Dec. 2, the last day on which it was possible to work because of the increasingly wintry weather. The skull was embedded in a travertine matrix, and Prof. Barbour described the infinite care and skill with which Dr. Davidson Black removed the matrix, taking repeated casts and photographs, in an effort to ensure that the fullest records should be available for future workers.

The skull is that of a young adult, for the sutures are deep and unfused. The lower face is apparently missing, but the ear-hole and the back of the skull are present; the jaw sockets are massive, suggesting marked biting capacity. Dr. Davidson Black considers that the length of the skull approximates to that of *Pithecanthropus*, which it also resembles in its massive brow-ridges, but the distinct frontal swelling and the development of slight parietal bosses mark it off from the Java skull. A feature of importance in the site is that remains of at least ten individuals have been found, and, curiously enough, all skeletal parts so far recognised belong to the head.

In addition to the richness of the *Sinanthropus* finds, the quantity and variety of the vertebrate remains form a striking feature at Chou-kou-tien.

More than fifty types of mammals, besides frogs, snakes, turtles, and birds, have been recorded. In the three seasons, 1927 to 1929, about 8800 cubic metres have been excavated, and 1475 boxes of fossil material have been removed. The most characteristic types are *Sinanthropus*, *Euryceros* (flat-antlered deer), *Rhinoceros*, cf. *sinensis*, and *Hyæna sinensis*. *Trogontherium* (big beaver) and *Bubalus* (primitive buffalo) also occur. The fauna has suggestions of a southern affinity and is distinctly older than the Loess fauna of Middle Pleistocene date, which includes *Rhinoceros tichorinus*, *Hyæna crocuta*, and *Cervus elephas* in place of those mentioned above. It can be closely dated as very early Pleistocene in view of the absence of truly archaic types and the presence of modern types, including *Equus*, but it is definitely older than the Middle Pleistocene. The fossil material is found *in situ* at various level deposits, and is of essentially the same age from top to bottom.

The finds were made in deposits of breccia, gravel, sand, and clay filling fissures and caves in Ordovician limestone. With the aid of a series of remarkably clear photographs, sections, and block diagrams, Prof. Barbour demonstrated the origin, by dissection, of the various clefts or caves, which at one time must have formed shelters for animals and are now filled with the brecciated clayish or sandy fossiliferous formations, comprising the typical Chou-kou-tien deposits. The interest of the lecture was greatly enhanced by the exhibition of casts of *Sinanthropus* and of a tooth. Prof. Barbour concluded by pointing out that all new data are issued from the laboratory of Cenozoic Research, under the combined control of the Geological Survey of China and the Peking Union Medical College. He paid a tribute to the way in which work has been continuously carried on in spite of the grave difficulties due to the prolonged political crisis in China. Reference was made to the important paper by P. Teilhard de Chardin and C. C. Young in *Bull. Geol. Soc. China* (vol. 8, No. 3, 1929), which not only gives a clear and detailed account of the geological history of the Chou-kou-tien formations, but also has a bibliography of all publications on the subject up to December 1929. Vol. 9, No. 1, 1930, gives further data.

It had originally been planned that Prof. Elliot Smith should open a discussion on the characters and affinities of Peking man, but he decided in early August to go to China to study *Sinanthropus* on the spot. His report, and a further one from Dr. Davidson Black, will be awaited with keen interest.

Staining Yeasts with Methylene Blue.

WORKERS who use the time-honoured method of staining yeasts with methylene blue are familiar with the untrustworthy results often obtained when an attempt is made to distinguish living from dead yeasts. It is now realised that apparently contradictory results may be due to differences in working conditions employed by various workers, and in this connexion a recent letter in NATURE (Brooks, **125**, p. 599; April 19, 1930) may be cited, in which the importance of pH value, concentration and purity of the stain, and of the effects of light are indicated.

Fuchs also (*Woch. Brau.*, **46**, p. 437; 1929: **47**, pp. 171, 183; 1930) has pointed out that the concentration of methylene blue, which is usually 0·0001 per cent, may be increased to 0·001 per cent without any immediate marked change in the proportion of stained to unstained cells. After 15 minutes, however, this proportion may increase very rapidly. If this result is correlated with the fact that granulated cells, which are usually considered dead, stain well, we have a certain amount of evidence that methylene blue is toxic to yeasts after a short period of contact.

Haehn and Glaubitz (*ibid.*, 315) actually showed, however, that preparations from which unstained yeasts were entirely absent grew in wort, and they therefore concluded that cells which take a weak stain are living, though impaired in vitality. The weak staining in the first instance may probably be attributed to adsorption by mucilage on the cell-walls. In both cases a 0·0001 per cent solution is favoured, and Fuchs adds this until the colour is blue-green and immediately counts the deeply stained dead cells. In the case of suspensions in wort the proportion of stain must be increased, as some is adsorbed by the wort-colloids.

Against this increase in stained cells on prolonged

contact must be set the decolorising effect of reductase, which persists when the cell is dead and is greatly increased at low pH values (for example, in wort). The influence of pH values has been accounted for by Fink and Weinfurtner (*ibid.*, **47**, pp. 89, 110, 124; 1930) by the fact that methylene blue is a base, the hydrochloride of which is soluble in neutral or in acid solutions. In alkaline solutions, however, the less soluble base is liberated and is available for adsorption. Thus, at pH 2·2 less than 1 per cent of the cells examined were properly stained, the remainder being pale-blue in colour, whilst at pH 4 a deeper shade of blue was obtained, increasing progressively in depth of colour until, at pH 8, all the cells were deep blue. The marked time-effect is illustrated by the increase in one case of from 5 per cent to 20 per cent of stained cells in 3 minutes (pH 2·6 to 6·8).

Yet another source of anomalous results was traced to the electrolyte-content of the medium in which the yeast is suspended. Thus, staining occurs more rapidly in distilled water than in tap-water, but a trace of electrolyte (for example, salt) added to the former before the addition of the stain inhibits its action. It is not clear to what extent this is due to a corresponding change in pH value, since some substances, for example, dextrose and lævulose, have the effect of predisposing the yeast to staining. Maltose and glycerol are less effective in this respect, while mannitol is inactive. Electrolytes containing chlorides, iodides, thiocyanates, bromides, sulphates, nitrates, tartrates, citrates, and acetates act as inhibitors in decreasing order of efficiency, and it is suggested that their absence renders the yeast-walls more permeable to the stain.

Another important fact which emerges from these investigations is that one set of conditions cannot be formulated for all strains of yeast, so that there appears to be every reason why a study should be made of possible substitutes for methylene blue. In this connexion attention may be directed to the proposal of a 0·25 per cent solution of erythrosin by Devereux and Tanner (*Jour. Bact.*, **14**, p. 217; 1927), and to the use by Tolstouhov of eosin-yellow for pH values above 3, and acid fuschin for pH 0·8-3·0.

International Eugenics Conference.

THE International Federation of Eugenic Organisations held a conference at the Larmer Tree Grounds, Tollard-Royal, Wiltshire, on Sept. 10-15. Eighteen countries maintain membership in the Federation, and many of them sent representatives. Among those present were Sir Bernard Mallet, of Great Britain; Dr. A. Ploetz and Prof. Rüdin, of Germany; Prof. Reichel, of Vienna; Dr. Heuyer, of Paris; Dr. Van Herverden, of Utrecht; Dr. J. A. Mjøen, of Oslo, and Dr. H. H. Laughlin, from the Eugenics Record Office, U.S.A. Mrs. C. B. S. Hodson acted as organiser and interpreter of the conference. One object of the conference was to co-ordinate research in different countries. Reports were received on eugenics and war, and on recent eugenic developments in various countries. Committees were formed or continued for the study of human heredity, race crossing, racial psychiatry, and the standardisation of anthropometrical measurements, physical and mental. Different conferences were held on the standardisation of human measurements, on race crossing, on racial psychiatry, and on human heredity. Miss Tildesley outlined proposals on behalf of English anthropologists for standardising measurements, and Miss B. Schieffelin discussed methods of measuring psychic differences.

In her report on the work of the American Eugenic Research Association on Mental Measurement, Miss Schieffelin pointed out that the search for any such thing as a measurement of hereditary mental endowment has proved a failure. A central clearing-house should be established so that all mental tests could be thoroughly classified and their value gauged. This clearing-house, which would of necessity be an expensive business, would be able to review the situation and plan future research. Workers would be able to apply to it for advice and should be able to obtain the existing position in relation to mental testing and its application to hereditary factors.

Prof. Rüdin outlined a scheme of research on racial psychiatry, and Prof. C. G. Seligman contributed some observations on Chinese and Japanese psychiatry. An afternoon was devoted to papers on human heredity.

A public meeting held in the Tythe Barn, Hinton St. Mary, at the invitation of Capt. Pitt-Rivers, on "The Urgency of Eugenic Reform", was attended by many local people. Sir Arthur Keith spoke on eugenics from the evolutionary point of view; Prof. Ruggles Gates, on human heredity and segregation in racial crossing; Prof. Rüdin, on heredity of insanity; and Dr. C. J. Bond, on dangers of racial decay and the remedy.

Sir Arthur Keith, in his address, briefly traced the development of modern man from the time of *Pithecanthropus erectus* through the age of agriculture and showed how gradually the production of race was sacrificed for the accumulation of wealth. The new age, the eugenic age, is, it is hoped, to be one of constant race improvement. There are many difficulties in the way of execution of eugenics ideals, chief of which are human prejudice, emotion, and passion. The Church is falling into line, placing its blessing on attempts at racial improvement and paving the way for the more practical side which is the work of the eugenist. The evolution of man is not, as some people imagine, at a standstill, for it is slowly but surely progressing, and must be directed by the knowledge of the eugenist.

Dr. C. J. Bond emphasised the presence of a considerable element of mental and physical degeneracy in the general population. He pointed out that the remedy lay in first of all carrying out an exact ascertainment of the degree of mental and physical deterioration in the various social groups and then applying the principles of sterilisation and segregation. This would in course of time eliminate the defective and unstable members of society.

At another public meeting, cinema films showing various features of cell division and embryonic development were shown by Prof. Ruggles Gates, and Prof. Elton Mayo, of Harvard University, spoke on the physiology of efficiency.

Excursions were made to the surrounding country to view some of the numerous archæological remains in this vicinity. Under the guidance of Mr. O. G. S. Crawford and Mr. St. George Gray, the ancient British village and Roman camp on Hod Hill, Ackling Dyke, Worbarrow, Stonehenge, Woodhenge, and other neolithic and later remains were visited. The numerous archæological relics and models of excavations to be found in the Pitt-Rivers Museum at Farnham, Dorset, were also examined, as a preliminary to visiting some of the places from which they were excavated.

Historic Natural Events.

Sept. 28, 1876. Tornado at Cowes.—A rapidly revolving whirlwind, looking like a waterspout or huge funnel, point downwards, approached the south-west shore of the Isle of Wight between Blackgang Chine and the Needles. It passed north-eastwards across the island and reached Cowes between 7 and 8 A.M., doing damage estimated at £10,000 to £12,000. Corn, light articles, and even bricks were dropped on vessels in the Solent, and on the mainland south of Titchfield.

Sept. 29, 1210. Tay Flood.—Cant, in his notes to the Muses' Threnodie, says: "So violent was the torrent that the whole town [of Perth] was undermined, the houses levelled, and many persons of both sexes lost their lives. The Royal Palace [of William the Lion] did not escape. The King's youngest son, John, with his nurse, were carried down the river and drowned, with about fourteen of the Kings domesticks."

Sept. 29, 1538. Formation of a New Volcano.—Monte Nuovo is a conical hill, 440 feet in height above the sea-level, and lies about 8 miles west of Naples. For two years before the eruption that formed it there had been frequent earthquakes in the district that increased in frequency and reached their maximum on Sept. 27-28, 1538. The next day a fissure opened in the ground, from which scoriæ, lapilli, dust, and mud were ejected and, falling round the fissure, gradually formed a hill similar to many others in the district. The eruption died down in about a week, most of the hill having been formed during the first two days.

Sept. 29, 1915. Hurricane in the Gulf of Mexico.—The most intense hurricane in the history of the Gulf of Mexico struck the coast of Louisiana on Sept. 29. At Burrwood, La., the wind reached a velocity of 140 miles per hour in a gust, the highest ever recorded in the Gulf. In New Orleans nearly every building was damaged and several were totally destroyed, and some neighbouring towns and villages were completely wrecked: there were a number of shipwrecks, and the loss of life amounted to 275. This loss would have been far heavier but for the warnings issued by the U.S. Weather Bureau; in fact the greatest individual catastrophe, at Rigolets, resulted from the complete disregard of specific advice.

Sept. 29, 1927. Rainbow Phenomena.—About 4 P.M. seven distinct rainbows were seen simultaneously near Campbeltown in Kintyre. The three interior bows were the brightest, especially the third.

Sept. 30, 1513. Rockfall in Ticino, Switzerland.—A fall of rock from the Pizzo Magno dammed the lower part of the Val Blenio in Ticino. The waters of the river Brenno accumulated behind this dam and drowned the village of Malvaghe, including its campanilo 130 feet high. The dam broke on May 20, 1515, and the valley was entirely devastated, 400 houses destroyed, and 600 persons killed. When the flood reached Lake Langensee immense waves were formed and several shipwrecks occurred.

Sept. 30, 1555. Flood in London.—Holinshed records that "on the last of September by occasion of great wind and rain that had fallen was such great floods that the Kings palace at Westminster and Westminster Hall was overflown with water".

Oct. 1, 1250. Storm in North Sea.—This gale was very violent in the southern North Sea. It is said that the sea flowed twice without ebbing and the noise of the waves was heard a great distance from the shore; at night it appeared to burn as if on fire. Many ships were wrecked, and at Winchelsea, besides the damage to bridges, mills, and dykes, three hundred houses and some churches were drowned owing to the height to which the waters rose. Enormous damage was done in Holland and the marshes of Flanders, where the rivers, choked back by the rise of the sea, overflowed their channels.

Oct. 1, 1899. Whirlwind over Wiltshire.—During the passage of a barometric depression from south-west to north-east across England, a whirlwind or tornado about 2.15 P.M. travelled from south-south-west to north-north-east through Wiltshire, the track having a length of nearly 20 miles but a breadth of only about 100 yards. Many trees were uprooted and a great deal of damage done to buildings.

Oct. 3, 1780. West Indian Hurricane.—A violent hurricane developed to the south of Jamaica on Oct. 2 and travelled northwards across Jamaica, Cuba, and the Bahamas. On Oct. 6 and 7, in about 28° N., 74° W., it wrecked Admiral Rowley's squadron of eight or nine vessels and so moved away to the north-west, doing further damage to a squadron off Cape Henry. The wind and the inrush of the sea entirely destroyed the town of Savanna-la-Mar in Jamaica and several ships were left stranded on dry land; the *Princess Royal*, in fact, was afterwards used as a house. The ground half a mile inland was submerged to a depth of ten feet. The dead lay unburied for weeks, and a pestilence carried off many of the survivors. In the town of Lucea only two houses remained standing, and near Montego Bay four men-of-war were lost.

Oct. 4, 1526. Hurricane at Porto Rico.—According to Dr. Juan de Vadillo, "on the night of Oct. 4 there began on the island of Porto Rico such a storm of wind and rain, here called a hurricane, as to destroy the greater portion of the city of San Juan and to do great damage to the estates in the country by overflowing the rivers".

Oct. 4, 1869. "Saxby's Gale."—In 1868 Lieut. Saxby, a British naval officer, basing his prediction on the supposed influence of the moon, foretold a great storm on Oct. 5, 1869, but without specifying the locality. The storm, accompanied by a very high tide, which crossed New Brunswick, Maine, and Nova Scotia on Oct. 4, was popularly hailed as a verification of this forecast and remembered as "Saxby's Gale".

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting at Southampton), Sept. 9.—**D. Hanson**: The use of non-ferrous metals in the aeronautical industry (Autumn Lecture). The present state of aerial transport is in large measure due to the development of suitable alloys and their use in aircraft construction in large quantities. The non-ferrous alloys are strong for their weight, and also possess the advantages that they can readily be used as die-castings, forgings, stampings, and so on, and lend themselves readily to methods of standardised production. Perhaps the most notable feature in regard to aluminium alloys is the extent to which heat-treatment is employed in developing their useful properties. The use of magnesium alloys is of more recent origin, but is rapidly extending. Improvements in melting and casting methods, as well as the discovery of new alloys, have contributed to this extension, and the application of the processes of heat-treatment in suitable instances will probably lead to further improvements.

Sept. 10.—**Ernest A. Smith**: Rolled gold; its origin and development. The paper deals briefly with the history of the rolled-gold industry from its begin-

ning in Birmingham, in 1817, until the present time.—**W. Rosenhain, J. D. Grogan, and T. H. Schofield**: Gas removal and grain refinement of aluminium alloys. A number of selected volatile chlorides have been passed into molten aluminium and certain alloys. All were found to be efficacious in removing dissolved gas from the metal. Some, particularly titanium tetrachloride, also produce a marked reduction in grain-size. The reduction of grain-size occurs also when titanium is added to aluminium in the form of titanium-aluminium alloy produced by the 'Thermit' process. **J. D. Grogan**: Pressure die-cast aluminium alloy test-pieces. The behaviour of selected alloys when subjected to the attack of molten aluminium alloy and the method of entry of metal under pressure into a simple cylindrical mould are described. If certain serious technical difficulties can be overcome, the pressure casting process will yield products of excellent mechanical properties.—**N. W. Ageew and Olga I. Vher**: The diffusion of aluminium into iron. The process takes place in two stages: (1) Solution of iron in liquid aluminium; (2) diffusion of the alloy formed into solid iron. Weiss's law of diffusion has been verified for the binary system iron-aluminium.—**K. L. Meissner**: The artificial ageing of duralumin and super-duralumin. The effect of artificial ageing upon duralumin consists, after an initial softening at lower temperatures, mainly in raising the yield-point, whilst the tensile strength is influenced only slightly. At the same time, the elongation, flexibility, and other cold-working properties are decreased very markedly, and, as shown in previous work, the resistance against corrosion is also decreased. In contrast to duralumin, the tensile strength of super-duralumin (duralumin with addition of silicon) is markedly raised by artificial ageing, but the rise keeps behind that of the yield-point, relatively.—**Wm. L. Fink and Kent R. Van Horn**: Lattice distortion as a factor in the hardening of metals. Rockwell hardness measurements and diffraction patterns showed that lattice distortion can be accompanied by appreciable softening in an externally stressed aluminium alloy ('17 S') or α-brass. Maximum lattice distortion and maximum hardness are not necessarily coincident in age-hardened alloys.—**Marie L. V. Gayler**: A study of the relation between macro- and microstructure in some non-ferrous alloys. The results of a previous investigation are confirmed, namely, the higher the temperature from which an alloy is cast the coarser becomes the macrostructure, and at the same time the microstructure becomes finer, but in a less marked degree. The macro- and microstructure of an alloy do not seem to be affected by various gases, provided the casting temperature is kept low. If, however, the casting temperature is raised, the atmosphere to which the molten metal is exposed has a very marked effect on the macrostructure, together with a small effect on the microstructure; thus hydrogen causes the formation of a fine macrostructure in contrast to that obtained on casting under normal conditions. A copper-aluminium alloy which has been previously freed from gas by the nitrogen process and then melted *in vacuo* still shows inverse segregation. Furnace gases have little effect on the 'modification' of aluminium-silicon alloys. 'Modification' of a silicon-aluminium alloy cannot be obtained by casting into a heavy, water-cooled copper mould.

PARIS.

Academy of Sciences, Aug. 4.—Bigourdan: The astronomical instruments and observations of Bochart de Saron.—**André Roussel**: The general expression of the infinitesimal increase of a function.—**Georges Giraud**: The principal Cauchy integrals and their application to certain problems relating to equations of the elliptic type.—**Thadée Banachiewicz**: The determination of the orbit of Pluto.—**Benjamin Jekhowsky**: The trans-Neptunian planet Pluto.—**Maurice Robert**: Starting low tension dynamos.—**Pierre Chevenard and Albert Portevin**: The influence of reheating on the expansion and hardness of tempered aluminium-silicon alloys.—**J. Perreu**: The measurement of the vapour pressures of aqueous solutions of some hydrated salts. Measurements made by a differential method against water are given for solutions of sodium hyposulphite, sodium sulphate, and manganous chloride.—**Chapas**: The solubilities of some substituted benzoic acids in some chloro-aromatic hydrocarbons.—**Maurice Nicloux**: The determination of oxygen in sea water. A modification of Winkler's method requiring only 5 c.c. of sea water.—**Mlle. Jeanne Lévy and J. Sfiras**: The action of ammonia and of dimethylamine on the ethylene oxides of allylbenzene, phenylcyclohexene and their homologues.—**E. Urion**: The catalytic decomposition of divinylglycol by reduced copper.—**A. Mailhe and Renaudie**: The transformation of ethylene into liquid and solid hydrocarbons. The ethylene was passed over silica gel heated to 700° C.; a complex mixture of hydrocarbons was obtained with boiling points ranging from 75° C. to 330° C.—**Georges Brus and J. Vébra**: The transformation of camphene into isobornyl esters and the decomposition of bornyl and isobornyl esters into camphene. It is shown that the transformation of camphene into isobornyl esters is a reversible reaction, and consequently cannot be quantitative.—**R. Weil**: Observations on quartz.—**H. Derville**: Napoleon marble and its varieties.—**M. Tenani**: The tides of the eastern Mediterranean.—**G. Guittonneau and J. Keilling**: The separation of two soluble sulphur compounds in a soil rich in organic matter. The presence of hyposulphite and pentathionate has been proved.—**J. Risbec**: The duration of evolution in *Æolidia amœna*.—**A. Sartory, G. Hufschmitt, and J. Meyer**: A new mycosis caused by a yeast of the genus *Debaryomyces*: *Debaryomyces mucosus*.—**G. Cuvier and J. A. Carrère**: The action on cancerous subjects of extracts of tumours, administered by the mouth in small doses.

Aug. 11.—The president announced the death of A. J. Le Bel.—**Bigourdan**: Observations and co-ordinates of the Châtillon tower.—**Alayrac**: Extension of the method of conformal representation to movements in three dimensions.—**L. Brillouin**: Electrons in metals and the classification of the corresponding de Broglie waves.—**Louis Natanson**: The variations of relative intensity in the resonance spectrum of selenium.—**René Truchet**: The reaction of organo-magnesium compounds on the aryl sulphonchlorides. The principal reaction is $ArSO_2Cl + RMgX = Ar.SO_2.MgX + RCl$, the author confirming the work of Gilmann and Fothergill.—**P. Mondain-Monval and B. Quanquin**: The formation of peroxides in the direct oxidation of hydrocarbons by air. Hydrocarbons (pentane, hexane, octane) mixed with air and passed through a tube kept at 300° C. give, besides aldehydes and carbon dioxide, a yellow oily substance. This oil gives the reactions of a peroxide of the type of the methyl hydroperoxide of Rieche and Hitz, $CH_3.O.O.H$.—**G. Chalaud**: The first phases of the development of the gametophyte in *Lophocolea cuspidata* and in *Chiloscyphus polyanthus*.

Aug. 18.—**G. Bigourdan**: The observations of Méchain and of Saron. The co-ordinates of the Observatory of Colombes.—**Ch. Achard and M. Hamburger**: The proteins of the blood serum in some

anæmic conditions. Details of ten cases giving the number of red corpuscles, total proteins, serine, globuline, and, in five cases, the myxo-protein. In pernicious anæmia the diminution in the number of red corpuscles is always accompanied by a reduction in the serum proteins, and the latter increase when the number of red corpuscles goes up under treatment.—**Ch. Achard** and **I. Ornstein**: Some constituents of blood-serum in myxœdema. Analytical details of twelve cases.—**C. Gutton** and **E. Pierret**: Radiotelephonic transmission on waves of 17 cm. length. Details of apparatus giving successful transmission over a distance of 6·8 km.—**Edouard Callandreau**: Remarks on the elastic line of a bar loaded at one end.—**Albert Portevin** and **Etienne Pretet**: The influence of deformation on forging or hot rolling on the mechanical properties of steel.—**Thadée Banachiewicz**: A new method of determination of the orbit of a trans-Neptunian planet.—**A. Bogros**: The saturated vapour pressure of lithium. A modification of Knudsen's effusion method was employed; vapour pressures for six temperatures between 510° C. and 572° C. are given.—**Ny Tsi Zé**: The influence exercised by the X-rays according to F. Allison on the magnetic rotatory polarisation and on the properties of inactive liquids. In a field of 21,000 gauss, no confirmation of Allison's effect could be obtained with water, carbon disulphide, or nitrobenzene.—**A. Cotton**: Remarks on the preceding communication.—**B. Nitikin** and **L. Komleff**: The amount of radium in the petroleum waters of Baku and Daghestan.—**Mme. Pierre Curie** and **Georges Fournier**: A relation between the disintegration constant of radioactive elements emitting α-rays and their capacity of filiation.—**M. Prettre, P. Dumanois**, and **P. Laffite**: The oxidation and inflammation of mixtures of pentane and air. This hydrocarbon shows two points of inflammation, one between 260° C. and 300° C., the second between 660° C. and 670° C. In the first interval the gas mixture shows a blue flame, which disappears when the temperature is raised above 300° C.—**L. Bert** and **P. Ch. Dorier**: A new method of synthesis of cinnamic aldehyde and its homologues.—**Pan Tcheng Kao**: The micrography of piezoelectric quartz.—**E. Rothé, J. Lacoste**, and **Mlle. J. Roess**: Earthquakes in France in 1928 and 1929. Details concerning five earthquakes in 1928 and eight in 1929.—**Pierre Dangeard**: A labile iodo-complex produced by Laminaria.—**Marc de Larambergue**: The cytology of the autofertilisation of *Bullinus contortus*.—**H. Pénau** and **D. Santenoise**: The isolation and preparation of vagotonine, a new pancreatic hormone.—**E. Ducloux** and **Mlle. G. Cordier**: The study of certain humoral modifications arising in the course of experimental bovine marginal anaplasmosis.—**C. Labailly, G. Desbouis**, and **A. Voulland**: An efficacious method of treatment of one of the most widespread causes of infantile mortality in crèches: pneumococcic infection.—**F. Vlès, A. de Coulon**, and **J. L. Nicod**: New researches on the treatment of tar tumours in mice by certain amino-acids.—**Mme. N. Dobrovolskaia-Zavadskaia**, and **N. Kobozieff**: The lethal factor accompanying anuria and brachyuria in mice.

ROME.

Royal National Academy of the Lincei, April 27.

U. Cisotti: Isotropic tensors.—**M. La Rosa** and **L. Sesta**: A two-valve circuit emitting trains of discontinuous waves. The mode of action of a two-valve circuit coupled with a resistance amplifier is considered.—**G. Barba**: The functional equation $f(x).f'(x) - f[f(x)]$ related to a geometrical problem (2). The analytical solution to the problem of determining the form of the intrinsic equation of a curve in order that this may be similar to its own evolute is now considered in relation to the initial geometrical problem.—**F. Sbrana**: Characteristic properties of the infinitesimal operation in the group of derivations.—**G. Krall**: A general method for the approximate evaluation of the critical loads for beams of any type whatever.—**G. Natta**: The crystalline structure of hydrogen sulphide and hydrogen selenide (2). By means of the powder method and with the help of a special spectrograph adapted for low temperatures, it is found that at $-170°$ solid hydrogen selenide possesses a cubic unit cell of side $6·020 \pm 0·005$ A. and volume $218·2 \times 10^{-24}$ c.c., containing four molecules; the calculated density is 2·456. Hydrogen sulphide and hydrogen selenide exhibit analogous lattices of the fluorite type (spacial group, O_h5). Given the analogies in the structure and in the lattice dimensions of these two compounds, their perfect isomorphism may be anticipated. In calculating the intensities of the lines of the photograms of the compounds, better agreement with the experimental intensities are obtained on the assumption of an ionic structure.—**A. Ferrari** and **C. Colla**: Chemical and crystalline structures of certain complex nitrites. The triple nitrites of potassium and lead with copper, nickel, and cobalt respectively form monometric crystals, the unit cell containing four molecules. The values of a and of the calculated density are: $K_2PbNi(NO_2)_6$, 10·55 A., 3·50; $K_2PbCo(NO_2)_6$, 10·49 A., 3·66; $K_2PbCu(NO_2)_6$, 10·52 A., 3·56. The lattice of potassium cobaltinitrite is cubic and of the same type as the preceding: a 10·32 A., calculated density 2·73; the water found on analysis is probably water of impregnation of the lattice and not true water of crystallisation.—**C. Andreatta**: Bianchite, a new mineral. This mineral, which occurs on the goslarite of an artificial grotto of the Raibl mine, represents a new species of natural hydrated sulphate of the composition $FeSO_4$, $2ZnSO_4$, $18H_2O$. No distinct crystals were obtainable, but the compound appears to crystallise in the monoclinic system. The degree of hydration of the mineral under different conditions has been studied.—**A. Belluigi**: Physical characteristics of the marginal Apennine plain of Modena.

Official Publications Received.

BRITISH.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 2, 30th August. Pp. 117-219. (London: Edward Stanford, Ltd.) 5*s*.

The Journal of the Institute of Metals. Vol. 43. Edited by G. Shaw Scott. Pp. xii+838+40 plates. (London.) 31*s*. 6*d* net.

Ceylon Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for 1929. By Dr. Joseph Pearson. Pp. G18. (Colombo: Government Record Office.) 40 cents.

The Indian Forest Records. Entomology Series, Vol. 11, Parts 9 and 10: On the Genus Xyleborus. Part 9: Neue *Xyleborus*-Arten (Col. *Scolytidae*) aus Indien, von Hans Eggers; Part 10: The Biology of the Genus *Xyleborus*, with more New Species, by C. F. C. Beeson. Pp. 96+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2*s*. 3*d*.

Proceedings of the South London Entomological and Natural History Society, 1929-30. Pp. xx+82+2 plates. (London.) 8*s*. 6*d*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1302 (Ae. 445): The Stresses in a Radially Spoked Wire Wheel under Loads applied to the Rim. By Prof. A. J. Sutton Pippard and W. E. Francis. (T. 2910.) Pp. 43+17 plates. 2*s*. 3*d*. net. No. 1308 (Ae. 448): A Micromanometer of High Sensitivity. By E. Ower. (T. 2917.) Pp. 7+3 plates. 9*d*. net. No. 1312 (Ae. 451): The Stability of a Body towed by a Light Wire. By H. Glauert. (T. 2927.) Pp. 22+2 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1930-31. Pp. 72. (London.)

Oceania: a Journal devoted to the Study of the Native Peoples of Australia, New Guinea and the Islands of the Pacific Ocean. Published for the Australian National Research Council. Vol. 1, No. 1, April. Pp. 128. (Melbourne and London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Gold Coast Colony. Report on the Survey Department for the Year 1929-1930. Pp. ii+31+5 plates. (Accra: Government Printing Office; London: The Crown Agents for the Colonies.) 2*s*.

Journal of the Chemical Society. August. Pp. iv+1709-2036+xii. (London.)

FOREIGN.

Publications of the Manila Observatory. Vol. 1, No. 9: Meteorites in the Philippines. By the Rev. Miguel Selga. Pp. 52+2 plates. (Manila: Bureau of Printing.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 4, July. Pp. 281-322+4 plates. (Tokyo and Sendai: Maruzen Co., Ltd.) 1.00 yen.

Five Years of Research in Industry, 1926-1930: a Reading List of Selected Articles from the Technical Press. Compiled by Clarence J. West. Pp. 91. (New York: National Research Council.) 50 cents.

Ministry of Agriculture, Egypt: Cotton Research Board. Seventh Report, 1928. Pp. v+57+50 plates. (Cairo: Government Press.) 15 P.T.

U.S. Department of Agriculture. Technical Bulletin No. 195: Control of the Mountain Pine Beetle in Lodgepole Pine by the use of Solar Heat. By J. E. Patterson. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUES.

The "Clarostat" Book. Fifth edition. Pp. 48. (Liverpool and London: Claude Lyons, Ltd.)

A Large Selection of Books on most branches of Literature, including Notable Works from well-known Libraries and other Sources, recently Purchased. (Catalogue No. 529.) Pp. 108. (London: Francis Edwards, Ltd.)

Wild-Barfield High-Temperature Electric Furnaces for the Heat Treatment of High Speed Steel and General Purposes requiring temperatures up to 1400° C. (Section K.) Pp. 12. (London: Wild-Barfield Electric Furnaces, Ltd.)

Pituitary (Posterior Lobe) Extract B.D.H. Pp. 16. (London: The British Drug Houses, Ltd.)

Surveying and Drawing Instruments and Appliances. (Catalogue No. 564.) Pp. 266. (London: Casella and Co., Ltd.)

Diary of Societies.

WEDNESDAY, OCTOBER 1.

SOCIETY OF PUBLIC ANALYSTS (at the Chemical Society), at 8.—G. W. Baker: Scientific Evidence relating to Firearms, with Special Reference to a Recent Murder Trial. (As the author cannot be present, Mr. G. H. Perry has kindly consented to read the paper and to demonstrate the evidence.)—J. W. Croxford: The Composition of Rye Oil.—G. E. Lester Smith: The Determination of Unsaponified Oil in Soap or Fatty Acids.

THURSDAY, OCTOBER 2.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (in the Chemical Department, The University, Bristol), at 7.30.—Prof. J. W. Hinchley: Air and Water.

FRIDAY, OCTOBER 3.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Crispin: The Development of the Bridge.

SATURDAY, OCTOBER 4.

ROYAL SANITARY INSTITUTE (in the Assembly Room, Town Hall, Hereford), at 10.—Councillor Mrs. Luard: The Place of Women in Local Government.—G. H. Jack: The Preservation of the Countryside.—Councillor J. R. Barker: The Health Authority and the Milk Supply.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at the College of Technology, Manchester), at 4.—R. W. Stubbs: Presidential Address.

MONDAY, OCTOBER 6.

SOCIETY OF ENGINEERS (at Burlington House, Piccadilly), at 6.—Lieut.-Col. H. C. Hawkins: Some Impressions of America.

IRON AND STEEL INSTITUTE (Joint Meeting with the Cleveland Institute of Engineers) (at the Cleveland Technical Institution, Middlesbrough), at 7.30.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—J. Šarek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—L. W. Schuster: The Effect of Contamination by Nitrogen on the Structure of Electric Welds.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

TUESDAY, OCTOBER 7.

INSTITUTE OF METALS (Birmingham Local Section) (in Chamber of Commerce, Birmingham), at 7.—T. G. Bamford: Chairman's Address.

IRON AND STEEL INSTITUTE (Joint Meeting with the Lincolnshire Iron and Steel Institute) (at the Secondary Schools, Doncaster Road, Scunthorpe), at 7.—F. Bainbridge: Developments in Fuel Economy at Skinningrove.—J. A. Jones: Chromium-Copper Structural Steels.

IRON AND STEEL INSTITUTE (Joint Meeting with the Sheffield Metallurgical Association) (at 198 West Street, Sheffield), at 7.30.—D. F. Campbell: High-Frequency Steel Furnaces.—W. H. Hatfield: Permanence of Dimensions under Stress at Elevated Temperatures.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.

WEDNESDAY, OCTOBER 8.

ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street, W.C.2), at 6.30.—Report on Progress in Illuminating Engineering, and Display of Exhibits illustrating Recent Developments in Illumination.

INSTITUTION OF CHEMICAL ENGINEERS (in the Chemical Society's Rooms), at 8.—Dr. Saral J. Kohli: The Effect of Surface Conditions on Heat Transmission.

THURSDAY, OCTOBER 9.

ROYAL AERONAUTICAL SOCIETY (in the Lecture Hall of the Royal Society of Arts), at 6.30.—C. R. Fairey: The Growth of Aviation.

INSTITUTE OF METALS (London Local Section) (at Society of Motor Manufacturers and Traders, Ltd., 83 Pall Mall), at 7.30.—W. T. Griffiths: Chairman's Address.

INSTITUTION OF WELDING ENGINEERS (at the Engineers' Club, Albert Square, Manchester), at 7.45.—J. Ryder: The Training of Operators in the Welding and Cutting Industries.

FRIDAY, OCTOBER 10.

ROYAL SANITARY INSTITUTE (in the Guildhall, Nottingham), at 4.30.—Alderman A. R. Atkey: River Pollution.—Dr. L. P. Lockhart: Industrial Medicine in Relation to Public Health.

IRON AND STEEL INSTITUTE (Joint Meeting with the Local Branch of the South Wales Institute of Engineers) (at the Royal Metal Exchange, Swansea), at 7.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. Dunlop: The Refining of Cane Sugar.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, University, Sheffield), at 7.30.—Conjoint Meeting for the Sixth "Sorby" Lecture.

SATURDAY, OCTOBER 11.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at the Technical College, Burnley). F. Griffiths: Belgian Moulding Sands in the Iron Foundry.

PUBLIC LECTURES.

MONDAY, OCTOBER 6.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Types of Pneumococci in Adults and Children and their Significance (Harben Lecture 1).

TUESDAY, OCTOBER 7.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Epidemiology; the Refining of Antipneumococcus Serum (Harben Lecture 2).

KING'S COLLEGE, LONDON, at 5.—Dr. J. W. Pickering: Blood Plasma and Platelets. (Succeeding Lectures on Oct. 14, 21, and 28.)

WEDNESDAY, OCTOBER 8.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Therapeutic Use of Vaccines and Antibacterial Sera (Harben Lecture 3).

THURSDAY, OCTOBER 9.

KING'S COLLEGE, LONDON, at 5.15.—Rev. Dr. N. Sykes: The Age of Reaction and Reconstruction (1815-65).

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. H. Spemann: Introduction to the Theory and Practice of Experimental Embryology (in English). (Succeeding Lecture on Oct. 10.)

CONGRESS.

SEPTEMBER 29 TO OCTOBER 1.

FARADAY SOCIETY (in Laboratory of Physical Chemistry, Cambridge).—Discussion on Colloid Science applied to Biology.

Monday, Sept. 29, 2 to 4 and 4.30 to 7.—Equilibrium in Protein Systems. In Chair—Sir William Hardy, who will introduce the Discussion.

Prof. A. V. Hill: Membrane-Phenomena in Living Matter Equilibrium or Steady State.

Dr. R. A. Gortner: The State of Water in Colloidal and Living Systems.

Prof. E. J. Bigwood: Distribution of Diffusible Ions in Gels.

Prof. W. Pauli: The Behaviour of Proteins towards other Colloids and towards Electrolytes.

Prof. F. F. Nord: The Biological Significance of the Physical Influence of Gases on Colloids.

Tuesday, Sept. 30, 10 A.M. to 11.15 A.M., 11.30 A.M. to 1 P.M., 2.30 to 4, and 4.30 to 7; and

Wednesday, Oct. 1, 10 A.M. to 1 P.M.—In Chair—Sir F. Gowland Hopkins, who will introduce the Discussion.

Dr. Honor B. Fell and Dr. Wilmer, followed by Kinematograph Studies of Living Cells by Dr. Canti: The Structure, Behaviour and Physiological Characteristics of Vertebrate Cells cultivated *in vitro*.

Prof. E. Faure-Fremiet: The Kinetics of Living Matter.

Prof. R. A. Peters: Surface Structure in the Integration of Cell Activity.

Prof. O. Warburg: Surface Reactions in Living Cells.

Prof. H. Pfeiffer: Isoelectric Point of Cells and Tissues.

Dr. A. von Muralt and Dr. J. Edsall: Double Refraction in Protein Systems.

Dr. J. H. Quastel: The Mechanism of Bacterial Action.

Other speakers will be: Prof. E. F. Burton, Prof. J. Duclaux, Prof. H. Euler, Prof. H. Freundlich, Prof. H. R. Kruyt, Prof. H. Lundegardh, Dr. P. Lecomte du Nouy, Prof. W. J. V. Osterhout, Prof. Wo. Ostwald, Prof. and Mme. Jean Roche, Dr. Straub, and Prof. T. Svedberg.

SATURDAY, OCTOBER 4, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Science and Society.

Among the subjects discussed at the recent meeting of the British Association, few have attracted so much interest or comment as the relation of science to unemployment and to labour. The question was fairly raised in Prof. T. E. Gregory's presidential address on "Rationalisation and Technological Unemployment", and his assertion that rationalisation, one of the most popular remedies for unemployment, may in itself be one of the causes producing the evil, was not seriously challenged in the discussion which followed. If, therefore, we have to admit that the elaboration of scientific methods of production and management is increasing, even if temporarily, the volume of unemployment, it is at least intelligible that labour should be dubious about acknowledging or accepting that leadership of science which we have frequently discussed in these columns.

There is, indeed, in the present situation much to excuse a passing reflection that perhaps, after all, the people of Erewhon were wiser than ourselves in destroying their machines, lest, as Marx predicted, the machines reversed the original relation and the workmen became the tool and appendage of a lifeless mechanism.

There is a popular fallacy, to which Sir Richard Gregory alluded in his recent address to the Bristol branch of the Independent Labour Party, which regards science as synonymous with mechanical invention, and therefore as largely responsible for the mechanisation of the age and its attendant evils. From this point of view the undoubted increase in the volume of unemployment which has accompanied the improvement of the means of production may well be regarded as a high price to pay even for the elimination of some of the grosser forms of labour to which in the past men were compelled to submit. To-day in the Ruhr ninety per cent, and in Belgium eighty per cent, of the coal produced is mined with pneumatic picks, and the mine of the future will probably be a brilliantly illuminated underground workshop, operated by electricity, the miner a skilled mechanic. The magnetic crane enables a workman to operate from a control-house at one time tons of pig-iron which formerly men handled in discomfort, pig by pig. The comfort and the welfare of the few, on this view, may, however, be too dearly purchased when we consider the lot of the displaced workers, and perhaps still more the repression of individuality and the retarded development which, as Marx predicted, have often accompanied mass production. Moreover,

although, contrary to prediction, the hours of labour have been shortened and not lengthened, and the standard of living has been raised considerably, in the modern Press, and in certain phases of broadcasting and the cinematograph, mechanical science has tended to project its mechanising influence into hours of leisure and intensify that mechanisation of the mind which is one of the symptoms and evils of our age.

If science, therefore, were nothing but mechanical invention, it would not be easy to plead that civilisation requires not less but more science in the control of affairs. The truth is that inventive ingenuity has often little in common with science, and even in the case of mechanical science, which is only one branch of science, unsatisfactory social conditions are a consequence not of scientific discoveries and advances, but of incapacity to use them aright. On the other hand, the discoveries with which in every branch of science scientific workers are most closely associated are creative discoveries, and these are responsible not for displacing labour, but for creating new demands and new industries in which labour is absorbed. Nearly a hundred years ago the discoveries of Faraday in the laboratory of the Royal Institution provided the fructifying idea which soon bore fruit as the dynamo. From these purely scientific discoveries has developed the vast electrical engineering industry, which in its light, power, and traction companies, electrochemical plant, and the companies manufacturing electrical equipment and apparatus, provides employment for millions of workers.

The radio industry is similarly the outcome of the scientific researches of Maxwell and of Hertz on the properties of electromagnetic waves, and the film industry, the automobile industry, the rayon, the aircraft, and the synthetic ammonia industries are all the result of fundamental scientific investigations, the practical importance of which was undreamt of at the time. Yet to-day, as Dr. Little pointed out in his presidential address to the Society of Chemical Industry at Manchester last year, each of these industries employs thousands of workers, reaching more than four million in the case of the automobile industry.

It is to creative science that society must look for the best hope of an ultimate solution of the unemployment problem. Indirectly, therefore, the problem of unemployment is linked with the problem of fostering the most vigorous intellectual activity among scientific workers and attracting into the service of science the most able minds the present generation can provide. Conditions which tend to lower the standard of recruitment for the various branches of the profession of science may react dangerously upon the welfare of the community. If full contact is secured between the finest type of such scientific work and industry, a fertilisation of industrial research will result from which all branches of the community must and will benefit.

So competent an observer as Prof. Henry Clay remarks in this connexion that industrial expansion takes place less as the result of the establishment of entirely new firms to exploit new processes and new demands than as a result of existing firms, which are making profits by the efficiency of their management, applying these profits to finance expansion in new directions. It would seem that only through the rationalisation of industry can creative science exert its full influence in expanding employment.

It is significant that the recent Trades Union Congress has shown some appreciation of this fact, and in his presidential address Mr. John Beard pointed out that the unemployment situation must be judged in relation to the last quarter of a century's concentration upon invention and scientific discovery. Mr. Beard went on to urge the need of a bolder, more *scientific*, and more energetic attack on the problem of unemployment than had been thought of so far. The emphasis placed upon industry rather than upon politics by this Congress encourages the hope that labour will tend more to assist in the process of industrial growth and not limit its discussions to the distribution of profits.

The more carefully the problem is considered, the clearer it becomes that defective leadership is largely responsible. Over-production is not so much a necessary consequence of the more rapid and abundant production of goods made possible by scientific invention as of the errors in judgment on the part of those who assumed the risks and direction of industry. Prof. Henry Clay, in the discourse before the Royal Institution to which we have already referred, described over-production as the production of more than can be sold at the price anticipated when production was undertaken, and points out the effect of such failure in checking further production.

Such failures in judgment must not, however, necessarily be interpreted as involving culpable negligence on the part of those responsible. They are merely an example of the far-reaching effect of human mistakes in industry and in politics to-day. Society probably still suffers less from the evil

wrought by heartlessness than from the inability of the individual human factors to comprehend the complexities of the situations and their reactions in a world which science in one sense has bound so closely together. Modern technical achievement and scientific thought foreshadow a new economic structure for society, and the greatest danger to civilisation to-day is the divorce between science and politics. There is little hope for society unless its political institutions are sufficiently elastic to allow scientific and technical knowledge to exercise decisive influence upon the major policies of the State.

Modern society suffers from two evils, of which the unemployment problem is only one symptom. The first is its inability to control the results of its own thinking, as exemplified in the achievements of modern science, pure and applied. A main task of our epoch is the reconciliation of industrial and political practice with progressive scientific thought. Neither the disarmament problem nor the unemployment problem, for example, would present the same problem in the world to-day if the scientific thought, the application of which has revolutionised the conditions of warfare and of industry, exercised its proper and rational influence in political and diplomatic quarters. Fulfilment of such tasks involves wise direction of mechanisation, and this is the fundamental case for scientific management. The freer the play of creative scientific thought, the easier industry in particular and society in general will find the transition or adjustment to reasonable social conditions under the impact of the new economic forces.

Perhaps still more important is the contribution of creative science to the amelioration of that other evil of society, the mechanisation of mind, which, originating under the conditions of mass production, is often perpetuated into the hours of recreation by such agencies as the Press, the cinema, and even broadcasting. The loss of the power of self-amusement, the absence of the knowledge of the right use of its increased leisure, are characteristic of the age, and there is no more urgent duty than the encouragement of individualism. The fountain-heads of human progress, from Plato onwards, have been the fundamental thinkers, and the problem is not only to bring thought of this quality into closer touch with public affairs, but also to enable the common man to appreciate more vitally the quality of such thinking. The more standardised the conditions of labour become for the mass of mankind, the less the demand for handicraft and the creative spirit during the hours of employment, the more important it is for society that the common man should be stimulated to self-expression in his hours of leisure.

The application of that stimulus may not be left to art alone. Science must bring to sociology that spirit of adventure and experiment which have ever led to those great creative discoveries from which mankind has reaped the greatest benefit, whether of thought or of action. The most startling and successful pieces of reconstruction in the post-War world have resulted from the handling of complicated economic, social, and international problems along new rational and scientific lines. Efficient organisation is an indispensable factor in human progress to-day, but originality of thought and character are still its mainsprings. Such thought and such character can bring into the rationalisation movement to which industry is bound that humanising influence and elasticity which can make it the liberator and benefactor of industry and not its tyrant.

If there is a sense in which science, through the uncontrolled development of its mechanical applications, has seriously threatened the physical and mental development of man, it is still to the free play of creative scientific thought in industry, in politics, in society, that we must look for the liberation of man from mechanisation and for the control of the material and economic forces in his environment which at times assume such threatening proportions. In truth, science, after liberating the world from the thraldom of baser superstition and the irrational fear of natural phenomena, has made the continued expression of certain of man's acquisitive and combative instincts in industrial and international rivalry inconsistent with the safety of civilisation. It has now the task of revealing to man the channels in which his instincts and individuality can find a safer and a finer expression in co-operation in the exploration of yet unravelled secrets of Nature, the conquest of disease, and of those other factors in his environment which still take their toll of human life and happiness.

It is creative science which must lead society in that search of truth for the control of Nature and transformation of matter for the service of mankind, the liberation of the human spirit from ignorance, superstition, and slavery to the forces of Nature, and the reformation of social and political institutions for the benefit of the greatest number, which Hu Shih declared to be the characteristic of an ideal and spiritual civilisation.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Phenomenon in the Change of Resistance in a Magnetic Field of Single Crystals of Bismuth.

FROM many investigations it is well known that bismuth shows very variable behaviour. We have investigated a very pure specimen; Hilger's bismuth was purified still further. The crystals made from this material proved to be excellent. With X-rays they show very sharp interference spots or lines, and when compressed nothing could be observed of the phenomenon of 'cracks' as described by Borelius, Lindh, and Kapitza (*Proc. Roy. Soc.*, A, vol. 119, p. 366; 1928). From these crystals we measured the change of resistance in the magnetic field at different temperatures.

First we determined the change in resistance of several crystals having the principal axis parallel to their length. The current flows in the length direction of the crystal. The rod is put in the magnetic field with its length (that is, principal axis) at right angles to the lines of force of the field, and it is possible to turn it round an axis coinciding with the principal axis.

We determined the curves giving the change of resistance as a function of the intensity of the magnetic field, when one of the binary axes was either parallel to or at right angles with the field. These curves show a very complicated form, extremely so if the binary axis is at right angles with the field.

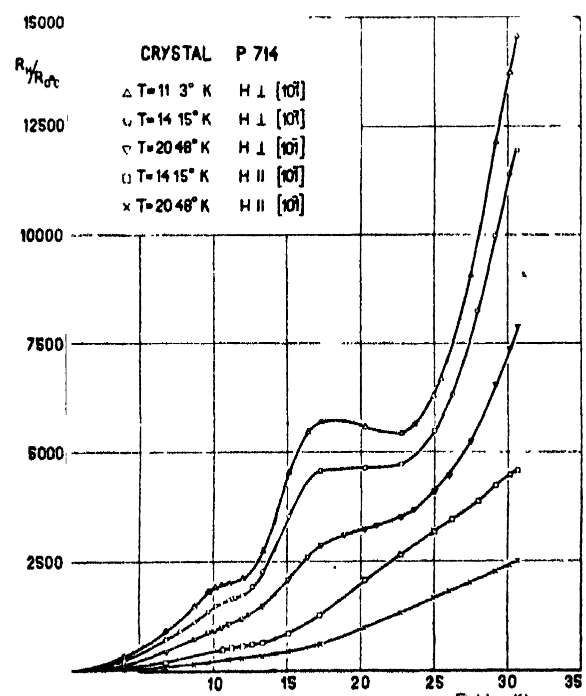


FIG. 1.

In Fig. 1 these curves are given for the temperatures 20·48° K., 14·15° K. and 11·3° K. The abscissæ are the intensities of the magnetic field; the ordinates are the values of $R_H/R_{0°\,C.}$ R_H is the resistance in the magnetic field at low temperatures; $R_{0°\,C.}$ the resistance without a field at 0° C. It will be seen that the curves do not show a parabolic part in the beginning which gradually changes into a linear part at higher field strengths. It has been found that the whole phenomenon strongly depends on temperature: at higher temperatures the curves become more and more simple. This can already be seen at 20·48° K. Here the first flat part found at about 9·5 kilogauss, and prominent at 11·3° K., has nearly disappeared. Measurements at higher temperatures, for example, 64·25° K. and 77·40° K., show a very simple curve, just as has been found hitherto at all temperatures.

In order to investigate the phenomenon more thoroughly we measured the change of the resistance, keeping the field constant, but changing gradually the angle between a binary axis and the lines of force, and

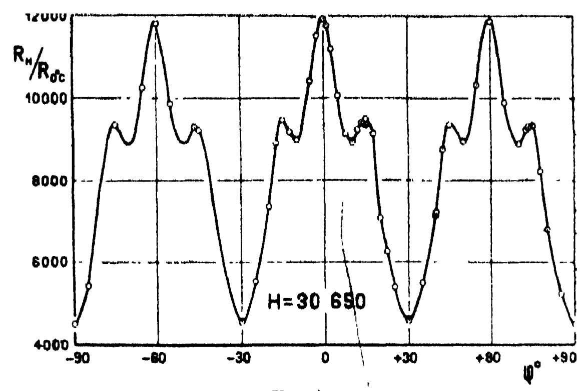


FIG. 2.

reading the resistance and the angle after each displacement. In Fig. 2 the abscissæ are the angle ϕ, between the crystallographic direction [112] in the crystal and the lines of force, ordinates are the values of R_H/R_{0} C. at those different angles, in a field of 30·650 gauss at a temperature of 14·15° K. This curve does not show cosine form, but gives a much more complicated relation of the resistance to small changes of the angle. Simple cosine curves have been found only at very low field strengths. At higher temperatures we do not find the complicated form.

We are now investigating some crystals having two different orientations. Both these orientations have the principal axes at right angles with the length of the crystal. For the first orientation, the length coincides with the direction of a binary axis (and with the axis round which the crystal can be turned, it being also at right angles with the lines of forces and coinciding with the direction of the current). For the second one all this is the same, but the length coincides now with the direction of a bisectrix of two binary axes. Here, too, we investigated the change of resistance with temperature, field strength, and angle of the principal axis with the field. The most important result of these investigations is that the curves have much in common with those given above for the other orientation (Figs. 1 and 2).

Here, too, we find at low temperatures that the resistance in the field changes rapidly with small changes of ϕ. This phenomenon disappears only when we pass to high temperatures and to weak magnetic fields. Of course the form of the curve giving $R_H/R_{0°}$ C. as a function of ϕ is in this case quite different from the one given in Fig. 2.

The results are very much influenced by the purity of the material used for the crystals. As an indication of this purity, it may be stated that our crystals show at 1·3° K. a resistance having a value of some thousandths of that at 0° C. At 11·3° K. the resistance in a magnetic field of 31 kilogauss is 922·000 times higher than that without the field.

L. SCHUBNIKOW.
W. J. DE HAAS.
University of Leyden.

Intensity of Total Scattering of X-Rays by Monatomic Gases.

RAMAN (*Indian J. of Phys.*, **3**, 357; 1928) and A. H. Compton (*Phys. Rev.*, **35**, 925; 1930) have calculated according to classical electrodynamics the scattering of X-rays by an atom in which the electrons are arranged with random orientation and with arbitrary radial distribution. The intensity of the X-ray scattered at an angle θ to a distance R is given by

$$I_\theta = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}\left\{Z + (Z^2-Z)\left[\int_0^a 4\pi r^2 p(r)\frac{\sin kr}{kr}dr\right]^2\right\} \qquad (1)$$

where I is the intensity of the primary beam, $k=(2\pi/\lambda)\sin\frac{\theta}{2}$, $4\pi r^2 p(r)$ is the probability that any electron shall lie between r and $r+dr$ from the nucleus, a is the maximum radius of the atom, and Z, e, m, and c have their usual significance. In comparison with Wentzel's theory of X-ray scattering, Compton has separated I_θ into two parts, namely, I_1 representing the intensity of coherent scattering and I_2 the intensity of incoherent scattering, where

$$I_1 = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}Z^2F^2, \qquad I_2 = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}Z(1-F^2),$$

and
$$F = \int_0^a 4\pi r^2 p(r)\frac{\sin kr}{kr}dr.$$

Raman (loc. cit.) has come to the same conclusion from simple classical considerations. When corrected for the change of wave-length, equation (1) becomes (cf. Compton, loc. cit.)

$$I'_\theta = \frac{I_2}{[1+\gamma(1-\cos\theta)]^3} + I_1 \qquad (2)$$

where $\gamma = h/mc\lambda$. We expect this formula to give a closer approximation to the intensity of the total scattering.

If instead of the probable position of a single electron, we regard $4\pi r^2 Zp(r)dr$ as the probable number of electrons between r and $r+dr$, we see therefore that the calculation of the intensity of the total scattering depends entirely on the evaluation of the radial charge distribution of the electrons in the atom. It is well known that Thomas (*Proc. Camb. Phil. Soc.*, **23**, 542; 1927) and Fermi (*Zeit. f. Phys.*, **48**, 73; 1928) have independently derived an approximate expression for the charge distribution of the electrons in the atom by considering the electrons as a degenerate gas surrounding the nucleus, an idea which seems to be in accordance with the atomic model postulated by Raman and Compton in deducing equation (1). If the charge density of the electrons in the atom evaluated by the Thomas-Fermi method is substituted in place of $Zp(r)$ in equation (2), the intensity of the total scattering for any scattering angle can be numerically calculated. Owing to the interference effect due to neighbouring atoms in diatomic molecules, we expect equation (2) to be directly applicable only to the scattering of X-rays by monatomic gases and vapours. A calculation has been made of the intensity of the scattering of X-rays by helium and argon, and the results are compared with the experimental data recently obtained by Barrett (*Phys. Rev.*, **32**, 22; 1928) in Fig. 1, where the scattering per electron is plotted against the scattering angle θ.

While the curve I represents the scattering from helium for a wave-length equal to 0·49 A., the curves II and III represent the scattering from argon for wave-lengths equal to 0·40 A. and 0·48 A. respectively. The classical theory of J. J. Thomson for the scattering from a single electron is plotted as the broken curve marked C. Since Barrett's measurements give relative values of scattering per electron for different angles and for different gases, but not absolute values, so in each case the experimental data have been multiplied by an arbitrary factor throughout. It is seen that the agreement between theory and experiment seems to be satisfactory.

Recently Waller and Hartree (*Proc. Roy. Soc.*, A, **124**, 119; 1929) investigated theoretically the intensity of total scattering of X-rays by atoms of a monatomic gas on the basis of quantum mechanics. For the case of argon a strict comparison of their

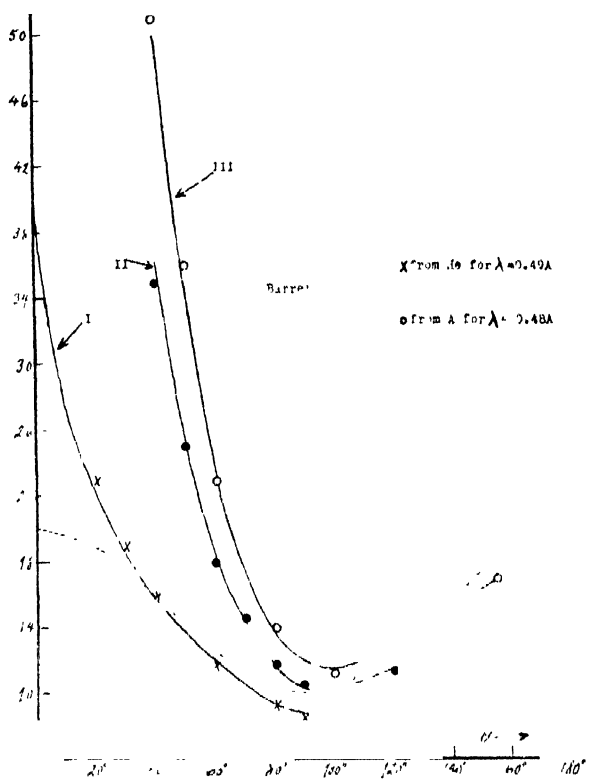


FIG. 1.

calculation with Barrett's results seems not to be possible. This is ascribed by these authors to the fact that the wave-lengths used by Barrett are rather short, so that for the experimental results 'relativity effects' are appreciable, whereas in their derivation of the theoretical formula these effects are completely neglected. A comparison of Waller and Hartree's results for argon with those of the present calculation indicates that the absolute value of the intensity of scattering per electron for the large angle of scattering given by Waller and Hartree is much higher than that calculated according to equation (2). Unfortunately, no experimental data are available to decide this point. Moreover, owing to the factor introduced to correct for the change of wave-length, equation (2) shows that the quantity R defined by Waller and Hartree is not a function of $\sin\frac{\theta}{2}/\lambda$ only, a result not in agreement with the conclusion drawn by these authors.

Finally, it may be remarked that by the method outlined above the scattering by all monatomic gases and vapours can be approximately estimated. I have evaluated numerically the scattering from helium,

argon, neon, krypton, sodium, potassium, and mercury for molybdenum $K\alpha$ and copper $K\alpha$ radiation and experiments are in progress to test these results.

A detailed account of this work will be published elsewhere.

Y. H. WOO.

Department of Physics,
National Tsing Hua University,
Peiping, China, July 28.

Raman Effect in Hydrogen Sulphide.

THE Raman spectrum of hydrogen sulphide, both in the gaseous and liquid states, has been successfully photographed by me. The liquid exhibits a single intense and quite sharp line shifted by 2578 wave-numbers from the exciting mercury radiation. With the gas, the line appears in a slightly different position, with a frequency shift of 2615 wave-numbers, and is distinctly more diffuse than in the liquid. According to Barker and Meyer (*Trans. Far. Soc.*, **25**, 912; 1929) the infra-red absorption spectrum of gaseous hydrogen sulphide shows a complex band at about $3\cdot7\,\mu$ which evidently represents the superposition of rotation on this vibrational frequency. The plates for both the liquid and the gas showed indications of other faint lines or bands which were adjacent to the exciting mercury radiations and presumably could be ascribed to a rotational Raman effect. It may be remarked that the line observed with the liquid hydrogen sulphide is identically in the same position as a prominent line obtained in the Raman spectra of a series of organic hydro-sulphides studied at Calcutta by Venkateswaran, and also in its frequency shift with an important infra-red absorption frequency of these compounds.

S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta,
Aug. 9.

Pearl-like Object found in a Prawn.

IN 1910 Prof. F. H. Herrick, of the Western Reserve University, Cleveland, brought to the notice of the scientific world, through the columns of the *American Naturalist* (vol. 44, pp. 294-301), the very interesting find of a pearl-like structure embedded in the muscles inside the claw of a lobster. The object, which was believed to be unique, was first examined by some pearl dealers, and declared to be a true 'lobster pearl'. It was more or less spherical, with one flat side, and was 11 mm. in diameter. Its specific gravity was 1·45 and hardness 'about 3'. After a careful examination of the object, Prof. Herrick came to the conclusion that the 'pearl' was only an ingrowth of chitin due to some "vagary of the process of regeneration".

Recently a similar 'pearl' has been brought to me by Mr. D. D. Mukerji, of the Zoological Survey of India. It was really discovered by his sister, Miss Jutheca Mukerji, who, while eating a prawn (a small Peneid), felt something hard between her teeth. As only the abdominal region of the prawn is eaten, it seems evident that the 'pearl' must have been embedded in the thick abdominal muscles.

The 'pearl' is spherical in shape, with slight protuberances and hollows. There are two or three fairly large irregular depressions on the surface, but these are probably due to some mechanical cause, perhaps to the action of the teeth while the prawn was being eaten. The 'pearl' is more or less uniformly round, without any flat pole. It is slightly less than 3 mm. in diameter and its absolute weight is 0·0174 gm. Its specific gravity is about 1·32 and the refractive index 1·558. It is practically colourless and has a somewhat pearly lustre. It is transparent and has no nucleus. Its hardness is about 2·5. Dr. J. A. Dunn, Curator, Geological Survey of India, who has kindly measured the specific gravity, refractive index, etc., for me, is of the opinion that it is made of material which "grew radially from the centre, the crystalline direction radiating outwards from the centre, so that the sphere shows a dark cross between crossed nicols, which rotates with the nicols, analogous to a radiating fibrous mineral". On a careful examination the 'pearl' appears to be formed of close concentric layers. The outer surface is covered throughout by extremely fine meridional striations, and in places, when the outer layer is broken, the striations can be seen on the inner strata also. Another remarkable feature of the 'pearl' is that it is apparently some-

FI . 1.—Pearl-like object (enlarged) from a prawn.

what porous. In the course of the specific gravity tests, spread over two or three days, it absorbed 0·0004 gm. of water, the weight returning to normal (0·0174) on its being allowed to dry.

There seems to be scarcely any doubt that the 'pearl' is made of chitin, similar to the hard shell of the prawn. Sollas has shown (*Proc. Roy. Soc. London* (B), 79, pp. 474-481; 1907) that the specific gravity of chitin precipitated from its solution in strong acids approximates to the value of 1·398, and that its refractive index lies between 1·550 and 1·557. In the present case the refractive index agrees with the figure given by Sollas, but the specific gravity is somewhat lower, which may perhaps be due to the concentric formation of the object and its apparent porosity to air and water.

Apart from its lower specific gravity, the present 'pearl' differs from that examined by Herrick in one or two very important respects. The previous specimen had a flat end, which, according to Herrick, represented its place of attachment with the outer shell; the present 'pearl' does not show any signs of ever having been attached. The latter is also formed of close concentric layers, while Herrick's specimen was apparently one homogeneous mass. Further, the surface of the 'pearl' examined by Herrick was punctate, the punctations, according to Herrick, representing the 'hair-pores' of the crustacean shell; in my specimen there are only very fine close striations on the surface.

It is very difficult to express any definite opinion about the origin of this curious object. Herrick was of the opinion that it must have been formed by an ingrowth or pocketing of the outer shell due to some mechanical injury, probably soon after a moult. As

a connexion would be retained with the outer shell, this would involve the shedding of the 'pearl' at the next moult, and unless the irregularity of growth is obliterated, similar structures would be formed and shed at subsequent moults. The present specimen, however, does not show any point where it could have been attached to the shell. Further, the apparently concentric nature of its formation suggests that layer after layer of chitin has been added at each moult. It seems possible, therefore, that some cells of chitin-producing epithelium may have got pushed into the mesoderm, probably due to some injury when the skin was soft; and the connexion with the outer shell being cut off, the cells went on producing chitin, and, according to their function in normal conditions, went on adding layers at subsequent moults. There is still another, though remote, possibility. It is conceivable that some of the mesodermal cells themselves, as a result of some peculiar, unknown stimulus, have taken on the function of the chitinogenous epithelial cells. Differentiation and dedifferentiation of tissues is known to occur at the time of regeneration, metamorphosis, and similar phenomena. Perhaps something similar has happened in this case also.

My best thanks are due to Dr. J. A. Dunn for all the help he has so kindly given me.

B. N. Chopra.

Zoological Survey of India,
Calcutta.

Eugenic Sterilisation.

As a member of the Committee of the Eugenics Society for Legalising Eugenic Sterilisation, I should like to be allowed to say a few words concerning the leading article in Nature of Aug. 30 on our proposals. It is stated there: "Is there not a real danger that the advocates of such legislation as here may mistake the assent of the political machine for victory? If assent were gained, would it not be much more accurately determined as the hall-mark of failure? It is not the assent of the State, but the initiative and creative power of the State, that is needed to secure essential progress. . . ."

With the last sentence I entirely agree; but I fail to perceive how a step in the right direction can be regarded as the hall-mark of failure—unless, indeed, the Committee should be so stupid as to believe that the taking of this one step had brought us to our final goal, which is certainly not the case. The article opens with references to the difficulties in the way of progress which are created by timid and ignorant public opinion, and continues, "if, as Sir Walter Fletcher has lately pointed out, a mere ailment, like cancer, has only been made accessible to scientific study through the lifting of foolish and superstitious taboos, how can we expect the direr social maladies to be approached courageously?" I think I can speak for the Committee in saying that we realise to the full the extent of these intangible difficulties, and that it is precisely for that reason that we have concentrated on a small but tangible and urgent beginning. Somehow or other the public has to be made race-conscious, has to be imbued with the eugenic idea as a basic political and ethical ideal. We believe that a campaign of the kind we have launched, directing attention to a gross racial defect, will be the best possible way of turning their thoughts in the desired direction.

Comment is also made on the fact that the prevention of reproduction by all defectives would only lower the incidence of mental defect by about 17 per cent in one generation. The article fails to remind readers that the process is cumulative, and also does not point to any other way in which it could be reduced more rapidly. Finally, the most relevant fact of all is omitted, namely, that one of the greatest obstacles to securing assent to the sterilisation of defectives has been and is the widespread belief that, since two normal persons may have a defective child, therefore preventing defectives from reproducing will have no effect on the proportion of defectives in later generations. Dr. R. A. Fisher has gone carefully into the matter, and has shown that, even when the most unfavourable assumptions are made, prevention of reproduction by all defectives would result in a reduction of some 17 per cent—which to me at least seems considerable, as it would mean that there would be above 50,000 less defectives in Great Britain after the lapse of the, biologically speaking, trivial span of one generation.

I am glad that Nature has directed attention to the gravity of the problem, and look forward with interest to further discussion of the problem in its columns.

J. S. Huxley.

King's College, London, W.C.2.

Prof. Huxley's letter leaves some doubt as to whether he is really in any fundamental disagreement with the article to which he refers. If he is, it is over the use made by the Committee of Dr. Fisher's calculation. Further discussion: yes, by all means. Only, it is rather inconvenient to have to keep an eye upon changing terms. The minimum reduction of the incidence of defectiveness of 17 per cent in a generation promised by Dr. Fisher is conditional upon the prevention of *all primary aments* from breeding. It was the contention of the article that the Committee's measure did not provide for the satisfaction of this condition. Prof. Huxley, like the Committee and the signatories to the letter to the *Lancet*, ignores this condition. In the last paragraph but one of his letter, Prof. Huxley says: "Dr. R. A. Fisher . . . has shown that, even when the most unfavourable assumptions are made, prevention of reproduction by all defectives would result . . ." The reader is left to assume that the "small but tangible and urgent" beginning would lead to this result, whether a 17 per cent decrease or more.

If the voluntary principle, emphasised so strongly by the Committee, is to operate, the fertility of "all living mental defectives" will not be prevented, and that is the condition underlying Dr. Fisher's calculation. Experience of the ways of the relatives of defectives and the insane would lead most people to the conviction that they are far from tractable. Ascertainment, again, the basis of the English figures, shows an amplitude of variation that suggests very serious differences in the efficiency of investigators or in the sense of responsibility of elected persons. In such matters the Committee aims at improvement.

It was certainly not intended to suggest that the Committee is stupid. The criticism is directed towards the machine it is trying to use. While the political wedge is often held to possess the same properties as its mechanical prototype, its thin edge seems at times to acquire graft-like properties which inhibit rather than facilitate further progress.

If the eugenic problem were only a biological problem, a generation would be, of course, a trivial span. It is often held to be a social problem as well, a problem created by man in the very short time that he has been occupied in making it possible for several men to live where one lived before. If that is true, should correctives be allowed to lag?

The present state of the law is so absurd that one would think the self-respect of legislators would secure its alteration.

The Writer of the Article.

Microphotometric Analysis of Movietone Sound Records.

IN a letter published in a recent number of NATURE (July 19, p. 93), Dr. Louis V. King announced a method of microphotometric analysis of movietone sound records. Evidently Dr. King has overlooked that this method was described by me seven years ago in a paper, "Photographic Recording and Photoelectric Reproduction of Sound", published in the *Transactions of the Society of Motion Picture Engineers*, No. 16, 1923. On page 113 of the paper, Fig. 24 serves to illustrate this method of sound analysis. A comparative study of analysis of sound records by means of Moll's thermoelectric microphotometer and Koch's photoelectric microphotometer was made in 1927. A brief report thereof was published in the *Bulletin of the American Physical Society*, vol. 4, p. 2, April 1929, and also in the *Physical Review*, vol. 33, p. 1094, 1929, under the title "Application of Microphotometers for the Analysis of Photographic Sound Records".

J. T. TYKOCINER.

Electrical Engineering Laboratory,
University of Illinois,
Urbana, Illinois, U.S.A., Aug. 16.

I AM greatly interested in Prof. J. T. Tykociner's comment on my short letter to NATURE on the microphotometric analysis of movietone sound records. Had I known of his work on the subject, I should certainly have referred to it. In view of some fog-alarm tests I was planning at the time, the purpose of the letter was to bring out any work which might have been done along these lines, as well as to direct the attention of lighthouse engineers to the extremely convenient method of recording the performances of fog-alarm installations afforded by the use of the movietone camera. I do not believe, however, that the records would have their full value without the use of a standard of sound of some kind, and I directed attention to this in view of the possibility of having some firm of instrument makers take up the design I had in mind, should there be a sufficient demand for this method of sound measurement. It should be possible, on the basis of Prof. Tykociner's researches, to have available for general use portable and easily operated instruments for recording and measuring sound.

LOUIS V. KING.

Metis Beach, Que., Sept. 14.

A Galvanometric Method of Measuring Electrolytic Resistance.

THE ordinary laboratory bridge method of measuring electrolytic resistance employing a telephone is somewhat unsatisfactory, owing to the difficulty of accurately judging the position for minimum sound in the telephones. Experiments made by different observers are, for this reason, often liable to give results which vary considerably. A method in which the telephone is replaced by a galvanometer possesses, therefore, a decided advantage, and the following simple device, which I have not seen described elsewhere, has been found quite satisfactory for ordinary purposes.

The points P and Q of the bridge (Fig. 1) are connected through a thermionic valve (Mullard type PM. 5) to a galvanometer. The grid and anode of the valve are joined, so that it constitutes a diode. An alternating potential difference between P and Q produces a unidirectional current through the galvanometer, since the diode acts as a 'half wave-rectifier'. The resistances in the arms of the bridge are adjusted until the galvanometer indicates zero, calculation being made in the usual way.

Owing to the high impedance of the valve, a sensitive galvanometer is required. Using a 'Pye Unipivot' instrument, of sensitivity about 2 divisions per micro-ampere, with resistances of 100 ohms in the bridge arms, and an applied potential of 30 volts, a change in resistance of 1 ohm in any of the four arms

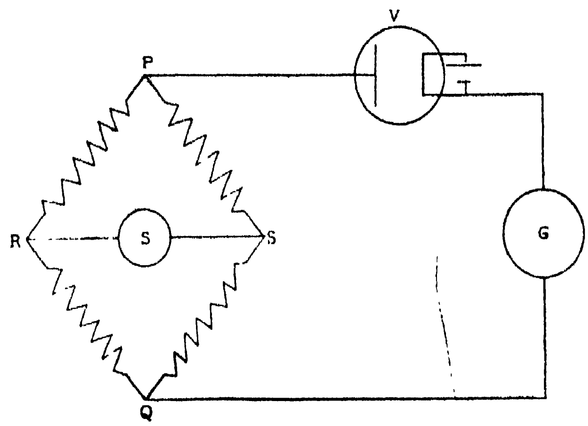


FIG. 1.

of the bridge produces an out of balance deflection of 2 divisions. For higher sensitivity a more sensitive galvanometer is required, but in such cases a very steady source of supply is essential. Obviously the deflection of the galvanometer is always in the same direction for all out of balance conditions, and does not pass from a positive value through zero to a negative value, as when the bridge is supplied with direct current.

Other methods of employing the thermionic valve in connexion with bridge determinations of electrolytic, and of very high wire resistance, in which use is made of the amplifying and rectifying properties of the valve, are to be published later in the *Indian Journal of Physics*.

J. A. C. TEEGAN.

Physics Department,
University College,
Rangoon, Aug. 16.

Wireless Reflections and Echoes.

A REMARK has just occurred to the writer, on turning over the account of cognate phenomena in Rayleigh's "Theory of Sound" (vol. 2, § 270), which seems to be of weight in this subject and may indeed be already familiar as a guide to observers. Long waves can penetrate a heterogeneous atmosphere of the lumpy type much better than shorter waves the length of which is comparable with the dimensions of the patches scattered through the medium. But in reflection from a layer of transition the opposite conditions prevail, the longer waves being most turned back: for reflection is only sensible when the gradual change of properties is completed within a depth small compared with the wave-length, though the new values must afterwards be maintained for a depth at least comparable with the wave-length. Atmospheric reflection downward must be in any case slight so that the augmenting of the effect by lengthening the waves may be an effective mode of test.

JOSEPH LARMOR.

Cambridge, Sept. 3.

Veterinary Science and Agriculture.*

By Dr. P. J. Du Toit.

THE prominent position which veterinary research occupies in the scientific life of South Africa to-day and the valuable practical results which have been obtained in this field of work have encouraged me to choose as the subject of my address the rôle which veterinary science plays in the agricultural development of a country. For obvious reasons my remarks will be confined almost exclusively to the live-stock side of agriculture in the wider sense; and for equally obvious reasons most of my examples will be quoted from South Africa.

Since the beginning of the present century the growth of veterinary science has been remarkable. Indeed, it may be said that a new veterinary science has arisen unobserved by the general public. A quarter of a century ago the veterinarian was looked upon as a moderately useful though obscure member of the community, whereas to-day he is regarded as an essential factor in the economic machine of the State. In this transformation of veterinary science the British Dominions and Colonies played no unimportant part. The veterinarians who had migrated to those countries and taken with them the stock of knowledge which they had obtained at the European veterinary schools, found themselves confronted with new problems which required solution. Research work on a large scale became necessary. Novel methods of attacking disease had to be devised. The farmer soon came to realise that his very existence depended on the protective measures of the veterinary staffs.

I propose to review briefly some of the most notable achievements of veterinary science in recent years, and to indicate how the work of the veterinarian has become interrelated with that of workers in other branches of science.

Animal Diseases.

Trypanosomiases.—Probably no other single group of disease-producing organisms has retarded the agricultural development of the continent of Africa more than that of the trypanosomes. If the cattle population of Africa be estimated at about 40 million head, it is quite safe to say that this number could easily be doubled if the danger of trypanosome infection were removed. In Nigeria, for example, only a portion of the drier northern provinces is suitable for cattle ranching; the much more fertile southern provinces are practically devoid of cattle on account of the ravages of trypanosomiasis. Similar conditions obtain in almost every territory in Africa (except the extreme south). The soil is fertile, grazing is plentiful, the climatic conditions are favourable, but the presence of tsetse flies and trypanosomes renders cattle farming impossible.

Fortunately, we can record considerable progress in this field of work during recent years. The problem has been attacked along two lines mainly. A direct attack has been launched against the parasite by means of drug treatment; and an indirect attack on the disease has been made through a campaign against the transmitter, the tsetse fly. The third line of attack, the immunisation of animals against infection, has not yielded very promising results.

One further trypanosome disease should be mentioned here, namely, dourine. Known for about a hundred and fifty years, this disease has been responsible for very heavy economic losses to horse breeders in Europe and other countries. With the aid of modern methods the disease was eradicated from most of the closely settled and well-organised western European States. But in the vast open spaces of Canada and other countries its eradication proved to be a much more difficult problem. It was only when Watson in Canada succeeded in perfecting a delicate diagnostic test for the detection of the infection that the eradication of the disease could be attempted seriously, and the results of the subsequent campaign in Canada have been entirely satisfactory. It should be added that Watson's success has stimulated further research into the problem of diagnosing other trypanosome infections by serological methods. A fair amount of success has attended these efforts and quite recently Robinson at Onderstepoort has reported further progress in the serological diagnosis of *Trypanosoma congolense* infection.

Piroplasmoses.—Under this heading are included diseases like redwater or Texas fever of cattle, biliary fever of dogs and horses, 'gallsickness' or anaplasmosis, and East Coast fever of cattle.

Their etiology was completely obscure until Theobald Smith and Kilborne in America, in a series of brilliant researches extending over the years 1888–92, succeeded in elucidating the nature of the first-named disease. Not only did these investigators discover the causal organism in the blood of infected cattle, but they also proved that the disease was transmitted by ticks and that the infection passed through the egg of the tick from one generation to the next. All this was completely new to science; it was the first time that the transmission of a mammalian disease through an invertebrate host had been proved experimentally. This contribution to science by two veterinarians is worthy of special note.

In the case of redwater, great advances can be recorded. The direct method of attack is eminently satisfactory, thanks to the discovery by Nuttall and Hadwen in 1909 that the drug trypanblue has a specific action on the parasite of redwater of cattle and biliary fever of dogs. The treatment is so successful that the disease has lost much of its terror since the discovery of the value of this drug.

In the case of anaplasmosis, a method of immunisation has been practised in South Africa for nearly twenty years and has been the means of saving thousands of animals.

Of the diseases mentioned in this section, East

* From the presidential address to Section M (Agriculture) of the British Association, delivered at Bristol on Sept. 8.

Coast fever is the most formidable, because of the very high mortality attending it. This disease must have cost South Africa several million pounds since its first appearance nearly thirty years ago. The loss to the country has been partly direct through the death of many thousands of animals, partly indirect through the costly organisation which it is necessary to maintain to fight the disease.

It is impossible in this brief review to discuss the methods employed in the eradication of East Coast fever, or the many practical difficulties encountered in this campaign. For our purpose it is sufficient to state that the dipping of cattle in an arsenical bath has proved to be a very valuable aid in the fight against East Coast fever or any other tick-borne disease.

In South Africa dipping has been practised since the beginning of this century, and has now become an integral portion of the daily routine of farming. No up-to-date stock farm can be found to-day without at least one dipping tank. Even if all the tick-borne diseases should now disappear, the majority of farmers in South Africa would continue to dip their animals regularly. The extent to which dipping is practised to-day may be gauged by the fact that there were in the Union of South Africa in 1929 more than 13,500 dipping tanks.

In the United States of America, where Texas fever (redwater) is the only serious tick-borne disease, an attempt is being made to eradicate completely the transmitter, *Boophilus annulatus*, by means of dipping. Large areas have already been cleared of these ticks, and the economic advantages to which these areas are entitled after being declared tick free, more than compensate for the expenses incurred.

Virus Diseases.—The vast sums of money which have been spent in Great Britain during the last few years on the eradication of foot-and-mouth disease should convince even the layman of the importance of this group of diseases.

In the olden days it was rinderpest which caused the severest losses. It has been calculated that the losses in Europe during the eighteenth century amounted to 200 million head of cattle. The disease made its appearance in England in 1865. A Royal Commission was appointed and its report is of value to this day. Later on, improved methods of eradication and prevention were evolved, and to-day most countries are free of rinderpest. However, in the Far East and in Central Africa the disease is still prevalent, and causes serious losses.

Two recent outbreaks of rinderpest, one in Belgium in 1920 and the other in Australia in 1923, both of which were eradicated completely within a few months, have again shown how far veterinary science has advanced during the last century.

South Africa has been free of the two diseases just named for many years. But there are several other virus diseases which play a very important rôle. Among these, horsesickness and bluetongue of sheep are perhaps the most important. An extensive study of the former disease by Theiler and his co-workers has yielded some very valuable results, but the problem of horsesickness cannot be said to be solved. At present a method of immunisation with hyperimmune serum and virus is practised, and this method has given excellent results in mules. About 4000 mules are immunised annually, and it has been stated that if the Onderstepoort Laboratory had produced nothing else except this method of immunising mules, its existence would have been justified.

The second important virus disease of South Africa is bluetongue of sheep. The disease is of great economic importance and would have been a very serious hindrance to the sheep farmer had it not been for the fact that Theiler discovered a simple method of vaccination by means of which the losses from the disease can be reduced to a negligible quantity. Every year two to three million doses of this vaccine are issued to the farmers, and the ultimate saving to the country must be enormous.

Of the many other virus diseases of animals, only one more need be referred to here, namely, rabies. This most dreaded of all human and animal diseases has been eradicated from many countries, and is being kept out by strict quarantine measures. In 1918 the disease was introduced into England with a dog which had been smuggled in in an aeroplane. Strict measures were put into force and in a comparatively short space of time the disease was stamped out completely. Methods of preventive inoculation of dogs, in countries where the eradication of the disease is very difficult, have been tried on a large scale. The results have, on the whole, been very good; but it is too early to predict the future scope of these methods.

Bacterial Diseases.—Of the host of bacterial diseases, only a few need be mentioned here. The deadly glanders, which was known before the time of Christ, and even twenty-five years ago still caused severe losses amongst horses and constantly threatened the human population, has now been practically eradicated from all civilised countries—thanks to the accuracy of the diagnostic tests which are used to identify the disease.

Another disease which at one time was responsible for very serious losses and which has now practically disappeared is pleuro-pneumonia (lungsickness) of cattle. In the year 1860 about 187,000 head of cattle are stated to have died in Great Britain of this disease; and the mortality in other European countries at that time was corresponding high. Towards the end of last century the disease was stamped out in Britain and to-day the greater part of Europe is free of the disease. South Africa, in spite of the fact that neighbouring countries are still infected, has been free of lungsickness since 1915.

Only one other bacterial disease can be mentioned here, namely, tuberculosis. In 1901, Robert Koch, who about twenty years previously had discovered the cause of the disease, startled the scientific world by announcing to a Tuberculosis Congress in London that human tuberculosis and bovine tuberculosis were two distinct diseases which were not communicable from the one species to the other. Unfortunately, this statement proved to be wrong. We know to-day that human beings do contract bovine tuberculosis, and for this reason most

civilised countries adopt measures for the suppression of the disease in cattle. The United States and Canada are leading the world in this respect and have spent millions of pounds in compensation for the destruction of tuberculous reactors. Denmark, Germany, England, and other countries are also doing much and have achieved a large measure of success in their efforts to supply to the population milk and beef free of tubercle bacilli. But very much remains to be done. In human beings the mortality from tuberculosis is still high in all countries, and a considerable percentage of the deaths must be ascribed to the bovine strain of the organism. The disease in cattle *can* be stamped out provided enough money is made available.

Recently great interest has been shown in the attenuated strain of tubercle bacilli produced by Calmette and Guerin of the Pasteur Institute. Experiments in which it is attempted to immunise children and young animals, with this strain, are in progress throughout the world. It is sincerely hoped that all this work will prove that the method of Calmette and Guerin has given us yet another weapon against this insidious disease.

Internal Metazoan Parasites.—The only group that need be mentioned in this brief survey are the worms. These parasites have become more and more important and to-day they actually constitute the 'limiting factor' in successful sheep farming in many parts of the world. This subject forms a highly specialised science of its own, the science of helminthology—in which many notable successes have been achieved in recent years.

The ordinary stomach worm of sheep (*Hæmonchus contortus*) is world-wide in its distribution and is the cause of very severe losses. Better farming methods will undoubtedly improve the position, but in the meantime farmers look to the veterinarian to rid their sheep of these deadly parasites. Various chemicals have been tried with varying degrees of success, but perhaps nowhere has the success been so marked as in South Africa, where, as a result of the researches of Theiler, Veglia, Green, and others, a method of treatment was recommended which has proved the salvation of many sheep farmers. The method consists of the accurate dosage of a mixture of arsenite of soda and copper sulphate; and the extent to which this method has been applied may be gauged from the fact that at present some 25 million doses of the mixture are issued annually from Onderstepoort. The method is not perfect, but it has been a great factor in making sheep farming a success where otherwise it would have been a dismal failure.

One further fact must be emphasised here. The menace of worm infection has become so great that no sheep farmer can hope to be successful if he disregards the teaching of modern science. Overstocking of farms must be prevented at all costs; marshes must be drained or the sheep kept away from them; the sheep must be treated regularly according to the best methods known. If these precautions are adopted, the parasites can be kept in check and profitable sheep farming will become possible; if the advice is ignored, then the financial loss to the farmer will be the smaller the sooner he gives up farming.

External Parasites.—The two most important groups of ecto-parasites, the ticks and the tsetse flies, have already been referred to.

A further very important group are the mites. These minute parasites are responsible for the diseases known as scab or mange in animals, and have caused untold losses. In the fight against these diseases the British Dominions have had very signal success. Australia and New Zealand have eradicated sheep scab completely, Canada is practically free of it, and in South Africa, where the presence of a large native population owning a very inferior class of sheep has made the campaign particularly difficult, the incidence of the disease has been reduced to infinitesimal proportions and complete eradication is hoped for within a short time.

Another very important ecto-parasite of sheep is the so-called blowfly. The trouble is caused by these flies depositing their eggs in the wool of sheep, especially in the soiled and moist parts, and by the resulting maggots causing serious damage to the wool and the sheep itself. The pest has assumed alarming proportions in Australia and is becoming more and more important in other countries, including South Africa. Determined efforts are being made to combat the pest and valuable progress has been achieved. In this research entomologists and veterinarians are working hand in hand.

Diseases due to Poisonous Plants.—That certain plants are poisonous and may have fatal effects when consumed by animals has probably been known for centuries. However, it is only during recent years that plants have been studied which produce diseases comparable with epizootic diseases. In this field of research South African workers have been prominent.

One of the most remarkable of these diseases is that known in South Africa as gousiekte (rapid disease) of sheep, which was studied some years ago by Thieler, Du Toit, and Mitchell. The cause of the disease was shown to be the plant *Vangueria pygmæa*. The poison contained in the plant acts on the heart muscle, causing a myocarditis with subsequent dilatation of the ventricles. As soon as the process has reached a certain stage the animal dies of 'heart failure'. To the casual observer the disease presents all the characteristics of an infectious disease.

Other no less remarkable diseases were studied by Theiler and his co-workers. A disease called geeldikkop (yellow thick head) in sheep was shown by Theiler (1928) to be due to a plant *Tribulus terrestris*, although more recent work by Quin, Steyn, and others at Onderstepoort has shown that there are other factors to be considered in the causation of this disease.

Vomiting disease of sheep was studied by Du Toit (1928) and proved to be caused by *Geigeria* spp. The disease may produce very severe losses in certain years, especially after droughts, when the plant is very widespread.

The study of poisonous plants is now being actively pursued in various countries, and further

interesting developments may be expected. It is obvious that the co-operation of botanists is essential for the success of this work.

Deficiency Diseases.—The great importance of the vitamins in the nutrition of human beings is so well known that it need not be stressed here. In the case of the common domestic animals (except perhaps the pig, the dog, and the fowl) the vitamins seem to be of far less importance than in human beings. On the other hand, mineral deficiencies are, generally speaking, much more important in animals than in human beings. In recent years it has been found that large portions of the earth's surface are deficient in some mineral or other essential for the normal health and growth of animals.

In South Africa, as well as in other African territories and in Australia, the most serious deficiency is that of phosphorus. Theiler and his co-workers have investigated the ill-effects of this deficiency on cattle very fully. They have shown that cattle grazing on phosphorus-deficient pastures develop a depraved appetite for bones and other carcase debris, and this may lead to the ingestion of toxic material with fatal results (lamsiekte in South Africa); further, that such cattle remain stunted in growth, are late in maturing, are frequently unfertile, produce very little milk, and are very susceptible to various diseases. By the addition of a small daily ration of phosphorus to the diet, they were able to bring about an almost miraculous improvement in the condition of the animals.

As a result of the general feeding of phosphorus compounds in the deficient areas of South Africa, the disease lamsiekte, which a dozen years ago caused enormous losses, has practically disappeared and cattle farming in those areas has again become profitable. The significant fact may be recorded here that the village of Vryburg in Bechuanaland, where ten years ago milk was very scarce, to-day owns a creamery which handles a larger volume of cream than any other creamery in South Africa.

Other Veterinary Problems.

Problems in connexion with the nutrition of animals are now receiving attention in many countries. The vast importance of correct feeding can be illustrated best by referring again to the phosphorus deficiency which exists in the pastures of South Africa and other countries. The astounding results which have been achieved with the addition of a small quantity of phosphorus compounds to the ration of the animals promise to revolutionise the beef and dairy industries.

Animal breeding also presents problems of great importance and these are intimately bound up with the problems of disease and nutrition. In South Africa, as in other countries, there is a constant cry for the replacement of the scrub bull by pedigree sires. This demand would be met to a far greater extent were it not for the fact that in many parts of the country pedigree bulls cannot live because of disease or nutritional difficulties.

In South Africa control over the diseases mentioned above is gradually improving and, in regard to the deficient areas, recent investigations by Du Toit and Bisschop have shown that the grading up of native stock can be carried out with complete success provided the deficient mineral is supplied. Both beef cattle and dairy cattle have been bred on the extremely deficient veld of Bechuanaland without signs of deterioration, and the cost of the supplementary ration has been negligible in comparison with the advantage derived from such feeding.

Gratifying though the success which has been achieved may be, the need for further research on live-stock problems has never been greater than it is to-day. The development of enormous areas in the British Dominions and Colonies is entirely dependent on the progress of research. With the aid of further scientific measures, these new countries could absorb a very much larger population than they now harbour. Over-population will not make itself felt for generations, nor need over-production be contemplated seriously.

The prosperity of a very large percentage of the population, both European and native, in the Dominions and Colonies depends on the live stock industry—breeding of pedigree stock; beef, mutton, or pork production; dairy farming; wool or mohair production; skin and hide trade; poultry farming, etc. These farmers look to the veterinary service of their countries more and more for assistance and protection. Without this assistance, profitable stock farming, especially in the tropical and subtropical countries, is impossible. The assistance, if it is to be effective, must be based on the latest achievements of scientific research. Rule-of-thumb methods will not suffice.

In a humble way South Africa has proved the wisdom of maintaining an adequate veterinary research service. At Onderstepoort the Government twenty-one years ago established what must be regarded as a fairly large research institute, if the size of the population be taken into consideration. This institute, under the brilliant directorship of Sir Arnold Theiler, soon proved to be not a liability but a valuable asset to the country. The results obtained in any one of its various sections would probably have justified the maintenance of the entire institution.

I have said that the Dominions and Colonies have played an important part in the recent growth and development of modern veterinary science. The quality of the research work produced by veterinarians in these countries has been of such high order that it soon placed veterinary science (which not many years ago was regarded as the Cinderella of sciences) abreast of the other sciences. As a matter of fact, in South Africa it can be said, without disparagement to any other group of workers, that veterinary science occupies a very high, if not the leading, position. This has had a wholesome influence on the science itself and on the type of worker who was recruited in its service. The stigma of inferiority which for so long was attached to the veterinarian has disappeared. To-day, veterinary science is looked upon as a field of work which offers almost unlimited scope for research and, in its practical application, may bring untold material benefit to a country.

Correlation of the Archæological and Geological Records.

By M. C. BURKITT.

FOR the prehistorian the problem of correlating the archæological and geological records is a thankless task. No sooner has a satisfactory correlation been obtained in the study than field workers produce fresh factors which have to be accounted for and the problem is demonstrated to be still more complicated than before. However, recent researches, especially those undertaken by Mr. Reid Moir and Dr. K. S. Sandford, have thrown a flood of light on the whole matter, and while it is still too early to hope for a final solution of the knotty problem, a comparison of their work with that of earlier continental investigators does bring out certain salient points.

Although it has undergone some vicissitudes, the fourfold glacial system of Penck certainly seems to meet the facts in Nature, although the length and the intensity of the glaciations of that scheme seem to have differed in various areas, not only according to latitude (as might be expected) but also according to the longitude of the site. However, for the purpose of this article, Penck's scheme will be adopted, not least because both Mr. Reid Moir and Dr. Sandford, as well as many continental prehistorians, have a fourfold glacial system in their minds. Before tabulating the recent work in East Anglia and the Oxford district, it will be well to summarise some of the results obtained abroad: chiefly must the results of investigations at three sites, namely, Bouchiéta, Conliège, and Cotencher, be combined together.

Bouchiéta.—This site is a small cave half-way up the steep side of the Soudour hill, which rises in the middle of a tributary valley of the Ariège, close to the village of Bedeilhac and not far from Tarascon-en-Ariège. The section in the cave revealed morainic material overlaid by a deposit containing Mousterian implements. Below the level of the cave, along the hillside, can be seen the remains of another lateral moraine due to a glaciation which was not sufficiently intense to rise to the height of Bouchiéta. This glaciation must, of course, have been subsequent to the one which did reach the cave, as its moraines have not been thereby obliterated. If it *had* been sufficiently intense to reach the cave, doubtless the contents would have been cleaned out, and the remains left by the previous glaciation, with the deposit containing Mousterian implements resting on it, largely destroyed. *The evidence at Bouchiéta thus demonstrates that some Mousterian industries are subsequent to a glaciation which was not the last.*

Conliège.—In eastern France two terminal moraines can be determined, one considerably farther out in the plains than the other, due of course to the fact that the glaciation which formed it was the more intense of the two. But that the greater glaciation was not subsequent to the lesser is obvious, because if it had been, the terminal moraine of the former would have been largely destroyed. In a deposit resting on the earlier moraine, that is, the one farthest out in the plains, and beyond the range of the subsequent and lesser glaciation, was found an Acheulean implement. It is hard to dogmatise about the exact age of a single specimen, but so far as can be judged from pictures, it does not seem to be of very early Acheulean date. *The evidence at Conliège demonstrates that a part at any rate of the Acheulean culture is subsequent to the last but one important glaciation of a district.*

Cotencher.—This site is in Switzerland (Neufchâtel). It is a small cave lying just within the orbit attained by Penck's Würm glaciation at its maximum, and it was completely filled by morainic material assignable to this last great glacial epoch. Within the morainic material were found some Mousterian tools, which must therefore have been fashioned and dropped before the Würm glaciers picked them up and deposited them at Cotencher. *Cotencher demonstrates that the Mousterian culture, in part at least, was anterior to the maximum of the Würm glaciation.*

But the Mousterian in France * is found with an arctic fauna and is stratigraphically later than the Acheulean, which is associated with a cool fauna. It follows, therefore, that the French Mousterian must be, in part at any rate, correlated with the Würm glaciation, it and a part at least of the Acheulean being subsequent to the Riss glacial period. Confirmation of this is given by the finds in the Somme Valley, where Acheulean industries occur in the older loess, which is found covering, and is therefore newer than, the lowest but one terrace, while it never overlies the bottom terrace—for the simple reason that at the time of its formation the bottom terrace was not there. Mousterian industries are found at the base of the younger loess, which does occur over the bottom terrace as well as over the lowest but one. Comparisons of the Somme Valley terraces with those of the Oxford district are very striking. Again, in the valley of the Garonne, Acheulean industries are found in a deposit resting on the lowest but one terrace and in the gravels of the bottom terrace—in the latter case in a rolled state. Once again the evidence shows that a part at any rate of the Acheulean industries can be dated to a period before the last glaciation but after the last but one.

Turning to Great Britain, the key sites in East Anglia are, in my opinion, those of Hoxne and the Cromer cliffs, to which must be added the recent discoveries in brown boulder clay at Hunstanton. Our knowledge of all three is due to the indefatigable energy of Mr. Reid Moir. Composite sections from

* I use the terms 'Mousterian in France' and 'French Mousterian' to distinguish these industries from the many flake industries found elsewhere, for example, in Great Britain, which have often been erroneously classed as Mousterian but are better designated 'Levalloisian' or 'Clactonian', and are often considerably earlier in date, being contemporary with various phases of the Acheulean culture.

these sites, together with those of the Oxford district, are given in the table below. The archæological finds from the Wolvercote channel have been correlated with the upper beds of Hoxne, the succession of industries being most helpful. The foreign evidence just detailed allows us to name the glacial periods according to the Penckian scheme. sands with the more temperate beds, probably lower Acheulean in date, of Hoxne and elsewhere. But the recent suggestions of Simpson (NATURE, Dec. 28, 1929) postulate a cold or at least cool inter-glacial at just about that time in the geological sequence of events. Assuming that the climate was temperate, as indicated by the Hanborough

TABLE OF CORRELATIONS.

Locality.	Oxford Region.		Hoxne.	Hunstanton.	Travellers' Rest, Cambridge.
Post Würm I	Modern flood plain gravels.		Sand and sandy-loam (? Upper Palæolithic in age).	Brown boulder clay containing derived Upper Palæolithic implements = Würm II.	Evenly bedded gravel at top.
Glacial Times = Würm I	Sunk channel (mammoth found). Denudation to sunk channel.	[Wolvercote channel] 1. Warp sands (climate very cold and wet). 2. Clays with rare Mousterian tools (climate cold). 3. Peats with subarctic flora.	[No industries found but presumably they would prove to be late Mousterian and early Upper Palæolithic.] Glacial deposits = chalky boulder clay. Brick earth.		Twisted loam and sand.
Interglacial Times = Riss-Würm	Upper Summertown–Radley terrace. (Hippo and *Corbricula flummalis* found.)	4. Sands with temperate Mollusca. 5. Layer with *Elephas antiquus* and unrolled Upper Acheulean and Micoque tools.	Early 'warm' Mousterian floor and temperate flora.	[Cromer District.]	Twisted sand (Moust.). Warm level-bedded sand (derived Chellean and Acheulean tools).
Glacial Times = Riss	Lower Summertown–Radley terrace. (Mammoth and derived Chellean and Acheulean tools found.) Wolvercote (40 ft.) terrace = outwash of Moreton ice sheet (derived Chellean tools found).		Gravel with Acheulean tools mammoth and reindeer bones. Arctic bed (sterile).	Runton sands (Upper Acheulean tools found). Contorted drift.	Scratched boulders.
Interglacial Times = Mindel-Riss	Hanborough (90-100 ft.) terrace pause in a period of denudation of the Thames valley.		Warm lacustrine beds (sterile).	? Perhaps represented by such a deposit as the Mundesley sands.	
Glacial Times = Mindel	Plateau drift.		Kimmeridge boulder clay.	Till (derived late Chellean tools found at base). Upper part of Cromer Forest Series.	
Interglacial Times = Günz-Mindel				Lower Cromer Forest Series. (Horizon of ancient Chellean land surface at base.)	
Glacial Times = Günz				Weybourne Crag, etc.	
Pre-Günz Times				Earlier Pliocene deposits to chalk.	

It would seem from the above that the whole period from the Eolithic industries of the sub-crag until close on chalky boulder clay times is occupied by Chellean and Acheulean industries, with which are associated at certain periods flake industries of Clactonian and Levalloisian types. The so-called 'warm' Mousterian which is earlier in date than the true Mousterian of France should, properly speaking, be included here. The only difficulty in the scheme is the correlation of the cold Mundesley terrace at Oxford and the lower bed at Hoxne, it is possible that in the intensely glaciated area around Cromer, which was more or less under the influence of the Scandinavian ice-sheets, the climate of this cool inter-glacial period was never warm enough to permit of our recognising an inter-glaciation, but that nevertheless the Cromer Till and the contorted Drift, far from being the result of one great glacial movement, are the result of two successive glaciations.

Obituary.

PROF. H. B. DIXON, C.B.E., F.R.S.

THE sudden death of Prof. Harold Baily Dixon, of the University of Manchester, on Sept. 18 last, removed a distinguished chemist whose work upon gaseous explosions during the past half-century opened a new era in combustion research.

He was born on Aug. 11, 1852, the second son of William Hepworth Dixon (1821–79), traveller and writer, and for some years (1853–69) editor of the *Athenæum*. The family came of an old puritan stock, the Dixons of Heaton Royds in Lancashire; but in 1846 Hepworth Dixon, who had been born in Manchester, migrated to London, where his children were reared.

Harold went to Westminster School, from whence, in 1871, he gained a close classical scholarship at Christ Church, Oxford. Owing chiefly to the zest with which he threw himself into the social and athletic side of university life, he scarcely fulfilled the expectations of his tutors in classics; but in 1873, at the instance of Dr. A. Vernon Harcourt, he turned his attention to science, with such signal success that two years later he graduated first class in the Natural Science School. Afterwards he was elected to fellowships successively at Trinity in 1875, and at Balliol in 1881, teaching at both Colleges and carrying out researches in a cellar at Balliol which formerly had been used by Benjamin Brodie for his researches on ozone.

It was also at the instigation of Vernon Harcourt that Dixon commenced studying gaseous explosions in 1876. During the sixty years which had elapsed since Humphry Davy's pioneering work on the subject, only R. W. Bunsen amongst chemists had much explored it, and for twenty years his results had been accepted without question as authoritative. More particularly the results of Bunsen's experiments (1853) on the explosion of mixtures of electrolytic gas with increasing amounts of carbonic oxide were held to be inconsistent with the principle of 'mass action' enunciated by Berthollet in 1805, and led to the erroneous view that a continuous alteration in the composition of such a gaseous medium produces a discontinuous ('per saltum') alteration in the course and products of its explosion.

It was during a research primarily undertaken to test this conclusion that Dixon made the epoch-making discovery that the prolonged drying over phosphoric anhydride of a mixture of carbonic oxide and oxygen in combining proportions renders it non-explosive when subjected to electric sparks of an intensity sufficient to ignite quite readily an undried medium. This astounding result, announced at the Swansea meeting of the British Association just fifty years ago, immediately made him famous, and (as he was wont to say) loosed a hare which, though since pursued by the hounds in full cry, is still uncaptured.

These early Oxford researches (1876–81) not only proved, *contra* Bunsen, the validity of Berthollet's 'law of mass action' in gaseous explosions, a conclusion simultaneously established by the independent work of Horstman in Heidelberg, but also led to the remarkable discoveries of H. B. Baker, who assisted Dixon at Balliol in 1884–85, regarding the incombustibility of rigidly dried and purified systems containing phosphorus or sulphur vapour and oxygen, even when strongly heated. Thus Dixon laid a firm and lasting foundation on which much later work has been built.

Up to 1880, on the strength of Bunsen's observations (1857), it was generally believed that gaseous explosions travel at rates not exceeding a few metres per second only; but in that year a disastrous explosion in a large gas-main in Tottenham Court Road, London, afforded conclusive evidence of much higher speeds. and caused Dixon to begin measuring 'rates of explosion', which was his next important work. He had not got far with it, however, before Berthelot and Vieille announced (1880) their discovery of the high constant flame speeds finally attained on the development of 'l'onde explosive' ('detonation') in gaseous explosions; this revelation, together with Mallard and Le Chatelier's classical "Recherches sur la combustion des mélanges gaseux explosifs" (1883), showed that the comparatively slow flame speeds observed by Bunsen apply only to the mild initial phase of such explosions. Working on parallel lines with them during the next twenty years, Dixon so successfully developed the methods initiated by the French savants that he became the leading authority upon such matters. In 1893 he gave the Bakerian Lecture to the Royal Society on "The Rates of Explosion in Gases", and nine years later published in the *Philosophical Transactions* a brilliant memoir embodying his photographic researches on "The Movements of Flame in the Explosion of Gases".

Dixon's third principal line of research, which chiefly occupied him during the last twenty years, was on the 'ignition temperatures' of explosive gaseous media, which he was the first to determine with any real accuracy; and only recently he made the important discovery that such 'ignition temperatures' are, or may be, profoundly affected by the presence of small amounts of impurities in the media, a matter of great importance in regard to coal-mine and other industrial explosions.

In 1886 Dixon was appointed to succeed Sir Henry Roscoe in the chair of chemistry at Owens College, Manchester; and this he occupied until his retirement in 1922, when he became honorary professor at the University while still continuing his experimental researches there. Under Roscoe the Manchester School of Chemistry had been so dominant in the country that some doubted whether his successor would maintain its great reputation. But Dixon's outstanding administrative gifts, his devotion to experimental research, his singularly clear and penetrative mind, his brilliance as a lecturer, his power of arousing in his students the true spirit of inquiry, and the way in which he always identified himself with the social and athletic interests of the University,

proved more than equal to the test, so that the reputation of the School continually increased under his leadership. He was indeed the *beau ideal* of a University professor.

Dixon's scientific and educational activities were by no means confined to the University of Manchester. He was president of the Manchester Literary and Philosophical Society during 1907-9 and of the Chemical Society during 1909-11. He served on the Royal Commissions on Explosions of Coal-dust in Mines (1891-94) and on Coal Supplies (1902-5); also he was a member of the Home Office Executive Committee on Explosions in Mines (1911-14), and since 1927 acted as Supervisor of Researches on the Ignition of Gases under the Safety of Mines Research Board. During the War he was Deputy Inspector of High Explosives for the Manchester area, in recognition of which he was appointed C.B.E.

In 1916 Dixon became chairman of the Royal Technical College, Salford, and afterwards of the Salford Education Committee, both of which positions he continued to fill until the end with conspicuous success and great advantage to the public. Latterly he also devoted much time to the establishment of the new Queen Mary's Secondary School for girls at Lytham, which is to be opened in the near future, and was returning from a meeting at Lytham in this connexion when he was suddenly taken ill and died.

Amid his manifold other interests, Dixon never lost his early love of the classics, and while voyaging to South Africa with the British Association in 1906 he produced for private circulation a verse translation of the Odes of Horace which for scholarly treatment and real feeling could scarcely be surpassed. Indeed Horace and Omar Khayam were his favourite authors, and he was filled with the spirit of the "Novum Organon" of which his scientific work was the fruit.

The Royal Society elected Dixon to its fellowship in 1886, and awarded him a Royal Medal in 1913; in 1922 the University of Manchester conferred upon him its D.Sc. *honoris causa*, the University of Prague having similarly conferred its Ph.D. some years previously. But, as he often said, his chief reward was the deep satisfaction which came to him through the affection and devotion of his many old pupils, and from the knowledge that, inspired by his example, they were handing on the torch which he had lighted.

Dixon was not only himself a great exponent of the experimental method, but also a master-trainer of those who were privileged to be his pupils in research; and it was here that the influence of his personality was most markedly felt. At all times he was unsparing in the guidance of his ripe experience, and unrelaxing in impressing the paramount duty of accuracy and truth, together with the highest standard of experimental work. Eschewing all rash speculation, and attaching little importance to theories save as working hypotheses, the dry light of science shone clearly throughout all his work; and he had a singular felicity in choosing just the right words in expounding it.

In his youth, Dixon was a good athlete, gaining his football 'blue' at Oxford; and well into middle life he continued to play both cricket and tennis. His chief physical recreation, however, was mountaineering, in which he excelled. During 1890-93 he accomplished more than twenty first-class climbs in the Alps, and was elected to the Alpine Club in 1894. Afterwards, in 1897, he climbed in the Selkirks, Canada, making first ascents of both Pollux and the Dome, and the second ascent of Castor with C. E. Fay and others. Also, in the Canadian Rockies, he made the first ascents of Mounts Lefroy and Gordon with C. E. Fay, Norman Collie, and C. S. Thompson.

He was twice married, first in 1885 to Olive Beechey Hopkins of Montreal, who died in 1917, and by whom he had a son and a daughter; and then in 1918 to Muriel Kinch of Yelverton (S. Devon), who survives him, by whom he had a daughter. All three of his children also survive him.

It is pleasing to know that even on the last morning of his life, Dixon was personally experimenting in his laboratory; within a few hours he had passed away, in the fullness of years and plenitude of powers, without pain or sadness of farewell, leaving behind him a host of pupils who will ever remember him with deep affection and gratitude.

Nihil tetigit quod non ornavit; fama semper vivat!

WILLIAM A. BONE.

SIR WILLIAM SMITH, C.B.

THE death of Sir William Smith, the well-known naval constructor, took place at Craiglands, Herne Bay, on Sept. 16. Though he was not fortunate enough to fill the office of Director of Naval Construction, there have been few in the Admiralty service with a higher reputation, and as Superintendent of Construction Accounts and Contract Work during the period 1902-12, he held a position second only to that of the directorship itself.

Born at Portsmouth on April 4, 1850, William Edward Smith began work in the rope-house at Portsmouth at the early age of eleven, but at fifteen became a shipwright apprentice, and four years later, as the result of a severe competitive examination, gained a scholarship at the Royal School of Naval Architecture and Marine Engineering at South Kensington. Passing out in 1873 as an assistant constructor, he was employed on the designs of the old ironclads *Northampton*, *Colossus*, and *Inflexible*, and later on succeeded Sir William White as instructor in naval architecture at Greenwich. Returning to the Admiralty, in 1887 he was appointed Inspector of Contract Work and later on was concerned with the designs of many of the ships built under the Naval Defence Act of 1889.

During his forty years' active career Smith served under Sir Nathaniel Barnaby, Sir William White, and Sir Philip Watts, and it was under the latter that he held the important post of Superintendent of Contract Work. From this appointment he

(*Continued on p.* 541.)

Supplement to NATURE

No. 3179 OCTOBER 4, 1930

Reviews.

Contributions to the History of British Surgery.

Plarr's Lives of the Fellows of the Royal College of Surgeons of England. (Thelwall Thomas Memorial.) Revised by Sir D'Arcy Power, with the assistance of W. G. Spencer and Prof. G. E. Gask. Vol. 1. Pp. xxvi + 752. Vol. 2. Pp. 596. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1930.) Cloth, 42*s*. net; half bound, 57*s*. 6*d*. net.

THE published registers of a college are not usually books of wide interest, but the two volumes of "Plarr's Lives of the Fellows of the Royal College of Surgeons of England" which have just been issued, edited by Sir D'Arcy Power, are very much more than a biographical register, for they provide a history of English surgery during the last hundred years. The Royal College of Surgeons in London was founded in 1800 to take the place of the Corporation of Surgeons, which had separated in 1745 from the joint Company of Barber Surgeons but came to an end through the negligence of its court after a life of about half a century. The College was thus the direct legal successor of the various guilds and companies into which the surgeons of London had successively grouped themselves since the middle of the fourteenth century. In this capacity the College continued to perform the important office of examining and licensing would-be practitioners of the "art and science of surgery", granting to the successful candidates its diploma of membership.

From its very foundation, however, the College was also entrusted with the care of the great collections John Hunter had gathered together to illustrate life in all its branches, which had been purchased for the nation in 1799, six years after Hunter's death. Much money was expended both by the Government and the College on the satisfactory establishment of the museum in Lincoln's Inn Fields at the beginning of the century; but it was not until 1830 that the catalogues began to be published, chiefly through the labours of Richard Owen, who had been appointed an assistant in the museum in 1826. In 1828 the first librarian, Robert Willis, was appointed; and in the early 'thirties the College was rebuilt, practically in its present form.

The College was thus firmly establishing its important position in the medical education of Great Britain, organising and making efficient its museum and its library, and in 1843 this good work was completed when a supplemental charter was obtained incorporating the College as the Royal College of Surgeons of England and instituting the order of fellows. The first fellows were to be elected by the Council from among the members—not less than 250 or more than 300 were to be elected within three months, and further fellows were to be added at discretion in the first year; after that, election to the fellowship was to be decided by a special examination supplemental to the examination for the diploma of membership. This very important development was chiefly due to Brodie; and, as is stated in the account of him in the collection under review, the institution of the fellowship has been largely instrumental in raising the College to be "the exemplar of surgical education to the whole kingdom".

It is, then, with the first 300 fellows elected in 1843 and with all their followers in the fellowship, whose life and work are already ended, that these volumes are concerned. As a preface to the actual lives, the text of the 1843 charter and the list of the first 300 fellows are printed in full at the beginning of the first volume. A perusal of this list will provide the reader with a clearer historical terminus than the mere date '1843' can convey. The great surgeons who had been Hunter's pupils and successors will not be found among the fellows—their labours were already finished when this new

order was established. Brodie is the senior vice-president in the first list of fellows, and other outstanding names are: William Lawrence, Benjamin Travers, J. H. Green, Liston, Ranald Martin, Syme, Cæsar Hawkins, Le Gros Clark, and James Paget; and of the second group of fellows, elected under the terms of the charter in 1844, George Murray Humphry, founder of the Cambridge school of medicine, is the last on the list.

The lives of these men and of their successors at the head of the profession form the body of the work. Each life is headed by a tabulated list of academic and civic (or military) degrees and honours, with the dates of their attainment. The lives follow, on the whole, the admirable models of the "Dictionary of National Biography", though they are not so severely utilitarian—anecdote and reminiscence are freely, but judiciously, drawn upon to make a portrait vivid; for, as the preface states, a considerable number of the fellows have been known to the editors either as their teachers, their contemporaries, or their pupils. Under the more important names, while a sketch has been given of the subject's whole career and general interests, chief attention has rightly been paid to his professional work, and this study is made more valuable by the select but exact bibliography appended to each life. Full references and acknowledgment are also given, in most cases, of the sources from which the material of the lives has been drawn. As an example, the most important article—Lister—which runs to nearly a dozen pages, gives a sufficient outline of his life and includes an essay, woven round his research and teaching, on "Antisepsis ensuring Aseptic Surgery"; and finally the reader is referred to the "Collected Papers", and to a number of biographies and general articles. But while there are many lives of detailed interest, there are many also which come to little more than a list of appointments gathered into a few lines. It is at first sight a little disappointing that more information should not have been forthcoming about many of these lesser figures. Possibly the publication of these volumes in their present form will elicit additional information from sources which have not been tapped.

The labour of collecting the material for these lives was undertaken by the late librarian of the College, whose name appears in the title, and to him is largely due the credit for such completeness as has been obtained, particularly in the accounts of the lesser men. The editors have prefixed a memoir of him to the collection. Victor Plarr in early life had been a member of the Rhymers' Club, that brilliant but tragic group of poets in the 'nineties, and some of his verses may still be met with in the anthologies of to-day. But for more than thirty years he was librarian of the College and did much useful work, including the completion of the catalogue of the library, which had been started by his predecessor. The volumes now issued will form a lasting memorial to his labours; but the editorship of Sir D'Arcy Power ensures that the student of medical history will find here not merely a collection of lives but also a series of valuable contributions to the history of British surgery.

The period covered begins before the introduction of anæsthetics and passes right through the conflict of opinion over Lister's teaching of antisepsis—here may be found lives both of his opponents and of his supporters and successors, down to the most recent times. The student can find, under the appropriate names, the history of ovariotomy and of the introduction of abdominal surgery, and the rise of scientific ophthalmology and other specialisms. Here also are many names important in the history of the Indian Medical Service. The rise of the modern science of public health is recounted in the lives of Sir John Simon and his fellow-workers. The excellent account of Sir Victor Horsley provides a detailed and worthy summary of his varied and important researches. These are but a few examples, and beside the pioneers and heroes of surgery itself, the amateur of medical history will find much to note in the varied pursuits to which many of these fellows turned aside and in which also they gained success. Many of the leading figures in the development of natural science in the last century are here—Richard Owen, Gideon Mantell the geologist, Bennett, one of the early investigators of Australian zoology, Busk the palæontologist. There are heroic missionaries, and even one bishop. Literature has had her worthy followers in this section of the medical world, and, as might be expected among surgeons, there are several artists of merit, of whom Seymour Haden may be mentioned. He is so deservedly well known as an etcher that his important career as a surgeon, here outlined, may be easily forgotten.

All who care for the history of science must be grateful to Plarr and to Sir D'Arcy Power and his fellow-revisers for their labours, which have so well supplied a long-felt need; and to complete the usefulness of "Plarr's Lives" the editors promise "a supplement every ten years". W. R. L.

Colloid Miscellany.

(1) *Kapillarchemie: eine Darstellung der Chemie der Kolloide und verwandter Gebiete.* Von Prof. Dr. Herbert Freundlich. Band 1. Vierte unter Mitwirkung von J. Bikerman umgearbeitete Auflage. Pp. viii + 566. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 39 gold marks.

(2) *Die Globuline.* Von Dr. Mona Spiegel-Adolf. (*Handbuch der Kolloidwissenschaft in Einzeldarstellungen,* herausgegeben von Prof. Dr. Wolfgang Ostwald, Band 4.) Pp. xv + 452. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 33 gold marks.

(3) *Traité de biocolloïdologie.* Par W. Kopaczewski. Tome 1: *Pratique des colloïdes.* Deuxième édition entièrement remaniée et mise à jour. Fascicule 2: *Mesure des concentrations moléculaires et ioniques.* Pp. 165-361 + vi. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.

(4) *Colloid Symposium Annual (formerly Colloid Symposium Monograph): Papers presented at the Seventh Symposium on Colloid Chemistry, Johns Hopkins University, June 1929.* Edited by Prof. Harry Boyer Weiser. Pp. viii + 300. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22s. 6d. net.

(5) *The Chemistry of the Colloidal State: a Textbook for an Introductory Course.* By Prof. John C. Ware. Pp. xiv + 313. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18s. 6d. net.

(1) IN the welter of books on colloid chemistry, Freundlich still stands like a great rock in a weary land. The new edition indicates that his great achievement is not to remain as a venerated antiquity; indeed, the growth of the subject is so rapid that the work is now to appear in two volumes, each as large as the original edition of 1909. The classical treatment of surface action originally adopted was so soundly conceived that little alteration in the general scheme has been found necessary to accommodate the additional matter now available. Hence this first volume includes the actual "Kapillarchemie", together with consideration of the kinetics of formation of new phases and the Brownian movement—the detailed treatment of sols and gels being reserved for the second volume. The increase in size is not due to the process of accervation so common in text-books, or to any sensational new developments, so much as to an increase in the intensity of our knowledge of domains hitherto incompletely explored. The author has not hesitated to prune in order to make room for recent work, which is nevertheless frequently introduced in an unobtrusive manner.

Among the new matter in this edition, an extended discussion of the relations between chemical composition and surface tension has been rendered necessary by the recent work on parachors. Adsorption is another branch of the subject which has been brought up-to-date, and in view of the tendency to deal experimentally to such a large extent with charcoals and silica gel as adsorbents for gases and vapours, a short section on the action of metals in this direction is to be welcomed. The portion of the work dealing with electrical phenomena at surfaces has also been extended, and throughout one finds that careful modification of statement in the light of experience which has characterised the earlier editions. It would indeed be difficult to find any important piece of work within the scope of the subject and capable of summarised treatment at the present time which has not been adequately dealt with.

(2) The increase in intensity of colloidal research during the last twenty-five years is indicated also by the important monograph of Dr. Spiegel-Adolf on the globulins. These proteins, even apart from their intrinsic interest, will always have a special appeal to English physiologists on account of the fundamental investigation of them by Sir William Hardy and the subsequent work of other English biochemists. The globulins have not hitherto received in the literature of the proteins the attention which their importance warrants, and it is very convenient to have in one volume such a masterly account of their behaviour. Hitherto such information has remained scattered through the numerous journals in which it was originally published, and, indeed, some of the matter here included has not been published before.

Although the greater part of the work is naturally devoted to the physical chemistry and colloid chemistry of the globulins and their reactions with acids, bases, and salts, there is an interesting section on their importance in biology and medicine which should appeal to the serious student of human physiology and pathology. In completeness and clarity this monograph leaves nothing to be desired.

(3) This second portion of the first volume of Prof. Kopaczewski's treatise represents a distinct advance in French scientific text-books, which hitherto have too often been written with an airy detachment from work carried out in other countries. The references to literature are reasonably numerous and

have not been dictated by geographical considerations. One would expect, however, in a work of this kind some mention in the chapter on osmometry of the determinations of the molecular weight of hæmoglobin by G. S. Adair, as direct measurements of osmotic pressure of biological substances have so seldom been made. The other chapters deal with cryoscopy, conductivity measurements, and the determination of *p*H. The usual methods are described, illustrated with diagrams which are mostly clear enough and large enough to be intelligible, and the tables of results of the most varied nature make interesting reading even for those who will never carry out the determinations themselves.

The main purpose of the whole work is seldom lost sight of, and special apparatus for biological use is a feature of the author's material; and while those engaged in practical work in this sphere may prefer to use more detailed works on the various subjects, this volume will appeal to those whose needs are somewhat broader.

(4) The unsuitability of the use of the term 'monograph' for a work containing twenty-three papers by as many different authors has been recognised by the substitution of the word 'annual' in this seventh year of issue: no doubt in time 'symposium' will give place to some term more descriptive of the occasions when these papers are presented. In general quality the contributions are well up to the standard which readers have come to expect from this publication, and in variety of subject ensure an appeal to a wide circle. It is almost invidious to select separate papers for comment, but the two papers on adsorption and crystal growth carry an interesting subject a stage further in definiteness and are distantly related to the one on the taking up of dyestuffs by hydrous oxides. Again, the articles on clays and the nature of flow have a marked practical bearing; the perennial fascination of gels is indicated by three papers on different aspects of their behaviour, and adsorption and the measurement of the surface area of adsorbents also claim attention. Biological problems are represented by three papers, including one on the projected methods of analysis of bacteria in quantity.

One has the feeling, however, that both the meetings and the report of them in this volume would be improved by the selection of a few dominant issues, to be treated with less detail of experimental work than is here included. Discussions on the papers are not included in the book, and there seems no direct way in which criticism of the papers could be brought forward by anyone not at the meeting. There is no doubt, however, that this annual meeting of American colloid chemists performs a useful function, and many will wish that a similar event might be organised in Great Britain.

(5) Dr. Ware states in his preface that "the purpose of this text is to present the fundamentals of colloid chemistry as they are disclosed by an analysis of the material available at this time and not in accordance with the facts of twenty years ago", as he alleges that in the elementary books on the subject both material and method of presentation are very largely obsolete. One therefore hoped to find in this volume a lucid and up-to-date account of a growing science; unfortunately, it is so marred by inaccuracies in detail that it would be inadvisable to place it in the hands of any but a very intelligent student. On the very first page the criterion of size of particles is stated to be insufficient as a definition of the colloidal state, but no clear definition is given, and the next forty pages are devoted to a description of some of the methods used to determine particle size. This discussion, and indeed the whole of the first half of the book, must leave the student wondering when the materials which have these queer properties are going to appear, for he has to wait until p. 170 before he is allowed to know how the simplest colloidal solution is made. His difficulties will be further increased if "any source of light falls at any angle on any particle" (p. 87), or if he uses a large block of uranium glass with the cardioid condenser (p. 11). The author is particularly pleased with a photograph of the Brownian movement showing a series of wavy lines as indicating the 'vibratory' movement of the particles, and gives the usual diagram of erratic lines with apologies; he does not seem to realise that the photograph was obviously taken with a moving sol or a moving plate (p. 110). On p. 224 the reader is told that particles in emulsions do not carry an electric charge; while on p. 250 the swelling of rubber in benzene is quoted as curious behaviour on the part of a *lyophobic* colloid.

These examples of ill-digested statement are casually selected—there are many more; and while the reviewer is not in agreement with the order of presentation, there is little object in discussing that while the facts presented are so inaccurate. The author suggests that to begin with Graham's experiment on dialysis produces "a combination of entertainment and confusion"; it would be difficult to find a more suitable expression for the results of his own work. P. C. L. THORNE.

Wave Mechanics.

(1) *An Introduction to the Study of Wave Mechanics.* By Prof. Louis de Broglie. Translated from the French by Dr. H. T. Flint. Pp. vi+249. (London: Methuen and Co., Ltd., 1930.) 12*s.* 6*d.* net.

(2) *Wave-Mechanics.* By Prof. Arnold Sommerfeld. Translated from the German edition by Dr. Henry L. Brose. (Supplementary volume to " Atomic Structure and Spectral Lines ".) Pp. xii + 304. (London: Methuen and Co., Ltd., 1930.) 21*s.* net.

HERE we have two books on wave mechanics dealing with the most recent advances in theoretical physics, written by two distinguished authors, each prominent in his own country in the ranks of constructive thinkers. It is of great interest to compare the imaginative work of Louis de Broglie with the more critical and exhaustive treatment of Arnold Sommerfeld.

To de Broglie (1924) we owe the almost bizarre conception which led later to the more complete formulation of wave mechanics by Schrödinger. Every particle possesses some of the attributes of a wave. A particle in motion must be associated with a certain periodicity and with a wave-length, the latter calculated very simply by dividing Planck's constant by the momentum of the particle. This relation is in some measure imposed by the fundamental principles of relativity. A ray of light possesses corpuscular properties, but the light corpuscle is guided by a wave. Such was the paradoxical view which suggested itself to the French physicist. At first it seemed to many only a fanciful and unpractical vision, but the young man's vision led to unforeseen experimental and theoretical developments. Several experimenters brought forward evidence, somewhat vague at first but later clear and definite, to show that moving electrons do behave as though they were controlled by waves when they encounter reflecting surfaces or thin films of matter. Even this experimental evidence would probably not have attracted so much attention, had not the theory of wave mechanics been developed in Schrödinger's papers of 1926 and 1927.

The new method is based on the century-old work of Sir William Hamilton, of Dublin, on the relation between optical and dynamical principles. The principle of Fermat in optics makes the time a minimum for the path which is actually taken by a ray of light travelling from one point to another. This is analogous to the principle of least action, which asserts that a certain integral representing the action has a stationary value for the actual trajectory of a particle. Classical dynamics presents a close analogy to geometrical optics; quantum mechanics presents a close analogy to physical optics. Instead of Fermat's principle we must now employ the principle of Huygens, according to which any point which is reached by a wave becomes the origin of a secondary wavelet which spreads outwards with the same velocity as the original wave. This principle may be expressed in a way familiar to mathematicians as a differential equation involving a complex quantity which Schrödinger calls ψ. The fundamental equations of mechanics must be replaced by a wave-equation in configuration space.

It has been said that Englishmen, who incline to concrete ideas, are less readily accessible to progressive abstraction than the older peoples of the Continent. Certainly many of them confess that they favour a 'picturesque' (*anschaulich*) description of physical phenomena whenever that is available. What, then, is the meaning of Schrödinger's field scalar ψ, or what is the interpretation of his waves? At first it seemed as if the experimental physicist were to be made happy with a concrete representation. The simplest idea is that which regards the particle or the electron as constituted by a group of waves; it is a 'wave packet'. " Unfortunately, when we pass to the domain proper of the new theory it appears scarcely possible to support this idea which is so attractive on account of its simplicity. . . . If they were simple wave packets the particles would have no stable existence." On another view, formerly supported by de Broglie, the particle is considered as a singularity in a wave phenomenon, but to this there are serious objections and it is not discussed at length in his present work. Another suggestion was published in his report to the Fifth Solvay Congress and may be called the theory of the pilot wave. The wave is considered as a reality and as occupying a certain region of space, while the particle is regarded as a material point having a definite position in the wave which serves to guide it on its way. This view also meets with serious difficulties and can only be retained by giving it a modified form.

Schrödinger attempted to interpret his field scalar, ψ, by connecting it with the density of electrical charge, and in dealing with the one-electron problem he obtained striking results by making the product of ψ and $\bar{\psi}$, the conjugate complex quantity, proportional to an electric

density. It is, however, difficult to see how this is to be generalised so as to apply to the case of many electrons. Sommerfeld refers to the view that the charge of the electron is continuously distributed in space as a somewhat unattractive hypothesis, and says: "We refuse from the outset to take literally the charge-cloud to which Schrödinger's theory leads. Rather we shall retain the well-founded view that the electron is point-like in form or at any rate is a configuration of sub-atomic dimensions." He concludes that the charge-cloud can have only a statistical meaning. "Giving up the idea of individual orbits we regard the charge-cloud as the sum total of possible paths of the electron and imagine the average time of stay of the electron in each individual position as determined by the charge-density at that point." On this statistical view, first given a logical basis in the papers of Born, the wave becomes no more than a purely symbolic and analytic representation of certain probabilities, and no longer constitutes a physical phenomenon in the old meaning of the term.

There seems to be little doubt now that the statistical interpretation, unwelcome though it may be, lies closer to the real truth than the earlier suggestion. It has the advantage that it harmonises with the "uncertainty principle" of Heisenberg, for Bohr has shown how the interplay of wave and particle concepts may be closely related to the lack of precision which is inherent in all physical measurements, and how the mathematical formulation is an expression of this unavoidable uncertainty. In conformity with this view, the ψ-function itself is only a mathematical auxiliary quantity, and it is its *Norm* (the German expression for the square of the absolute value), when multiplied by e, that has a real physical meaning, namely, the density of charge. In the same way, the electromagnetic field intensities, which satisfy the differential equations of Maxwell, may also be regarded as mathematical auxiliary quantities introduced for calculating the actual physical relationships between the energy and the motion.

As Dirac has pointed out, the trend of modern theory makes things less easy for the learner of physics. "The new theories, if one looks apart from their mathematical setting, are built up from physical concepts which cannot be explained in terms of things previously known to the student, which cannot even be explained adequately in words at all"!

All those who attempt to follow with halting steps the strides made by the expounders of the new wave mechanics will welcome these two volumes. The translators and the publishers are to be congratulated on the accomplishment of such imporant work, and many English readers will be grateful to Dr. Brose for providing at the end of Sommerfeld's book a list of German expressions and their English equivalents.

H. S. ALLEN.

Experimental Research on Cancer.

Some Aspects of the Cancer Problem: an Account of Researches into the Nature and Control of Malignant Disease commenced in the University of Liverpool in 1905, and continued by the Liverpool Medical Research Organization (formerly the Liverpool Cancer Committee), together with some of the Scientific Papers that have been published. Edited by Dr. W. Blair Bell. Pp. xiv + 543 + 90 plates. (London: Baillière, Tindall and Cox, 1930.) 63*s*. net.

THE aims and objects of this book are clearly set out on the title-page, and the work of the Liverpool Medical Research Organization is sufficiently well known to medical and pathological readers to need no introduction here. Since practically the whole of the contents have appeared previously in various scientific and medical journals, it will not be necesary to review the work in detail. Speaking generally, it may be said that this large volume is in the nature of an *apologia pro vita sua* on the part of the director and the Organization as a whole, and it concludes with an earnest plea for more financial assistance so that the work may go on.

As is the case when claims are made for therapeutic measures in malignant disease, this Organization has in the past encountered a great deal of criticism and hostility. It is well known by those attending meetings in recent years that the attacks have frequently been made with extreme bitterness, so that to disinterested observers it has appeared that whilst scientific problems have been forgotten, personalities have held the day. It naturally occurs, therefore, to look through the book to see what Prof. Blair Bell has to say to his enemies. The author or editor of a monograph has had a wonderful opportunity of hitting back at his attackers without their being able to reply except by publishing another monograph, but one is struck by the fact that Prof. Blair Bell entirely avoids personalities and does not in the least take advantage of his position as editor of the volume. One must admire the fairness of the editor's mind and

congratulate him on overcoming what must have been a severe temptation. Briefly, the contents of the book are as follows :

First, the introduction leads up to the hypothesis of the Liverpool school that malignant disease is similar to chorion in its power of invading normal tissues. From this the whole thesis is built up, and the editor points out that the adoption of lead as a therapeutic agent was due to the well-known fact that this metal causes abortion, possibly by destroying the chorion epithelium. It follows naturally that there must be a great many pitfalls in so wide a type of argument, and it must be admitted, at least by the reviewer, that the collected papers which appear in the later sections of the book do not altogether allay the various doubts arising in the mind. The first series of papers is concerned with physico-chemical considerations on cell membranes by a group of workers under Prof. Lewis. The majority of these observations are of a negative type; for example, the hydrogen ion concentration of the blood in cancer is shown not to differ from that of ordinary blood.

Then follows a long series of investigations by a group of biochemists on the measurement of the metabolism of isolated tissues, working with the methods of Prof. Otto Warburg. It will be remembered that Prof. Warburg showed the widespread nature of the property of glycolysis—conversion of carbohydrate to lactic acid—in all classes of tissues in the absence of oxygen. Only certain kinds of tissue, however, are able to continue producing lactic acid when they are placed in oxygen. At first the suggestion was made that this property was characteristic of tumour tissue, but recent work has made untenable this view of aerobic glycolysis as a specific defect in tumour tissue. Warburg himself, in a paper translated in the volume under review, recognises this fact. This being so, the somewhat elaborate investigations on the metabolism of chorionic epithelium lose some of their interest. Certainly, the fact that chorion has a positive 'U-value' is no criterion of its supposed malignancy, since it is now generally agreed that there are a number of examples of malignant tissues with negative 'U-value', and that this classification is unsound and must therefore be abandoned.

Metabolic studies designed to show the possible mechanism of the action of lead on tissue glycolysis are also included. The fact is recorded that minute concentrations of lead may actually increase tissue glycolysis. Otherwise there appears to be little difference between the action of lead and any other heavy metal. The poisonous effect of heavy metals on enzyme action is a well-known phenomenon, and we cannot agree with the statement on pp. 69-70 that hitherto the actions of poisons on enzyme action have not been found to follow a unimolecular law. In fact, several frequently quoted examples, such as the experiments of Euler and Svanberg on poisoning of saccharase action by aniline, come to mind.

Certainly, therefore, the metabolic measurements, whilst of some interest considered on their own merits, do little to support the general theme with which the book is concerned, namely, the treatment of cancer with lead preparations. There is no evidence from metabolic measurements that the action of lead is exceptionally valuable in destroying the cancer cell by depriving it of the energy necessary for its growth, under conditions where it does not also damage normal tissues to at least the same extent. In addition, the effect of lead in this respect does not differ from that of other metals (p. 511).

This section is followed by a long series of pharmacological observations on lead, the preparation of suspensions and colloidal solutions of the metal, and some observations on organic lead compounds. The changes in the blood during lead therapy are also described at length, and the latter part of the book is concerned with the treatment of cases. Perhaps the most interesting part of the whole work appears on p. 458, where the editor has set out in tabular form the results of their treatment from November 1920 to November 1928. In all, 566 cases were treated, but of these 360 died before the treatment could be completed and a further 77 after the treatment. Various others died of concurrent infections, and some refused treatment. Of the remainder, it is believed that 2 were completely cured but died of other affections later, whilst in 12 the disease was completely arrested, and in 51 the Organization considered the cure had been complete. This tabulating of the results is undoubtedly the most valuable part of the book, as it will enable future investigators to judge whether the risks, etc., of the treatment are justifiable.

In conclusion, a word of praise must be said concerning the general lay-out of the book. The indexing is very good from the point of view of both reference and subjects ; the amount of work involved in collecting the reprints, etc., must have been very great indeed. As to whether the book will be of permanent value and so justify all this reprinting, time alone will prove. The general impression given by reading the work is that the

investigators have strained every argument to support their theory, with the result that in many instances they would rather appear to beg the question. For example, on p. 511 the author does not appear to be quite clear about the Aschheim and Zondek test for pregnancy. Whilst it is true that the presence of a growth-promoting hormone has been noted in the urine in certain cases of cancer (among many other conditions) by these authors, the same principle is not that upon which the pregnacy test is based. This latter test is dependent upon the demonstration of the presence of a luteinising hormone affecting the ovaries and having no effect on general bodily growth in experimental animals. The use of this, therefore, to assist the argument for an analogy between pregnancy and cancer, loses much of its point.

As no general review of modern cancer research work would be complete without a consideration of the work at Liverpool, this volume, in presenting the view of the Liverpool school up-to-date, is of considerable value.

Mathematical Physics.

(1) *Foundations of Potential Theory.* By Prof. O. D. Kellogg. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 31.) Pp. ix + 384. (Berlin: Julius Springer, 1929.) 19·60 gold marks.

(2) *The Electromagnetic Field.* By Max Mason and Warren Weaver. Pp. xiii + 390. (Chicago: University of Chicago Press; London: Cambridge University Press, 1929.) 27*s.* net.

THE scope and quality of the two works under review are very different, but they are both concerned with branches of theoretical physics, and attack them rather from the point of view of the pure mathematician. This raises an important question of pedagogy, on which there may be differences of opinion. In introducing the differential calculus, for example, is it best to base it on crude ideas about the tangents of curves, or should we begin with the full machinery of the theory of limits? Most teachers adopt the former course, for the reason that it quickly opens out wide ranges for application, whereas, though the logical introduction may sharpen the student's faculties, he may become so busy suspecting the soundness of all the ordinary mathematical processes that he will never learn why anyone should ever want to differentiate anything.

The same divergence applies with even more force to the subjects of theoretical physics. The theory of attractions was developed to study such things as the figure of the earth and the electrical capacity of condensers, and most students learn it for such purposes. The teacher therefore aims at a rapid introduction, making the results appear reasonable to common sense, and opening the subject up as fast as possible so as to show the applications. If this is to be done, it is not admissible to enter into the noble sport of axiom-chasing, but the consequence is that every teacher will remember some clever student who objects to the looseness of the presentation. The student is really experiencing the inherent difficulties of the subject itself, but in trying to puzzle them out has found the weakness of the argument, and naturally blames that. Such troubles should be removed as soon as they are felt, but this is a different thing from carrying the whole exposition through rigorously from the start: for to do that would be to suggest many other difficulties the student has not yet perceived, which will give him far less trouble later when he is more familiar with the whole subject. The present works will find a most useful place in this way as commentaries to be read by a student who has already gained some knowledge of the subjects but has the tidy mind which cannot for a moment tolerate results, however reasonable, unless he can follow every logical step in their derivation.

(1) Prof. Kellogg has written so admirable a book on gravitational attractions that the above comments are perhaps a little ungracious to him. The excuse for them lies in a certain disparity between the first and the last part of the book. Thus the beginner will find that the first three chapters, and a few other parts of the book, will give him all that he needs for an elementary knowledge of the principles of potential theory. But interspersed with this he will find rigorous proofs of such things as Green's theorem, based on the theory of sets of points and the rest of the apparatus of pure mathematics. Seeing how elaborate the discussion becomes, he will be impressed with the difficulty of the subject, and there is a danger that he will think that this difficulty extends to all the applications. On the other hand, the advanced student, who will be a pure mathematician and not a physicist, will not want to waste his time over the elementary part, but will go right on to the rigorous proofs, integral equations, and existence theorems which constitute the important part of the book.

Among all this excellent matter we may single out as of special interest the historical account in

the last two chapters of the various attacks on the fundamental existence theorem. This is a brilliant piece of work, which describes and criticises the successive attempts to prove the existence of the potential, and their limitations ; it will be of great interest to those who are not specialists in potential theory as well as to the experts.

(2) The book of Messrs. Mason and Weaver does not contain any such advanced mathematical theory, but is a straightforward working out of the ordinary principles of elementary electrical theory with a careful analysis of the postulates involved. It falls into four chapters, each of which enters in detail into the principles concerned and also gives many useful examples. The first two traverse the subject of electrostatics. We may single out one point in the treatment which is superior to that of most text-books, and this is the early introduction of the idea that the potential may have a discontinuity at the surface of a conductor ; much of the confusion of thought about the Volta effect arises from the unwarranted assumption, made in most elementary treatises, that the potential of the conductor is the same as that just outside. The third chapter, on magnetism, is novel in that it takes as starting-point the magnetic interaction of electric currents, instead of beginning with permanent magnets. Consequently the vector potential comes in very early, and its curl, the magnetic induction, becomes more fundamental than the magnetic force. The last chapter discusses the field equations of Maxwell in the same detailed manner.

We may only comment on a rather vehement dislike expressed for the ether, which has an old-fashioned flavour. The ether is now usually only regarded as ' the subject of the verb to undulate ', and should have passed into a state where it is beyond the passions. The work goes perhaps a little too slowly to be used as an introduction to electrical theory, but it may be recommended for students who were not contented by their first reading of the subject, and especially for those who are more interested in logical principles than in the applications.

Small Talk about Linnæus.

Linné und Berlin. Von Felix Bryk. Berliner Festschrift zu Linné's Hundertfünfzigstem Todestage, 1778–1928. Pp. xv + 59. (Neubrandenburg : Gustav Feller, n.d.) n.p.

THIS seems to be a publication intended for the collector rather than for that large circle which is genuinely interested in the scientific work of Linné. The title scarcely indicates either its subject or the variety of curious and entertaining matter which the booklet contains. It expresses indeed little more than the fact that the hundred-and-fiftieth anniversary of Linné's death, in 1928, was celebrated more in Berlin than in any other place, and that an article on Linné's relations with Berlin, which Dr. Bryk of Stockholm wrote for the *Berliner Tageblatt*, but which did not appear, is now first published. The editor, C. L. Hansen, has, however, included the address Linné as artist, delivered on that occasion by Dr. Bryk, as well as a lecture that he gave on Linné from the bibliophil point of view.

The value of the book to the collector does not depend only on the small size of the edition, 67 copies : it will be prized also for its facsimiles of Linné's diploma from the Berlin Academy (signed, be it noted, by two Frenchmen, Maupertuis and Formey), Linné's letter of acknowledgment to Formey, and Linné's original sketch for his arms ; also, possibly, for the facsimile of part of the proof of the *Berliner Tageblatt* article. None of these has been published previously. Other facsimiles comprise the notification of Linné's death and numerous rough drawings by Linné himself, among which the most notable is the diagram of an egg in section, intended for his arms but objected to by the herald, Tilas, who eventually admitted the egg under protest but not without the decent covering of its shell.

Linné's relations with Berlin may be summarised in the facts that Celsius, then in Berlin, got a review (written by Linné) of the " Lapland Journey " translated into Latin and published at Nuremberg ; that Gronovius brought him to the notice of the Berlin Academy, with results already mentioned ; and that Gleditsch confirmed Linné's views on the sexuality of plants by a notable experiment. The female palm which Gleditsch fertilised is still growing at Dahlem.

Linné's artistic sense appears not so much in the rough sketches with which he explained his meaning, as in some small head- and tail-pieces, in his care for typographic style, in his accurate appreciation of colour, and above all in his continual praise of the beauty found in Nature. He constantly urged the employment of competent scientific draughtsmen, and Archbishop Benzelius is responsible for the assertion that the Archiater knew more about painting than anyone else in Uppsala.

Linné appears as bibliophil in his formation of a private library and in the bibliographic references

contained in his "Systema Naturæ". The interest of bibliophils in Linné is due partly to the enormous literature concerning him and his work, partly to the difficulty of deciding whether certain theses were due to his pen or to that of their nominal authors, partly to the minor variations in title-pages and the like so dear to the collector, and partly to the excessive rarity of some publications. The rarest must surely be the panegyric of which my Lord Baltimore in 1780 printed only two copies. That eccentric travelled through Sweden in a carriage so large that bridges had to be widened for him to pass with his retinue, including two cooks, eight mistresses, but only one physician. His reason for perpetually travelling was that he did not wish to know where he would be buried. Let this digression serve as a sample of the entertainment to be found in Dr. Bryk's enthusiastic pages.

The booklet is well produced and is provided with three indexes: to personal names, to literature quoted, and to place-names. The only serious omission is that of a date of publication on the title-page. F. A. B.

Design and Operation of Chemical Plant.

(1) *Filtration and Filters: an Outline of the Art.* By J. A. Pickard. With a Section on the Mathematical Aspects of Filtration, by A. J. V. Underwood. Pp. 488. (London: Ernest Benn, Ltd., 1929.) 45*s*. net.

(2) *Sulphuric Acid and its Manufacture.* By Dr. H. A. Auden. Pp. viii + 231. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 16*s*. net.

(3) *A Handbook for Cane-Sugar Manufacturers and their Chemists.* By the late Dr. Guilford L. Spencer. Seventh edition, revised, re-written, and enlarged by George P. Meade. Pp. xix + 560. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 30*s*. net.

(4) *The Chemistry of Leather Manufacture.* By Dr. John Arthur Wilson. (American Chemical Society Monograph Series, No. 12.) Second edition. Vol. 2. Pp. 497-1181. (New York: The Chemical Catalog Co., Inc., 1929.) 10 dollars.

A GREAT deal of scattered information is available relating to the design and operation of chemical plant. Some of it is contained in technical pamphlets, many of them excellent, which are issued from time to time by the actual plant manufacturers; some of it appears in the form of articles in technical journals; much of it is hidden away in the plant records of the chemical manufacturer. This scattered information may usefully be collected and summarised from the point of view either of plant design or of plant operation.

Of the books under review, the first is of use to the student of plant design; the others deal more particularly with operating conditions.

(1) Mr. Pickard's volume is primarily a useful collection of some four hundred illustrations with appropriate descriptive matter, showing the types of filtering apparatus and plant that are available for dealing with the different kinds of filtering problem. The treatment adopted in the book is almost entirely descriptive; little is said about the quantitative aspect of filtration. The arrangement of the book is somewhat uneven; considerable space is given to gravity oil separators, whereas such a useful appliance as the electrostatic precipitator is barely mentioned. Nothing is said about the effect of precipitating conditions upon the filtering characteristics of the precipitate. The book contains a valuable chapter by Dr. Underwood upon the mathematical theory of filtration.

(2) Dr. Auden's work is essentially a comprehensive notebook on the subject of sulphuric acid manufacture. It is addressed primarily to the student of applied chemistry. In his treatment of the subject, the author does not seek to obtrude his viewpoint to any great extent on the reader. He is satisfied to correlate and submit the opinions and conclusions of other workers in the field, drawn from the vast amount of published data available. In giving copious references to original articles, he provides the reader with a suitable jumping-off ground for a more extended study of the subject.

Chap. xii., on the theory of the chamber process, might well be cast somewhat earlier in the book—say, in place of Chap. ii., which treats of the handling and transport of acid. In many places there is a scarcity of diagrams; in others, too little descriptive matter accompanies the diagrams submitted. These points are small, but, as the work is intended primarily for students of industrial chemistry, the first suggestion would seem an obvious advantage, while the second would prove a decided help to those whose experience of plant has yet to be obtained.

It is remarkable how much information the author has succeeded in compressing into the relatively small space of sixteen chapters and two

hundred and twenty-one pages. That he has carried out a very creditable piece of work there can be no doubt. We have no hesitation in recommending this book to all those interested in the technical development of the sulphuric acid industry.

(3) A new edition of Spencer's well-known handbook on the cane sugar industry has been issued. Five new chapters are included, dealing, respectively, with the economic phases of the sugar industry, the keeping and refining qualities of raw sugars, hydrogen ion control, colour determination in the sugar industry, and fermentation. The book is a model of what a handbook to a large industry should be. The author describes clearly and completely the kind of plant that is used at each stage of the process, and discusses fully the design and operation of each plant, both from the chemical and the chemical engineering points of view. The book might equally well form a basis for a detailed chemical engineering study of the design and lay-out of a cane sugar factory.

(4) Vol. 2 of Dr. Wilson's important treatise on leather manufacture deals from the physical chemical point of view with the practice and theory of both vegetable tanning and chrome tanning, as well as of numerous other special tanning methods. The underlying principles of the various processes to which the leather is afterwards submitted are described very clearly and in great detail. Finally, the chemical and physical properties of the finished leather are considered both from the theoretical and practical aspects.

The leather industry, although one of the oldest industries in the world, is actively developing in numerous directions, thanks to the application of physical chemistry to the investigation of its problems and processes, and this book is a first-rate account at first hand of the newest developments in leather chemistry, written by one of the leading and most active workers in this field. It is a fascinating book, not only for the leather manufacturer, but also for the physical chemist and the chemical engineer.

Dinosaurs in East Africa.

The Dinosaur in East Africa: an Account of the Giant Reptile Beds of Tendaguru, Tanganyika Territory. By Dr. John Parkinson. Pp. 192 + 12 plates. (London: H. F. and G. Witherby, 1930.) 12*s.* 6*d.* net.

IN 1907 the late Prof. E. Fraas, of Stuttgart, discovered at Tendaguru in Tanganyika Territory (then German East Africa) an extensive deposit of bones of gigantic Dinosaurs comparable with the bone-beds in which startling discoveries had already been made in Wyoming, U.S.A. From 1909 until the end of 1912, Dr. W. Janensch and Dr. E. Hennig explored this deposit with remarkable success, and made a great collection of the Dinosaurian remains which are now in the Museum für Naturkunde in Berlin. They also studied the geology of the country, and published a valuable report on the subject, showing that the African and North American formations were of about the same age and had accumulated under similar conditions. Dr. Janensch is also still publishing a series of important monographs on the skeletons as they are prepared. After the war the British Museum undertook to continue the exploration, and among those who were engaged both to collect specimens and to re-examine the geological structure of the district was Dr. John Parkinson, who had already had much experience of field-work in Africa. Dr. Parkinson not only collected materials for a scientific report, but has also prepared a popular general account of his expedition in an attractive little book which is now before us.

Dr. Parkinson deals with a technical subject in a non-technical and entertaining manner, and enlivens each chapter with apt quotations ranging from Shakespeare and Dickens to H. G. Wells. As he proceeds from one aspect of the investigation to another, he imparts to the reader some of the enthusiasm of the discoverer. In less than two hundred pages he succeeds in giving a good idea of the problems which arise for solution.

The main bone-beds of Tendaguru extend over an area about 3½ miles from north to south and 1½ miles from east to west. There are also outlying deposits of similar bones in the surrounding region, all dating back at least to the beginning of the Cretaceous period, some perhaps a little older. The skeletons must have been washed together by river-floods in an estuary or lagoon, which was invaded at intervals by the sea; for there are layers of sand and clay full of marine shells intercalated at intervals in the river sands and clays.

The Tendaguru Dinosaurs themselves are much the same as the Dinosaurs which have been found in the corresponding rocks in North America and elsewhere. One of them, *Gigantosaurus* or *Brachiosaurus*, is interesting as being at least as large as the largest hitherto found in North America, probably well over 100 feet long. They formed the same kind of community, with strange lack of brain-power, yet dominating the world of life.

Dr. Parkinson refers to this strange dominance, and devotes one chapter to the mode of life of the Dinosaurs, and some possible reasons for the extinction of these and all the other giant reptiles at the end of the Cretaceous period when small mammals appeared ready to take their place. He particularly refers to the effect of parasites on the existing mammals of Africa, and suggests that the known change in the flora at the end of Cretaceous times may have led to an increase in certain injurious insects. The mystery still remains, however, for the sea-reptiles disappeared as suddenly as the land-reptiles, and the pterodactyls gave place to birds.

Dr. Parkinson, in discussing the Dinosaurs, brings together much curious information which, though familiar to palæontologists, will be new to most readers; and he concludes with a bibliography which will be useful to those who wish to pursue the subject in detail. We would only add that he might well have included a reference to the late Dr. W. D. Matthew's excellent Handbook of Dinosaurs, published by the American Museum of Natural History, New York. A. S. W.

Orchids.

(1) *Orchids for the Outdoor Garden: a Descriptive List of the World's Orchids that may be grown Outdoors in the British Isles; for the Use of Amateur Gardeners.* By A. W. Darnell. Pp. xx + 467 + 22 plates. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 42*s*. net.

(2) *Our Wild Orchids: Trails and Portraits.* By Frank Morris and Edward A. Eames. Pp. xxxi + 464 (130 plates). (New York and London: Charles Scribner's Sons, 1929.) 30*s*.

(1) THE cultivation of orchids out-of-doors has never been developed to the same extent as that of their hothouse allies, but with the increasing popularity of rock-gardening a greater interest is being taken in those species of orchids, mostly terrestrial, which can be grown in the open in Great Britain. So far only a few of the more striking European species such as *Orchis purpurea*, *O. militaris*, *Himantoglossum hircinum*, and various American species of *Cypripedium* have been cultivated at all frequently.

There are, however, many species which, judging from their native habitats, should be hardy in the British Isles and would well repay the trouble of growing them. Mr. Darnell, in the work here noticed, describes all the species which in his opinion fall into the above category. Generic descriptions are also given, while notes on distribution, habitat, time of flowering, and suggested cultural methods are added. A glossary of scientific terms and a short introductory chapter on methods of propagation and importation are also provided. Some of the more interesting species are figured.

In consequence of the wide scope of the work the number of species included is about one thousand, and it will be several years before even a tithe of them can be brought into cultivation. The book, however, should be a useful guide for anyone visiting any part of the world as to which orchids are worth collecting. Unfortunately there are few people who would be able to name the species collected in many countries even with the aid of Mr. Darnell's book. Anyone who has studied, for example, the genus *Habenaria*, of which there are 94 species included in the book, knows how difficult the species are to name even in a large and relatively complete herbarium. For many years it will be necessary to submit specimens of this and other genera mentioned to expert orchidologists in order to be sure of their identity.

Nevertheless, Mr. Darnell's book demonstrates in a convincing manner what a wealth of orchids there is available for growth out-of-doors in Great Britain, and should encourage those interested in gardening to endeavour to introduce as many as possible of such species. When growing, these may be studied more thoroughly by taxonomists than is possible from herbarium specimens alone. Our greater knowledge of the hothouse species can be attributed directly to such study in the living condition.

(2) The fascination which orchids have for the amateur in almost every country is no doubt bound up with the remarkable form and intricate structure of their flowers. For the same reason pictures of orchids are usually relatively more valuable than those of other plants since orchids are more difficult to describe adequately in words. Consequently by obtaining photographs of all the species of orchids growing in eastern North America, the authors of the present volume are rendering a considerable service to science.

However, the photographs, which might with advantage have been taken on an even larger scale, are only a portion of the book. Each species is described shortly and its popular names are given, while detailed notes on habitat, distribution, and flowering period are provided. The bulk of the book is taken up by accounts of the authors' searches for the various species, their adventures

on the way, and their final successes, often accompanied by charming pen-pictures of the areas visited and of the orchids themselves. The photographs, several of which are coloured, are all taken in the field, and therefore show effectively the natural habitat of each species. Keys to the genera and species are supplied at the end, together with a glossary of scientific terms used. The features mentioned above, together with the excellent format, render the book a useful and attractive addition to any botanical library. V. S. S.

Classification of Ore Deposits.

Ore Deposits of Magmatic Origin: their Genesis and Natural Classification. By Prof. Dr. Paul Niggli. Translated from the original German edition by Dr. H. C. Boydell. Revised and supplemented throughout by Dr. Niggli and Dr. R. L. Parker. Pp. xi + 93. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1929.) 9*s*. 6*d*. net.

PROF. NIGGLI has followed his important monograph of 1920 on the function of the volatile constituents in petrology by an interesting essay on their importance in the classification of ore deposits. He adopts the view that an ore is a rock and should be studied as such, and that "ore deposition is a part problem of magmatic differentiation in its widest sense". He regards as magmatic all products that arise originally from the interior of the earth, and holds that "magmatic processes are to no small extent involved in the formation" of even such materials as glass sands and those used for cement and pottery. He divides magmatic products into three kinds: the orthomagmatic, or directly igneous, to which some authorities limit the term; the pegmatitic-pneumatolytic; and the hydrothermal. He remarks that the meaning of the term pneumatolytic has been altered, since it was proposed by Bunsen for volcanic exhalations; but as the essential agent, according to Bunsen's conception, is superheated steam, the modern development seems justifiable. The author's introduction of the term orthomagmatic is useful, as its adoption would avoid the ambiguity as to the implication of the term magmatic.

The author is a master of the principles of physical chemistry, and his treatment of ore formation is throughout clear, though technical, and suggestive. He introduces many new terms, such as 'exogeospheric' for the processes of the atmosphere and lithosphere, and 'endogeospheric' for those of the interior, and 'telemagmatic' for operations that take place remote from the site of the magma.

The author lays stress on the threefold division of ores, based on depth and nature of formation, on geological age, and on geographical distribution. He applies to ores his well-known views on petrographic provinces, and adopts Pacific and Mediterranean groups of ores. That those terms are not used in a strictly geographical sense is shown by the remark that there are many Pacific provinces. His classification develops the well-established gradual passage from the deep-seated orthomagmatic to the superficial or hydrothermal ore deposits. He differs from many economic geologists in his conclusion that "complete sequences of ore deposits are connected with folding movements". He explains the poverty of the Alps in ore deposits as due to the movements which made the mountains having been promptly followed by the sinking of the area as a geosynclinal. There is much to be said for the alternative view that the ascent of the hydrothermal solutions takes place mainly along deep-seated normal faults in regions of tension.

The book refers briefly to a large number of ore deposits and there are naturally a few slips, such as the pre-Cambrian age of those of Mount Lyell, and reference to the titaniferous iron ore of Taberg in Sweden as an example of an orthomagmatic ore of great economic importance.

The careful translation by Dr. H. C. Boydell has been revised and supplemented by Prof. Niggli and Dr. Parker.

Peruvian Antiquities.

Dress and Ornaments in Ancient Peru: Archæological and Historical Studies. By Gösta Montell. Pp. viii + 262 + 3 plates. (Göteborg: Elanders Boktryckeri A.-B.; London: Oxford University Press, 1929.) 15*s*. net.

IT is characteristic of the cosmopolitan learning of our time that this study in Peruvian antiquity should be prepared at Gothenburg, translated into English, and published, with a generous Swedish subsidy, by the Oxford University Press. Besides the splendid ethnographical museum in Gothenburg over which Erland Nordenskiöld presides, more than a score of other museums and galleries have contributed material and illustrations.

For the cultures which preceded the Inca régime, the material is mainly archæological. A sufficient number of actual garments have been preserved by

dry climate, in early graves, to control the interpretation of the vividly pictorial art of the contemporary potters, not only as to the decoration of the clothing, but even as to its shapes and construction. The modelled and painted Chicama pottery is naturally the most eloquent, but the modelled black-ware from the Lambayeque and Trujillo districts contributes much interesting detail. Head-gear, head-ornaments, and hairdressing are, of course, included in the survey; and the difficult question (p. 92) whether tattooing coexisted with face-painting is settled by Dr. Folke Henschen's examination of a piece of mummified skin, which shows dead black "exogenous pigmentation, arisen during life, that is to say, the result of tattooing", though he has not been able to identify the pigment chemically. Its resemblance to coal-dust pigment, in the human lung, supports the obvious guess that soot was used.

For the Inca period, and especially for the culture of the Inca-folk themselves, the evidence is different. The damp climate of the Andes has wrecked most of the original garments, and apparently the pottery does not clearly distinguish between pre-Incan costume and Incan. But the Spanish descriptions, referring, as they do, to the higher ranks of society mainly, and consequently reproducing Inca habits, supply the deficiency of archæological material. Especially valuable, both for garments and for textile processes, are the naïve sketches in Huaman Poma de Ayala's manuscript. Another curious source of evidence is in the myths which describe the divine institution of certain venerable and unalterable costumes; and it is probable that this conservatism, as well as the skilled workmanship noted on p. 195, explains the "surprising consistency in the measurements of Inca shirts found in graves in the highlands, where more clothing was worn and conditions were more favourable for its preservation".

Numerous excellent illustrations and a full bibliography add greatly to the usefulness of this careful and well-written memoir.

Species-Hybrids in Plants.

Artbastarde bei Pflanzen. Von O. Renner. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Lieferung 7, Band 2.) Pp. iv+161. (Berlin: Gebrüder Borntraeger, 1929.) 28 gold marks.

THE eighteenth-century hybridisers—Kölreuter, Knight, Sageret, Gärtner—studied almost exclusively interspecific crosses, although Sageret, like Mendel, gave his attention to pairs of contrasted characters. This method of choosing the most complicated rather then the simplest cases in investigating the laws of heredity continued largely in vogue, with the great exception of Mendel, until near the end of the nineteenth century, and retarded for at least half a century the understanding of these laws. Following the rediscovery of the Mendelian analysis, investigators for many years dealt with variety differences, mainly in domesticated plants and animals. But with elucidation of the Mendelian principles, research on species-hybrids soon began again in such work as that of Baur on *Antirrhinum* and of East on *Nicotiana*. Later genetical work has drifted more and more into the investigation of genera by crossing and cytological study of their species.

This application of the Mendelian weapon to the more complicated problems of specific structure and relationship, in conjunction with chromosome study, together with taxonomic and distributional treatment, is one of the newer and most promising lines of development in genetics. Such studies have already led to important results, and are bringing us to new points of view in phylogeny and evolution.

Prof. Renner has done a valuable service to biology in summarising this recent genetical work on species-hybrids in plants. The first section of his book deals with the F_1 phenotypes, including intermediate hybrids, cases of unlike reciprocal hybrids (especially in *Œnothera*, *Epilobium*, and *Digitalis*), multiformity and vegetative segregation in the first generation. The structure of the pollen, the chromatophores and the chromosomes of such hybrids is discussed, as well as questions of hybrid vigour (heterosis), dwarfing, new formations, and sterility in these forms.

In another section the methods of reproduction and the offspring of species-hybrids are considered at length, including their chromosome behaviour during meiosis. A short chapter is concerned with the cases, mostly quite recent, where a constant hybrid has been produced through a doubling in its chromosomes. Here are cited *Œnothera gigas* and *Primula kewensis*, as well as cases in *Rosa*, *Nicotiana*, *Ægilops-Triticum*, *Raphanus-Brassica*, *Papaver*, *Crepis*, etc.

A final page only is devoted to species-crossing in Nature. This section could have been profitably much extended, but perhaps deserves separate treatment. Following the extensive bibliography there is unfortunately no index.

R. RUGGLES GATES.

Our Bookshelf.

Archæology and Ethnology.

Akan-Ashanti Folk-Tales. Collected and translated by Capt. R. S. Rattray. Pp. xx + 276 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 21*s.* net.

WITH this volume of folk-tales, Capt. Rattray completes a series of four works in which the customs, laws, and beliefs of the people of Ashanti have been surveyed. It is by no means the least valuable of the series, for in these stories the mentality of the people is revealed, more artlessly perhaps, but by no means less effectually, than in the analytical studies of the more formal investigations. These *Märchen* have been taken down in the actual words of the narrators just as they were told around the fire at night in the villages. Facing each page of native text on the opposite page is Capt. Rattray's translation, the incidents and persons of the tales being illustrated by drawings by native draughtsmen.

The translation has been made as literal as possible, allowing for the difference of idiom, but without altering the spirit and style of the original. All the tales have members of the animal world for their characters and, as usual, a large proportion are etiological. Although known generically to the native as *Ananse* stories, the spider (*ananse*) is not the hero of each. The stories in which the spider figures are, however, the most spirited and the most humorous. It is interesting to note that this prominence of the spider survives in the *Anancy* of some collections of stories told by American negroes.

Some interesting points relating to the stories are raised by the author in his introduction. He discusses the reason why animals are the actors in these stories, and why a vein of coarseness runs through them which is foreign to the mode of thought and act of the people. In regard to the former, he is of the opinion that it is not due to a confusion of the human and animal world, as has been suggested, but to the fact that it permits of a greater licence than if the names of persons were used; and in regard to the second point, that the fact that the stories are related at night admits of a freedom of action in the representations which sometimes accompany the stories and in the stories themselves which is not allowed by day. Something analogous is to be observed in the apologetic remarks prefacing the stories and in the text signifying that what follows is not to be taken too seriously.

The Archæology of Middlesex and London. By C. E. Vulliamy. (The County Archæologies.) Pp. xx + 308 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

THIS volume inaugurates a new series of County Archæologies of which the general editor is Mr. T. D. Kendrick of the British Museum. The need for such a series has doubtless been felt by many students for some time. Although the archæological sections of the Victoria County Histories are still invaluable, it is many years since most of them were written. During the last decade many new facts have accumulated; and fresh interpretation of the facts has profoundly modified many views on the prehistory of Britain.

Mr. C. E. Vulliamy's volume deals with the County of Middlesex and that part of the modern county of London that lies north of the Thames. The area is one which presents special difficulties from both the geological and the archæological points of view—not the least being the fact that a large proportion is under bricks and mortar, and direct evidence is obtainable only at haphazard as excavations for building and other works allow. Hence reconstruction is based to a great extent on museum material—too often, especially when in, or after having passed through, private hands accompanied by inadequate and imperfect data of origin and conditions of discovery. Much of the material also has been dredged from the Thames, and therefore affords little direct evidence bearing on archæological problems. There are also gaps in the time-series in respect of London itself. On this account Mr. Vulliamy sets aside the arguments which have been adduced for a Celtic settlement prior to the Roman, and concludes that is was practically deserted for some time after they left. Mr. Vulliamy makes no attempt to ignore all these difficulties; but this only serves to enhance the value of a book which promises well for the future of the series.

Minoans, Philistines and Greeks, B.C. 1400–900. By A. R. Burn. (The History of Civilization Series.) Pp. xv + 273 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 15*s.* net.

IT is scarcely necessary to stress the difficulties which Mr. Burn has had to overcome in attempting a continuous narrative of events in the eastern Mediterranean between B.C. 1400 and 900, that is, from the supremacy of Minoan Crete to the entry of the Dorians into the Greek world. There is, as he says, "in all human history, no period, no subject either of greater interest or of more profound importance". It would be almost equally true to say there is no period which offers more moot points for diversity of opinion.

Mr. Burn has divided his book into two parts. In the first certain controversial matters are discussed as necessary prolegomena—archæology and the legends, the Homeric question, the language problem, the origin of the Achæans, chronology and the like. For his second part—the narrative—the author claims no originality, and apologises for his temerity in trying to do what is not even attempted in the "Cambridge Ancient History". His fears are unfounded. Not only has he produced an eminently readable and interesting story, but also his wide knowledge of the facts and his critical

ability in handling the evidence enable him to make out a good case for his views on controversial matters. For those who are not specialists in Mediterranean archæology he has produced a narrative which will serve as the necessary framework for the appreciation of opposing arguments on questions in suspense. The free use made of the evidence from legends is eminently skilful and ingenious, in fact, a valuable demonstration of the legitimate employment of this somewhat elusive source.

A Scheme of Babylonian Chronology: from the Flood to the Fall of Nineveh; with Notes thereon, including Notes on Egyptian and Biblical Chronology. By Duncan Macnaughton. Pp. xii + 189. (London: Luzac and Co., 1930.) 7*s.* 6*d.*

An adequate commentary on this book would require a space as great as its text. The author apologises for his temerity in putting forward his theories, and excuses himself on the ground that he has no reputation to lose. He has, in any case, produced a stimulating book in which many of the arguments, astronomical, astrological, and chronological, are suggestive in that they frequently open up a new point of view on a vexed problem. It is interesting to note that he finds, for example, that the flood began on Jan. 6, 3181 B.C. in the Julian Calendar; that Hammurabi's reign falls considerably earlier than is usually held; and that Abraham was born not earlier than 2275 B.C. and not later than 2100, and in any case did not live in the reign of Hammurabi as is generally thought. Another interesting suggestion is that the Hebrew story of the Flood is an independent version, having originated in the Armenian mountains, and thus accounting for the fact that the Babylonian Flood began two days earlier. The fabulous number of years assigned to early dynasties by Berosus is ingeniously interpreted to bring them within a reasonable compass—perhaps the most pregnant suggestion in the whole book.

Astronomy.

The Magic of the Stars. By Maurice Maeterlinck. Translated by Alfred Sutro. Pp. 155. (London: George Allen and Unwin, Ltd., 1930.) 6*s.* net.

A book by a writer with the reputation of M. Maeterlinck must be approached with respect, but to be quite frank we must say that we have left this little volume with our respect greatly diminished. The book is partly an exposition of the latest views of astronomers and physicists on the more general problems of astrophysics, and partly an account of the author's own mystical ideas. Our objections to it are two: namely, that the exposition contains far more inaccurate than accurate statements, and secondly, that the science and mysticism—between which no connexion is shown—are so intermingled that the unenlightened reader cannot tell what is a generally accepted conclusion of science and what a fancy of the author's. It is easy, and generally idle, to quibble at inaccuracies of detail in a book by a non-specialist, and the criticism is particularly futile when the argument of the book requires only the broader aspects of science. We should not raise the matter here if the science in the book were merely the basis on which the mysticism was built, but it is not. It is definitely in the form of an exposition, intended to instruct the ignorant simply for the sake of instruction. When, therefore, we find the author frequently wrong in his statements, and, further, using scientific terms in that indefinite and 'woolly' sense which is fatal to clear thinking, we feel that protest is not only justified but necessary.

Our second objection also must be protected against misunderstanding. We do not object to mysticism, or even to M. Maeterlinck's particular brand of mysticism, although we may not find ourselves able to accept it. What we do dissent from is the random association of ideas arrived at by the scientific method with ideas conceived in some other way. It is profitless and confusing to mix ordinary geological facts and arguments with the notion that the earth is a conscious intelligent being with a purpose in view. When Tyl-tyl says: "There are no dead", we are impressed, but when we read, in an account of the universe of the astronomer, that "there are, strictly speaking, no dead and no cemeteries", we are simply irritated. Books of this kind can have no effect but a harmful one, and we hope that M. Maeterlinck's example will not be followed by other writers with metaphysical doctrines which they wish to impart.

H. D.

Modern Cosmologies: a Historical Sketch of Researches and Theories concerning the Structure of the Universe. By Dr. Hector Macpherson. Pp. vii + 131 + 12 plates. (London: Oxford University Press, 1929.) 7*s.* 6*d.* net.

This little book is a companion volume to the author's 'Modern Astronomy' published a few years ago. It consists of eight lectures delivered under the 'David Elder' foundation in the Royal Technical College, Glasgow, during the winter of 1928–29. The word 'modern' is always somewhat indefinite, and it may perhaps be well to state that, excluding an introduction on Greek ideas and a short initial chapter on the transition from the Ptolemaic to the heliocentric conception, the subject-matter ranges from the work of Herschel to that of the present day. It is treated in the main in a descriptive manner, with numerous quotations and references. There is very little independent criticism, but a conspicuous exception to this statement is found in a discussion of Sir William Herschel's cosmology, in which the author gives reasons for dissenting from the opinion of Struve and Proctor that Herschel abandoned the disc-theory of the sidereal system in his later years.

The book is well constructed and gives an excellent bird's-eye view of our present ideas on the structure of the galaxy, the local star system, and the nebulæ and star clusters. Such a summary is very welcome, but in these days of rapid advance by methods inconceivable to an earlier generation, it is perhaps even more timely that the principles employed by the astronomers of the last century in

dealing with this greatest of astronomical problems should be recalled to our memory for their validity to be re-estimated. The book is excellently illustrated, and the form in which it is reproduced makes it a pleasure to handle.

Tychonis Brahe Dani: Opera Omnia. Edidit I. L. E. Dreyer. Tomus 15. Pp. v + 54. (Hauniæ: Libraria Gyldendaliana, 1929.)

THIS volume completes the sumptuous and scholarly edition of the works of Tycho Brahe which Dreyer began and Ræder has completed. A monument of patriotic piety like this edition may not directly promote astronomical science, but there can be no doubt that it tends to foster an enthusiasm for the science to which Tycho Brahe devoted himself, and neither Dreyer himself nor Denmark as a whole can be charged with failing to take a full share in the progress of astronomy.

The present volume contains two short poems and an index to the whole work. Where portions have been separately indexed, references are given, but the details are not repeated. The original design was to include a bibliography and iconography, but we are told that the omission of these is made good by the copious treatment which Tycho Brahe's works and the literature which has gathered round him have received in Ehrencron-Mueller's Danish Bibliography.

One last word of thanks and congratulation is due to G. A. Hagemann and to the Carlsberg and Rask-Ørsted Institutes, the munificence of which has permitted the works to appear in a form worthy at once of the author and of the loving labour of the editors. J. K. F.

Biology.

Biology for Beginners. By Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. vii + 172 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s.*

IN this little book, Dr. Holmyard has organised a very comprehensive course in biology for the pupils in the lower forms of public and other secondary schools. When examining the amount of material which receives consideration, one feels that the author has been a little too ambitious. Although, as he claims from experience, the pupils might grasp all the facts dealt with, one suspects that they might miss the wood for the trees, and it is doubtful whether they would gain a sound knowledge of the general principles of life.

The physiological aspect in biology is probably the most controversial of all. Very judicious handling, therefore, is clearly essential when presenting such a subject to young beginners. By omitting certain facts, that is, by hiding part of the truth, wrong impressions may easily be conceived. The author must plead guilty of this, in some cases. For example, he leaves his readers with the impression that all green plants manufacture starch and that the food of plants is essentially different from the food of animals. In several places, too, terms and conceptions appear which are now out-of-date. The book, unfortunately, contains several points of this nature which, though not exactly errors, might well, with advantage, have been avoided.

Many good illustrations accompany the text, and each chapter is followed by useful questions. The book would probably be more useful to pupils who have already made a still more elementary study of the subject, rather than to actual beginners. It is well written in the author's inimitable style, which makes a free use of humour as a means of maintaining interest.

Further Illustrations of British Plants. By Roger W. Butcher. Drawings by Florence E. Strudwick. Forming with Fitch's Companion Volume to Bentham's Handbook a Collection of Illustrations of most of the Species in the British Flora. Pp. vii + 476. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 12*s.* net.

THIS book should prove an invaluable guide to students of the British flora. To trace the identity and relationships of a species is often a difficult problem, and, in such difficult cases, good illustrations are helpful. Illustrations, however, in many so-called handbooks, are often so poor that they are useless to the systematist. The illustrations given in this volume are distinct, and, although in most cases the whole of the plant is portrayed, many of the diagrams are accompanied by enlarged drawings of the more diagnostic features.

The Angiosperms are, of course, very fully represented among the illustrations; but a few Gymnosperms and Pteridophytes are included at the end of the book. Concise descriptions of the habit and habitat of the plant accompany each illustration.

The authors are to be congratulated on their admirable work, chiefly for its clarity and brevity, thus making possible the consideration of a large number of plants in a comparatively small volume. This work, together with Fitch's "Illustrations of the British Flora", will undoubtedly be accepted as authoritative. It has been compiled by authors who are clearly conversant with their subject, and this, together with the fact that much help has been given by specialists on various plant groups, will enable students of botany to consult it with confidence.

Chemistry.

Oxidation-Reduction Potentials. By Dr. L. Michaelis. Translated from the German Manuscript by Louis B. Flexner. (Monographs on Experimental Biology.) Pp. xii + 199. (Philadelphia and London: J. B. Lippincott Co., 1930.) 12*s.* 6*d.* net.

PROF. MICHAELIS's monograph is divided into two parts: in the first the theory of oxidation-reduction potentials is described, while the second is devoted to the physiologically important systems. The work may be considered the second volume of the author's "Hydrogen Ion Concentration", and the treatment stresses the relationship between oxidation-reduction potentials and hydrogen ion concentration. It provides a clearer and a thermodynamically

correct approach to cell energetics, and should lead to new investigations of the metabolism of the living cell. An oxidation is characterised by addition of oxygen or loss of hydrogen or loss of electrons, and a reduction by one of the converse processes.

In the first part, both inorganic and organic reversible oxidation-reduction systems are submitted to a mathematical exposition: in the second, the results are applied to sulphydryl and reversible respiratory systems of importance in biology; while the final chapter reviews the methods and results of measurements of the potentials in living cells. A bibliography is appended. The author does not claim an exhaustive treatment of the subject, since he does not consider our knowledge sufficiently advanced for a complete discussion of the physiological applications. The book gives an interesting and readable account of oxidation-reduction potentials, and should serve both to disseminate knowledge on the subject and to provide a stimulus to further research.

Lehrbuch der physikalischen Chemie. Von Prof. Dr. Karl Jellinek. Fünf Bände. Band 3: *Die Lehre von der statik homogener und heterogener Gasreaktionen.* Erste und zweite Auflage. Lieferung 8. Pp. 337-656. (Stuttgart: Ferdinand Enke, 1930.) 30 gold marks.

PHYSICAL chemists will welcome the appearance of a further portion of Prof. Jellinek's "Lehrbuch der physikalischen Chemie". Despite its somewhat misleading title, this part of Vol. 3 is chiefly concerned with equilibrium in liquid systems. About 30 pages are devoted to systems composed of non-electrolytes, and the remainder of the volume (270 pp.) deals with the properties of electrolytes in solution. The experimental methods for measuring conductivity, transport number, etc., are first described, followed by a thermodynamical discussion which includes a very complete account of activity coefficients and their determination. The volume concludes with an account of the modern kinetic theory of electrolytes as developed by Debye, Hückel, and Onsager. The whole is treated in the detailed and lucid manner which has characterised the earlier volumes of this valuable treatise.

Periodisches System: Geschichte und Theorie. Von Dr. Eugen Rabinowitsch und Dr. Erich Thilo. Pp. xii + 302. (Stuttgart: Ferdinand Enke, 1930.) 29 gold marks.

THIS book is essentially an essay on the periodic system from the point of view of modern physics. It opens with a historical account of the classification of elements; this is followed by an excellent description of the physicist's atom model, concluding with the Pauli principle and the allocation of electrons to the main and subsidiary energy levels of the atom. The evidence for the building up of the short and long periods is set out in detail and is illustrated by a large number of tables and diagrams of spectral terms. The properties of the elements and their principle compounds are then considered in the light of this physical evidence. Ionised compounds are of necessity discussed at greater length than covalent compounds, since the physical theory of the former type has proved to be more amenable to mathematical treatment.

Chemists in particular will be grateful to the authors for this useful and readable survey of the physical theory which underlies their science.

Electrical Engineering.

The Electrical Industry of Great Britain: Organization, Efficiency in Production and World Competitive Position. Pp. xvi + 233. (London: Beama Publication Department, 1929.) 42*s*. net.

THIS book has been prepared by the economic and statistical department of the British Electrical and Allied Manufacturers' Association; the statistical data given in it can therefore be trusted as approximately correct. It is very difficult to deduce rigorous conclusions from statistics, but some of the data given are instructive. It is interesting to note, for example, that the countries which exceed the 48 hour week convention are, in order of excess, Switzerland, Holland, Germany, and Hungary among European countries. Actually, 41·6 per cent of all Swiss employees are working in excess of 48 hours per week. Recent returns show that there are practically no unemployed in Switzerland during the summer months.

In Switzerland the 48 hour week can only be exceeded for economic reasons, such as for national security and for the countering of foreign competition at home. The result is that practically the entire Swiss engineering industry is now on the permissible maximum of 52 hours a week. Beyond 52 hours, overtime must be paid at the rate of 25 per cent extra, and not 50 per cent as in Great Britain.

Great Britain alone among the main competing countries is adhering to the exact letter of the 48 hour week. The authors consider that it would be inadvisable to advocate any reactionary move. They are in favour of establishing, with the help of cheap electricity from the grid, rural industries. They point out that in parts of Germany, particularly in Württemberg and the Black Forest, there has been a great industrial revival during the last five years, and that a large volume of applied art and furniture products are being exported from there to Great Britain.

Elektrische Gleichrichter und Ventile. Von Prof. Dr. A. Güntherschulze. Zweite erweiterte und verbesserte Auflage. Pp. iv + 330. (Berlin: Julius Springer, 1929.) 29 gold marks.

ELECTRICAL rectifiers and valves are used for converting alternating current into current which practically always pulsates in the same direction or into continuous direct current. This can be done in a great many ways, the most desirable in any given application depending on a great variety of circumstances.

In large power distributing schemes, rectifier sub-stations are used to replace small direct current generating stations. For broadcasting purposes there is a considerable demand for small rectifiers. Valves are also used for producing

high frequency current for laboratory use, for making cut-out switches, for producing alternating current having a special wave form, and for making measurements of very small alternating currents.

In the book under notice, mercury arc and mercury jet rectifiers are fully described. In addition we have good descriptions of contact, thermionic, electrolytic, and gas discharge rectifiers. In describing their action it is necessary to explain the many physical processes involved, and to get numerical relations advanced, mathematical theorems have to be employed. The author has done excellently in the space at his disposal, and the full bibliography given at the end of the book will be a great help to the researcher who wishes to probe more deeply into the subject. A list is also given of the patents which have been taken out for rectifiers, beginning with the aluminium condenser patented by Siemens and Halske in 1901.

The Theory of Electrical Artificial Lines and Filters. By A. C. Bartlett. Pp. ix + 155. (London: Chapman and Hall, Ltd., 1930.) 13*s.* 6*d.* net.

ALL engineers who are engaged in one or other of the numerous branches of electrical communication should know something of the theory of 'repeated' networks. These networks occur in artificial transmission lines, in line balances, in filters, and in phase shifters, all of which are of increasing practical importance. This book gives a very good account of the mathematical theory of these devices. Fifty years ago it was not uncommon for physicists to consider that the theory of numbers and subjects like determinants and continued fractions might well be omitted from a scientific or engineering curriculum. This book shows that it is lucky these ideas did not prevail. The theory of determinants --the author quotes Muir's "Theory of Determinants" as a book that should be consulted—is specially useful.

The generalised 'ladder artificial line section' is best solved by using continuants, a special form of determinants.

The methods of solving difference equations are also very useful in finding solutions of the physical problems involved in these networks. The author states that the literature of the subject is now so vast that he made no attempt to give a bibliography. From the engineer's point of view, however, it would have been helpful to give references to some of the classical papers.

Geology.

Geologisches Wanderbuch der westlichen Dolomiten. Von Dr. Maria M. Ogilvie Gordon. Pp. xv + 258 + 3 Tafeln. (Wien: G. Freytag und Berndt A.-G., 1928.) 15 gold marks.

DR. OGILVIE GORDON'S monumental treatise on the geology of the western Dolomites (see NATURE, vol. 121, p. 83; 1928) has been followed by the guide-book now under review. The region is famous for the beauty of its scenery, and is visited annually by many thousands of tourists; to the geologist it is of exceptional interest, as is evidenced by the numerous classical localities (St. Cassian, Heiligkreuz, the Marmolata, the Schlern, the Seiser Alpe, etc.) that lie within it. The picturesque jagged ridges and peaks and the elevated plateaux are formed by the various dolomitic stages of the Upper Trias, while the lower stages of the Trias and the underlying Permian may be well studied on the mountain sides. Other formations are of more restricted occurrence, but Jurassic rocks are found here and there, and the Neocomian beds of the Puez Alpe, in particular, are well worth a visit. The tectonics have not the bewildering complexity of many other Alpine regions, but nevertheless present many features of interest.

The first part of the book contains a useful summary of the stratigraphy and tectonics, and is illustrated by three plates of fossils. The area is then thoroughly explored in thirty-two excursions, each occupying a full day or rather less. Most of these follow the usual marked mountain tracks, and, if equipped with a large-scale topographical map, the geologist should have little difficulty in finding the way and in locating the exposures described. No particular experience in mountaineering appears to be called for except perhaps in the excursions to the Marmolata and the Sella group. Numerous vertical sections and excellent photographs illustrate the text, while the author's detailed geological map of the area between the Fassa and Gröden valleys is inserted in a pocket at the back of the book. The profuseness of its illustrations must be held responsible for the rather high price of this work. It will undoubtedly prove a most instructive and trustworthy guide to the geology of the region.

A Textbook of Geology. Part 1: *Physical Geology*, by Prof. Louis V. Pirsson; Part 2: *Historical Geology*, by Prof. Charles Schuchert. Part 1. Third edition, revised by Prof. William M. Agar, Prof. Alan M. Bateman, Prof. Carl O. Dunbar, Prof. Richard F. Flint, Prof. Adolph Knopf, Prof. Chester R. Longwell: revision edited by Prof. Chester R. Longwell. Pp. vii + 488. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 18*s.* 6*d.* net.

PIRSSON'S "Physical Geology" has deservedly been one of the most successful geological text-books during the last decade, although, like its many competitors, it had its weaknesses. Many of these are now removed from the very thoroughly revised edition that has recently appeared. The awkwardness of treatment involved by the former twofold division into dynamical and structural geology has been avoided by abandoning these divisions and changing the order of presentation. The treatment of stream erosion now emphasises the cycle of erosion for both humid and arid climates, and there is a new chapter on land forms in which the relations between landscape and geological structure are systematically and adequately dealt with. The chapter on volcanoes suffers from the absence of any reference to the work of Day, but is otherwise a well-written general account. The outer 2000-mile shell of the earth is regarded as 'solid', whereas the seismic evidence merely indicates that

it is rigid; there is no proof that it is crystalline below the crust. Isostasy is well treated, but recent work on near earthquakes and the crustal layers is not given. An up-to-date account of the structure of the Alps now appears. It is admitted that the cause of compressive deformation of the crust is one of the great mysteries of geology, and that it can at present be discussed only in a speculative way.

Many new illustrations have been added to the new edition, including admirable aeroplane photographs and block diagrams. Altogether the book is a well-balanced and effective presentation of a subject that is unusually difficult to deal with in an elementary way. Prof. Longwell and his collaborators have preserved the conservative spirit of the original text, clearly distinguishing between facts of observation and hypotheses of interpretation. The new edition should prove even more successful than the 1919 revision.

Structure and Surface: a Book of Field Geology. By C. Barrington Brown and F. Debenham. Pp. vii + 168. (London: Edward Arnold and Co., 1929.) 10*s.* 6*d.* net.

THIS admirable book has developed from an intention on the part of one of the authors to illustrate each of the simpler geological structures by an ideal block diagram and also by an actual example from an appropriate tract of the earth's surface. This enterprise has now been amplified by a text in which the structures and their recognition in the field are clearly discussed with special reference to the resulting land forms. The very numerous block diagrams, representing geological structures in three dimensions, are extremely effective, and give interest and vigour to a subject of which the treatment has often been woefully dull. To students of geology the book presents in a most attractive form the means of deducing from field observations many of the leading principles of structural geology and geomorphology, while for geography students it provides a sound basis for understanding intelligently the connexion between land forms and the rocks and structures out of which the surface relief has been carved. Two chapters are devoted to the construction of block diagrams, and notes on equipment and surveying instruments and field problems are added in three appendices. The book is one for which both students and teachers may well be grateful. Its production has clearly been a labour of love.

Mathematics.

Leçons sur quelques problèmes aux limites de la théorie des équations différentielles. Par Émile Picard. Rédigées par Marcel Brelot. (Cahiers scientifiques, Fascicule 5.) Pp. viii + 271. (Paris: Gauthier-Villars et Cie, 1930.) 60 francs.

IN continuation of Prof. Picard's course at the Sorbonne, this work is the third volume published in the 'Cahiers scientifiques' series. As would be expected from so distinguished an author, the book is a distinct mathematical contribution to both pure analysis and physics. The text is, for convenience, divided into two sections. The first, consisting of seven chapters, deals with ordinary differential equations which take their origin in mathematical physics. These equations in effect reduce to a study of the troublesome second order equation, and the author develops rigorously from both geometrical and analytical methods the powerful method of successive approximation. This involves an analytical consideration of the properties of certain functions, the conditions under which such functions exist in uniformly convergent series, and finally the theorem of Schmidt. The way is thus prepared for some important applications to the main problems of mathematical physics—the propagation of heat along a bar, vibrating strings, and the well-known problem of Fourier ("Œuvres", vol. 1, p. 85). The remaining chapters of Part I. are devoted to periodic integrals and infinite systems of linear algebraic equations which arise therefrom.

Part II. (Chaps. viii.-xii.) is concerned with partial differential equations. A consideration of harmonic functions, Dirichlet's problem, and the formulæ of Green and Poisson leads to a skilful extension of the contour method to that of a bounded surface. This yields greater generality in dealing with certain types of classical problems. Some instructive applications on the flow of heat in two dimensions and radiation in space are given. Finally, the equation of Fredholm and the potential functions of Laplace are studied together with some valuable deductions in analysis and physics.

The whole volume is most interesting and stimulating; it is undoubtedly a substantial contribution to the accessible literature on the theory of differential equations and their application.

The Theory of Approximation. By Prof. Dunham Jackson. (American Mathematical Society Colloquium Publications, Vol. 11.) Pp. viii + 178. (New York: American Mathematical Society, 1930.)

As the author of this work points out in his preface, "it is a brief essay in a field on which an encyclopædia might be written", namely, an investigation of the degree of approximation with which a continuous function can be represented by a polynomial of given degree.

Starting from the well-known theorems of Weierstrass on the approximate representation of a continuous function either by a polynomial or by a trigonometric sum, Prof. Jackson proceeds to prove other theorems on approximation by trigonometric sums, and then to examine the convergence of Fourier and Legendre series under the hypotheses of continuity over part of an interval, and of limited variation. Some generalisations of the principle of least squares are next discussed, and a very useful chapter follows on trigonometric interpolation in which some striking analogies between the theory of interpolation by means of trigonometric sums and by Fourier series are revealed. The interpolation formula analogous to the Féjer mean is especially interesting. In the final chapter is a very instructive introduction to the geometry of function space.

The book is excellently printed, and a welcome,

though somewhat rare, feature is the provision of an index of the principal theorems. This should prove a great advantage to the research student.

Cours d'analyse. (*Cours de l'École polytechnique.*) Par Prof. Paul Lévy. Tome 1. Pp. viii + 376. (Paris: Gauthier-Villars et Cie, 1930.) 120 francs.

This treatise is based primarily upon the course of analysis given by the author at l'École Polytechnique. It is divided into seven sections, each embracing from three to five chapters. The text covers the usual topics discussed in a modern study of continuous functions, namely, differential and integral calculus, theory of multiple integrals, geometrical applications of the calculus, and some elementary theory of differential equations.

Prof. Lévy has rightly insisted that the fundamental idea underlying an intelligent study of functions is the notion of growth in the value of a function and not mere formal calculus. The complete course is well planned and lucidly written, but the bulkiness of the volume renders it a little inconvenient to handle.

Miscellany.

The Drift of Civilization. By the Contributors to the fiftieth Anniversary Number of the *St. Louis Post-Dispatch*, including Charles G. Abbot, Richard E. Byrd, Albert Einstein, Guglielmo Ferrero, Sir Philip Gibbs, Maxim Gorky, Rudolf Maria Holzapfel, the Very Rev. Dean Inge, Count Hermann Keyserling, J. B. S. Haldane, Paul de Kruif, Stephen Leacock, Martin A. Nexö, Michael Pupin, James H. Robinson, Bertrand Russell, H. G. Wells. Pp. 254. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.

Most thinking people at the present time busy themselves more with questions of the future than of the past. A popular series on 'To-day and To-morrow' sells its ten thousands, while manuals of history are left to the few. The volume before us, however, will not attain great success, nor is it of much value, because it is a collection of scraps, not co-ordinated in any way and not throwing any clear light on the question which its title suggests. There is a confused flicker like the varied lights of cars and bicycles and lorries on a wet road in the dark. But it is difficult to tell where they are all going, and some of them are obviously going in opposite directions. The communist Nexö, for example, tells us that food must be found for the starving proletariat, while J. B. S. Haldane remarks on the "general prosperity which has nearly banished underfeeding as a cause of ill-health". Both statements no doubt are true in their different connexions and with different applications. The reader is therefore left to find out for himself what is the general drift of civilisation from the disconnected views of the various eminent and interesting persons who have been got together by an enterprising American newspaper. It need scarcely be said that they all have a vivid vision of something, but in each case it is just the one thing that happens to interest the particular writer, and none of them has written at sufficient length even to develop his own thesis to a general conclusion.

One can therefore only sum up impressions and temperaments, and this would lead on the whole to an optimist view in a limited field. Great things are ahead of us: great things mainly in the realm of science, power over Nature, and increased enjoyment for the masses. None of the writers speaks of any growth in spiritual depth or beauty, or of any spread of peace and quiet happiness in the world. The only one who deals at all with this side of the future—the Dean of St. Paul's—looks for another form of Protestantism as the religion of the future. The men of science, as one might expect, are the most definite and constructive; for the rest, the book ends, as it began, with a note of interrogation.

F. S. M.

British Museum (Natural History), Cromwell Road, London, S.W.: General Library. Place-numbers of the Societies and other Corporate Bodies issuing Serial Publications, and of the Independent Periodical Publications, with Alphabetical Indexes. Second edition. Pp. v + 175. (London: British Museum (Natural History), 1930.) 5*s.*

Shelf lists of libraries possess a peculiar fascination for bibliographers, for the shelf list is the true catalogue of a collection. If its entries are sufficiently full, the student commands with its aid a complete bird's-eye view of a collection with a definite guide to the location of each unit. It represents all that an atlas is to the geographer or a directory to the local resident.

The present list, however, is not altogether a shelf list, though it closely resembles the shelf list type. It shows the order in which independent periodicals and institutions publishing one or more serial publications are arranged on the shelves with their distinctive call-numbers. Thus S 2418 = The United States Department of Agriculture, and S 2426 = The Smithsonian Institution. The information given, it will be noted, does not tell us whether the library possesses complete sets of the serial publications of the above bodies, or merely a selection of their publications relating more or less to natural science. The list is arranged upon geographical principles, the periodical publications of a region being grouped under the names of towns. The geographical arrangement has some administrative advantages, but for a research department classification by subjects is to be preferred.

The library appears to possess a fairly complete collection of the publications of British local natural history societies, but in specific branches of natural science, for example, botany, entomology, fish and fish culture, etc., it is singularly weak. One judges that the library serials are recruited mainly by exchange or gift, and that adequate funds for the purchase of serials are not available. If this is the case, it is to be hoped that the library will receive in future more generous treatment. Some of the deficiencies in its serial collection might be made good by judicious exchange with other

libraries—if exchange is permitted—for the present list shows that the library contains many serials which have no biological significance.

Eleutheros, or the Future of the Public Schools: a Desultory Dialogue. By J. F. Roxburgh. (To-day and To-morrow Series.) Pp. 94. (London: Kegan Paul and Co., Ltd., 1930.) 2*s*. 6*d*. net.

FOR several decades, educational reform has made enormous strides, with the result that the old established public schools of Britain have had their full share of the spotlight. The same era has seen many profound changes in these schools. Dr. Roxburgh, himself the headmaster of one of our public schools, has emphasised the aims of public school education in a remarkable manner. He has followed this up by defending these endeavours, and finally attempted to prove that such schools are the best.

Any attempt to criticise Dr. Roxburgh's efforts might leave an erroneous impression of the critic's bias against the methods which exist in our public schools. This would be unfortunate, for, whatever views the educationist may hold of the value of a public school education, he must agree that, in these days of uniformity and communism of method, it is refreshing to see that the public schools, in their independence, retain their personality and individuality. The author makes much of this point. However, one can neither dogmatise nor generalise in education. Wide views must be taken, and here the book is at fault, for a very narrow view of the subject has been assumed. To state, as the author does, that men who never went to anything but an elementary school were therefore never educated after fourteen, is a grave injustice to our State education.

We may or we may not agree with the tenets propounded in the book; but it is well worth reading, for the author has adopted the age-old dialogue style. This, at any rate, enables us to maintain an interrogative interest, thus continually asking ourselves, 'Are we agreed?'

Romance of the Machine. By Michael Pupin. Pp. v+111. (New York and London: Charles Scribner's Sons, 1930.) 4*s*. 6*d*. net.

MORE than fifty years ago, Prof. Pupin arrived in New York from Serbia, a mere boy unacquainted with the English language and almost penniless; to-day he enjoys both wealth and distinction. Like thousands of others from the Old World, he found the United States to be the land of opportunities of which he was not slow to take advantage. Supporting himself by lessons in wrestling and boxing, he entered on a course of study which ultimately led him to a chair in Columbia University. With teaching he combined invention, and he is known for one of the greatest improvements in telephony.

With Prof. Pupin's success has come an unfailing admiration for the constitution and ideals of the country of his adoption, and in the little book under notice he takes up the cudgels against the critics of 'machine civilisation'; endeavours to show how the telegraph, the telephone, broadcasting, and the automobile have assisted in the "Consolidation of the Union"; and tells us something of the telephone industry, "the largest and most perfectly co-ordinated industrial organisation in the world". His picture of "the roads blocked for many miles", which "makes one believe that every family in New York has an automobile, and that they are all out for a pleasure drive", will not appeal to all alike, but we are at one with Prof. Pupin in his hope that the telephone, the telegraph, the vacuum-tube oscillator, and the aeroplane "will aid in the art of cultivating international friendships". As for America's share in discovery, we like to recall Lord Playfair's remark that "science has no country though its investigators have birthplaces".

A Hundred Years of Publishing: being the Story of Chapman and Hall, Ltd. By Arthur Waugh. Pp. xvii+326+50 plates. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

DICKENS, Trollope, and Carlyle, with Meredith figuring both as client of and reader to the house of Chapman and Hall—these are the names which will attract lovers of books to this work. The story of Dickens's relations with his publishers and of his love of gain at a time when he was in comfortable circumstances is a painful one. Mr. Waugh's narrative, however, is written in a large spirit of charity and forbearance towards all who served the firm whether as clients, clerks, readers, or managers.

The work, which is well illustrated with portraits and facsimiles, is not a mere chronicle of the output and fortunes of the firm. It is relieved by disquisitions on the successive changes which have taken place in the book trade from the time when publisher and bookseller were one down to present-day conditions. Within this period revolutionary changes have taken place, and the organisation of the publishing trade has become more complex and its business more speculative. The costs of publication have materially increased, and these costs cannot in all cases be passed on to the public in the shape of correspondingly enhanced prices. The chapters dealing with the new phases of publishing and book distribution are based upon competent authorities and add considerably to the value of the book. The work will be read with interest, and should find a permanent place upon the shelves of all concerned in the history of book production.

A Bibliography of Persia. By Lieut.-Col. Sir Arnold Wilson. Pp. x+253. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 20*s*. net.

WHEN Lord Curzon published his classical volumes upon "Persia and the Persian Question", it was his intention to add a third volume dealing with the bibliography of works about that country, but for obvious reasons this intention was never carried out. Sir Arnold Wilson has now partly supplied the desideratum by assembling in aphabetical order the names of the authors of some 6500 titles, including translations in European languages of original

Persian books and writings. From among this great mass of material the scientific specialist may pick out many details of special interest to himself, whether relating to such topics as the geology of oil-fields or local flora or to other matters, but his labour will be great until the work is completed by the addition of an analytical subject index. Among omissions we note the very informative "Quarterly Papers" of the 'Archbishop's Mission to the Assyrian Christians' at Urmi that were issued from 1890 until 1910; also R. Levy's "Bustan" and others. It would be helpful if well-known guide-books such as Murray's Handbook to Persia were entered under the name of the publisher as well as under that of the less familiar author. A brief chronological list of survey maps would also be a most useful addition. R. T. G.

Paint, Powder and Patches: a Handbook of Make-up for Stage and Carnival. By H. Stanley Redgrove and Gilbert A. Foan. Pp. xi + 170 + 16 plates. (London: William Heinemann (Medical Books), Ltd., 1930.) 7*s*. 6*d*. net.

THIS book gives a detailed and practical account of the art of 'making-up', both as regards the materials and technique. The authors claim that it is the first of its kind in which the subject is treated in a complete manner. Although addressed mainly to hairdressers who wish to become experts in the art of making-up, it will, as the authors point out, prove very useful to amateurs in theatrical performances, and many teachers may find it useful from this point of view. It is well written and illustrated, and gives a very large amount of information in a small compass.

Physics.

Magnetism. By Dr. Edmund C. Stoner. (Methuen's Monographs on Physical Subjects.) Pp. vii + 117. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.

THE present work is one of a series of monographs which will be very useful in the library of every physicist. It is almost impossible for any scientific worker to keep pace with the advance of any subject, even though it may be quite closely cognate with what he is himself working at. To read all the published work in the proper critical spirit would involve the same sort of trouble as that of the historian who in writing a universal history took a year to write the history of a day. The present little book will do much to remove this difficulty. It assumes a good deal of knowledge of magnetism, but concedes that the knowledge may be a little rusty, and sets to work to supply all the latest information, treating it in a sound critical spirit and not merely as a catalogue of publications. For example, anyone who studied the same author's larger work, when it appeared four years ago, will be able to understand the great changes that have supervened, and also to learn what parts of the subject are still unsatisfactory.

The book is in five chapters, and in each of them there is something new to say. The first summarises the work, old and new, of the type of the celebrated experiment of Stern and Gerlach. The second and third deal with dia- and para-magnetism respectively. The experiments measuring the exceedingly small susceptibilities of most substances are very difficult indeed, and there is still much discrepancy between different experimenters; consequently, the theorists have often had the comparatively easy task of calculating their constants only to an order of magnitude, since it is usually possible to find some experiment to support the values obtained. If the experimental values could all be known with confidence, it would not only be a good discipline for the theorists, but would also probably enable them to advance the theory of the solid state. The fourth chapter deals with ferromagnetism, the theory of which has been revolutionised by Heisenberg. There is a short sketch of his theory, but it was found too difficult to give its detail in the compass of the book; to do so would have required a complete account of the new quantum theory. The fifth chapter includes, among other matters, an account of Kapitza's work on electric conductivity. Altogether, it will be seen that it is a most useful book, not only to the researcher but also to the advanced student.

Der Ramaneffekt. Von Prof. Dr. Clemens Schaefer und Dr. Frank Matossi. (Fortschritte der Chemie, Physik und physikalischen Chemie, herausgegeben von Prof. Dr. A. Eucken, Band 20, Heft 6.) Pp. iii + 52. (Berlin: Gebrüder Borntraeger, 1930.) 8 gold marks.

THIS excellent summary begins with a general account of the Raman effect, in which its relationship to other similar effects is carefully considered. The theory is treated first classically, when it is shown that, in addition to the Tyndall and Raman effects, scatterings of higher order are to be expected, and the point is stressed that asymmetrical forces are required for the Raman effect to appear. The theory is then given in terms of wave mechanics, and correspondences between the two methods of treatment are pointed out. The experimental technique, the polarisation of the lines, their intensities, and the effect of temperature variation on them, are only briefly described.

Considering the small space available, the discussion of results is comprehensive. The rotational levels in gases, with special reference to the selection rules, the scattering by water in its different states, the broadening of lines scattered in liquids, and the continuous spectrum appearing in certain liquids are all discussed. Organic substances are treated separately, and examples are given of the internal and external vibrations associated with certain radicals. The non-appearance of Raman lines in the scattering by ionic lattice crystals such as rocksalt, and their appearance when the crystals have polyatomic ions as in the carbonates and sulphates, is also discussed. The appearance of inactive frequencies in great strength is mentioned, and the case of calcite is discussed in detail.

An important omission in such a survey of a rapidly developing subject is the exact date up to which material has been included. From the non-inclusion of a reference to the scattering by powdered crystals, it may be judged that this survey was concluded about September 1929.

A. C. MENZIES.

Grenz Ray Therapy. By Dr. Gustav Bucky. With Contributions by Dr. Otto Glasser and Dr. Olga Becker-Manheimer. Translated by Dr. Walter James Highman. Pp. xii + 170. (New York: The Macmillan Company, 1929.) 15*s.* net.

GRENZ ray therapy means the treatment of disease with X-rays having wave-lengths of from 1 to 3 angstroms. It was inevitable that someone should seek to give a name to the region of the spectrum occupied by long wave-length X-rays. The question is sometimes put: "Where do ultra-violet rays leave off and X-rays begin?" The term 'grenz' used to describe this portion of the electromagnetic spectrum has been suggested by Dr. Bucky. Long wave-length X-rays would seem a preferable term, as the rays are considerably longer than those used in X-ray diagnosis and therapy at the present time, especially as only an imaginary boundary separates the ultra-violet from the X-ray spectrum.

An interesting section on the physics of these rays is contributed by Dr. Otto Glasser. The remainder of the book deals with attempts that have been made by Dr. Bucky and others to use these very easily absorbed rays in the treatment of disease. They are easily absorbed by any kind of tissue. One of the greatest difficulties of their therapeutic application undoubtedly lies in their means of production. These difficulties have, however, largely been surmounted now, and there is less danger of the accidental production of more penetrating rays than is desirable. We gather from the text that there has been considerable controversy among radiologists as to the advantages of treating skin conditions with these easily absorbed rays.

A Text-Book of Illumination. By Prof. William Kunerth. Pp. x + 269. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

THIS book is intended as a text-book in illumination mainly for senior electrical engineers studying at a university. Two-thirds of the book is devoted to the theoretical aspects of the subject and the rest to short chapters dealing with general principles affecting the application of illumination to special problems. There is also a short account of twenty-four laboratory experiments involving the use of photometric apparatus and the usual photometric calculations. Some of the experiments are designed to illustrate various visual phenomena encountered in the study of illuminating engineering.

The subject matter of the book is well chosen, and it is desirable that all illuminating engineers should receive instruction somewhat on the lines indicated by the author. Indeed, a strong case could be made out for the inclusion of such a course in the training of all electrical engineers. Unfortunately, the author's treatment of the subject is not all that could be desired. The book is not free from errors of fact, and quite a number of arguments are developed in a loose and confused manner.

The Physics of X-ray Therapy. By W. V. Mayneord. Pp. viii + 177. (London: J. and A. Churchill, 1929.) 10*s.* 6*d.*

THIS is, we believe, the first book by an English author on the physics of X-ray therapy, and Mr. Mayneord, who is physicist to the Radio-Therapeutic Department of the Cancer Hospital, London, has written a book which cannot fail to be of the greatest value to medical radiologists. Three-quarters of the book is devoted to the physical properties of X-rays, their penetration of and absorption by matter, their quantitative measurement, and their means of production. The remainder of the book is devoted to a résumé of factors affecting the choice of therapeutic conditions. The author is fully alive to the fact that what is physically best is often clinically impossible. He has nevertheless shown how to make the best of necessary compromise in these matters. The information in this book has been very well selected for the particular aim that the author has had in view. Mathematical treatment is almost eliminated, so that there need be no hesitation on the part of medical readers in making use of this very valuable book.

Physiology and Anatomy.

Recent Advances in Physiology. By Prof. C. Lovatt Evans. (The Recent Advances Series.) Fourth edition. Pp. xii + 446. (London: J. and A. Churchill, 1930.) 12*s.* 6*d.*

THE new edition of "Recent Advances in Physiology" well maintains the high standard set in its three predecessors. The whole book has been carefully revised, and two chapters are entirely new. These are of great importance. The first deals with the coronary circulation; the author briefly explains the experiments which have been carried out by physiologists, particularly Anrep and his collaborators, to determine the controlling factors of this circulation, and shows that these are, in order of importance, the arterial blood-pressure, chemical changes in the blood, and reflex control by the nervous system. In the second chapter the student is reminded of the long-accepted theory that pressure high up in the neck causes slowing of the heart by stimulation of the vagus. He now learns that this cardiac slowing is due to a remarkable reflex initiated in the dilatation at the root of the internal carotid artery, known as the carotid sinus. This reflex has been closely studied by the experimental method, and Prof. Lovatt Evans points out its importance in the regulation of blood-pressure when affected by such changes as severe hæmorrhage and alteration in posture.

The rapid advance of physiological science makes it inevitable that what was new in 1925 must now

be relatively old, but our one regret must be that some subjects previously discussed have to be omitted to make room for others. So valuable is every chapter in this edition that we hope to see them all included in the next, even if limited space compels some abbreviation.

The Mechanism of the Larynx. By V. E. Negus. Pp. xxx + 528. (London: William Heinemann (Medical Books), Ltd., 1929.) 45*s*. net.

MR. NEGUS presents here the results of his extensive inquiries into the form and function of the larynx. They range over the vertebrate kingdom from *Lepidosiren paradoxa* to man, and no detail of the structure of the forms examined seems to have escaped from thorough and fruitful consideration. The work is elaborate and, as a sustained effort in comparative anatomy and physiology applied to a field which is restricted but of wide interest, exemplary. In an introduction of great generosity and good humour, Sir Arthur Keith remarks that the author has the same patient power of assembling observation as Darwin had, and the same hot pursuit of function as urged John Hunter in all his quests. If these comparisons should induce a certain negativism in the attitude of some readers, the book will dispel it. Of nearly 500 pages of reading matter, there are few which do not serve as a vehicle for some point of interest, and, if the general reader were forearmed with such a knowledge of laryngeal structure as may be obtained from an hour's dissection and ten minutes' reading, he would find this work of science more interesting than most books about science. For the specialist it will endure as a major treatise. It includes under one cover as large, if not a larger body of facts than the usual specialist compilation, but in addition it casts fresh light upon problems too numerous to particularise in a short notice.

The Mycoses of the Spleen. By Dr. Alexander George Gibson. (The Anglo-French Library of Medical and Biological Science.) Pp. xii + 169 + 10 plates. (London: Kegan Paul and Co., Ltd., 1930.) 12*s*. 6*d*. net.

IN this book Dr. A. G. Gibson has amplified the suggestion he put forward in 1913, that certain forms of splenomegaly were due to a streptothrix organism invading the spleen. His examination of many spleens has convinced him that the threads generally considered to be altered tissue fibres are mainly mycelial fibres, and he regards these as the causal organism of acholuric jaundice and the group of conditions known as splenic anæmia. The evidence for his conclusions is clearly described and well illustrated. The investigations of other workers who have found similar organisms are reviewed, and various criticisms are considered. Although Dr. Gibson puts forward a strong case and is convinced that his views are correct, he does not in any way regard this etiological problem as solved. He indicates a line of study requiring wider investigation, and is content to wait until results shall be general and uniform before considering his theory to be proved.

The Science of Voice: a Book on the Singing and Speaking Voice based upon the latest Research in Physics and Physiology, with advice to those interested in Talking Movies and other Mechanical Reproducing Devices. By Douglas Stanley. Pp. vi + 327. (New York, Boston and Chicago: Carl Fischer, Inc., 1929.)

IN this book the scientific aspects of voice receive much more elementary treatment than in the works of Fletcher or Paget. A considerable portion of the volume is devoted to the musical uses of voice, and the attempts made at their definition in physical terms are of interest. In the chapter dealing with researches upon breath expulsion one would have expected to find a careful discussion of the influence of the resonances of the apparatus, which is described as consisting of a French gas mask strapped tightly over the singer's face and connected by a large rubber tube to an air-tight box inverted in a tank of water. Such a system having resonances within the range of the singing voice would unduly facilitate the production of certain notes The third section of the book, devoted to interpretation and musicianship, might provide useful material for the psychologist.

Bainbridge and Menzies' Essentials of Physiology. Sixth edition, edited and revised by Prof. H. Hartridge. Pp. xii + 497 + 30. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 14*s*. net.

THIS is a most popular manual with junior students and is very widely used by them in preparation for examinations. The earlier editions were framed on the plan of Starling's excellent text-book of physiology and constituted readable and connected summaries of the latter, which the beginner found rather formidable. Emanating in the first instance from St. Bartholomew's Medical School, this little text-book has undergone improvement under the successive heads of physiology. The present edition has been subjected to drastic revision, with a resulting improvement which places it as the most up-to-date manual now at the disposal of students.

Psychology and Philosophy.

John Dewey, the Man and his Philosophy: Addresses delivered in New York in celebration of his Seventieth Birthday. Pp. vii + 181. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 10*s*. 6*d*. net.

THIRTY years ago, the young American who wanted to pursue the higher learning was apt to betake himself to a German university for three or four years. But, independently of the changes brought about by the War, that custom has become greatly modified. If he comes to Europe at all, he is more likely to stay only one year, and it is not a foregone conclusion that the year is spent in Germany. The fact is that America has been growing her own science and her own philosophy. In philosophy she had, following the European model, her school

of neo-Hegelians, represented by such a man as W. T. Harris. But she seems to have cast aside the *-isms* of the Old World, and to have excogitated a philosophy more in keeping with her own genius and her own outlook. The names of William James and John Dewey stand out in this connexion as names of which any nation might well be proud. Through them the influence of American thought is being felt to the ends of the earth. James died young, but Dewey is happily still with us. He passed his seventieth birthday in October last, and the occasion was marked by a celebration in which some of the foremost of American thinkers took part. This book places on record what was said on that occasion. The speeches constitute a worthy tribute to a very distinguished man; and we may add, for the benefit of people who have not read Dewey, that a good general idea of what has been going on in recent years in philosophical and educational America may be gathered from a perusal of these speeches.

Psychologies of 1930. By Alfred Adler, Madison Bentley, Edwin G. Boring, G. S. Brett, Harvey Carr, John Dewey, Knight Dunlap, J. C. Flugel, Walter S. Hunter, Pierre Janet, Truman L. Kelley, K. Koffka, Wolfgang Köhler, K. N. Kornilov, William McDougall, John Paul Nafe, I. P. Pavlov, Friedrich Sander, A. L. Schniermann, C. Spearman, Leonard T. Troland, Margaret F. Washburn, Albert P. Weiss, Robert S. Woodworth. Edited by Carl Murchison. (The International University Series in Psychology.) Pp. xix+497. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1930.) 27*s*. net.

THE editor of this volume is to be congratulated heartily upon having brought about a sort of quinquennial stock-taking of psychologies. A comparison of this collection of papers with that which appeared in 1925 shows fairly clearly the changes of attitude and conviction which have meantime taken place.

To the interested onlooker the conflict between the rival schools of psychology has its amusing as well as its edifying aspect. According to the tradition in which most of us were reared, psychology is the science of the mental life, and ascertains its facts by the method of introspection. According to the behaviourist school, which is strong in the United States, a study so pursued is no science at all, since science truly so called is conversant only with the objective facts, which in this case are the facts of human behaviour. So the behaviourist can make no terms with introspection. Similarly, as Prof. Spearman points out in his spirited contribution, the Berlin 'gestaltists' 'throw cold water' upon refined analysis; the structuralists would have the problems of function indefinitely postponed; and the functionalists think 'very small beer' of the structuralists. For his part, Prof. Spearman, who curiously labels himself a factorist, regards his school as a school to end schools, the destined healer of all these unhappy divisions.

Prof. McDougall indicates his position by an advance from the 'purposive' psychology of 1925 to the 'hormic' psychology of 1930. This volume also gives, for the first time in the English language, an account of the three leading Russian psychologies. Prof. Murchison claims that psychology is rapidly coming of age. The more controversial papers in this collection rather suggest that psychology is still suffering from growing pains.

The Creed of a Biologist: a Biologic Philosophy of Life. By Prof. A. S. Warthin. Pp. viii+62. (London: Constable and Co., Ltd., 1930.) 7*s*. 6*d*. net.

IN this little book, Prof. Warthin has put forward an argument in favour of a completely scientific basis of life. Yet, with scientific knowledge in its present state, this propounded philosophy appears to contain as much untrustworthy dogma as is commonly associated with religion. That there is no proof of an anthropomorphic deity and that life is governed completely by scientific law are two maxims which the author accepts without reserve. Yet there are still many cloaks of mystery, and where we have religious faith, we also have scientific hypothesis.

The chief principle of Prof. Warthin's creed is that the complete aim of life is evolutionary immortality. One assumes, therefore, that he believes in ontogenetic mortality but phylogenetic immortality; the latter being made possible by the continuity of the germ plasm. Such is his biological creed. What it is, and how one should behave in order to conform to its doctrines, are well worth reading. The book will meet with supporters and dissenters, and therein lies its value to intellectual thought.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Macmillan and Co., Ltd.—The Student's Flora of the British Islands, Sir J. D. Hooker. Re-issue; Hortus: a Concise Dictionary of Gardening, Dr. L. H. Bailey.

Anthropology and Archæology.

Allen and Unwin, Ltd.—The Evolution of the ... F. Müller-Lyer. Translated by F. W. Stella ... *ridge University Press.*—How it Happened, Rhoda Power; The Bronze Age, Prof. V. Gordon Childe. *G. G. Harrap and Co., Ltd.*—Folk-Tales of all Nations. Edited by F. H. Lee. *Methuen and Co., Ltd.*—A History of the Vikings, T. D. Kendrick; A Season's Work at Ur: Being an Account of the British Museum Archæological Mission to Babylonia, 1919, Dr. H. R. Hall. *Oxford University Press.*—Nuer Customs and Folklore, R. Huffman; Mesopotamian Origins, E. A. Speiser; Clay Figurines of Babylonia and Assyria, E. D. van Buren. *G. Routledge and Kegan Paul, Ltd.*—The History of World Civilization, from Prehistoric Times to the Middle Ages, Prof. H. Schneider.

2 vols.; A History of Modern Culture, 1543–1687, Prof. P. Smith; Wit and Wisdom in Morocco: a Study of Native Proverbs, Dr. E. A. Westermarck; A Sudanese Kingdom: an Ethnological Study of the Jukun-Speaking Peoples of Nigeria, C. K. Meek; Matriarchy in the Malay Peninsula and Neighbouring Countries, G. A. de C. de Moubray; The Mongol in our Midst: a study of Man and his Three Faces, Dr. F. G. Crookshank. New edition. *H. F. and G. Witherby.*—The Origin of the Human Skeleton: An Introduction to Human Osteology, Dr. R. Broom; The Formenkreis Theory and the Progress of the Organic World, Dr. O. Kleinschmidt. Translated by the Rev. F. C. R. Jourdain.

Biology.

George Allen and Unwin, Ltd.—Human Heredity, Bauer-Fischer-Lenz. Translated by Eden and Cedar Paul. *Edward Arnold and Co.*—Philosophy of a Biologist, Sir Leonard Hill; Hill Birds of Scotland, Seton Gordon. Popular edition; Environment and Plant Development, Prof. H. Lundegardh. Translated by E. Ashby, with notes and adaptations to British conditions. *Cambridge University Press.*—Agricultural Entomology, Kenneth Smith; Mendel's Principles of Heredity, the late Dr. W. Bateson. *Cassell and Co., Ltd.* -The Science of Life, H. G. Wells, Prof. J. S. Huxley, and G. P. Wells. *J. and A. Churchill.* —Recent Advances in Entomology, Dr. A. D. Imms. *Gurney and Jackson.*—Game Animals of the Sudan: their Habits and Distribution, Capt. H. C. Brocklehurst. *Crosby Lockwood and Son.*—Birds of Nyasaland, C. F. Belcher. *Oliver and Boyd.*—The Migration of Butterflies, C. B. Williams. *Oxford University Press.*—The Interpretation of Development and Heredity: a Study in Biological Method, Dr. E. S. Russell; The Evolution of Biology, Dr. C. Singer; Index Londinensis. An emended and enlarged edition continued up to the End of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns. Prepared for the Royal Horticultural Society of London by Dr. O. Stapf. Vol. IV. (Kadsura-Pedicellia); Early Theories of Sexual Generation, Prof. F. J. Cole; A Manual of Practical Vertebrate Morphology, J. T. Saunders and S. M. Manton; Sea Angling Fishes of the Cape (South Africa). A Natural History of some of the Principal Fishes caught by Sea Anglers and Professional Fishermen in Cape Waters, C. L. Biden; Plants of the Gold Coast, F. R. Irvine; The Woad Plant and its Dye, Dr. J. B. Hurry. *G. Routledge and Kegan Paul, Ltd.*—The Nature of Biology, Prof. L. Hogben. *Seeley, Service and Co., Ltd.*—The Life of the Sea Trout, especially in Scottish Waters. With chapters on Reading and Measuring Scales, G. H. Nall. *Sidgwick and Jackson, Ltd.*—The Biology of Mammals, Prof. J. Ritchie; A Second Biology, Prof. S. Mangham and Prof. W. R. Sherriffs (Biological Handbooks); The Principles of Animal Genetics, E. B. Ford; Experimental Zoology, Prof. J. S. Huxley; Animal Morphology, Prof. W. Garstang (Text-books of Animal Biology). *University of London Press, Ltd.*—General Elementary Biology, Lucy E. Cox and Mary E. Phillips; A Four Years' Course in Nature Study for Junior Schools, Elsie V. M. Knight. *H. F. and G. Witherby.*—A History of the Birds of Norfolk, B. B. Riviere.

Chemistry.

G. Bell and Sons, Ltd.—The Chemical Investigation of Plants, Dr. L. Rosenthaler. Translated by Dr. Sudhamoy Ghosh. *J. and A. Churchill.*—Recent Advances in Analytical Chemistry. Edited by Dr. C. A. Mitchell. 2 vols. *Constable and Co., Ltd.*—Quantum Chemistry: a Short Introduction in Four Non-Mathematical Lectures, Dr. A. Haas. Translated by L. W. Codd. *Longmans and Co., Ltd.* —Enzymes, Prof. J. B. S. Haldane; Recent Advances in Physical and Inorganic Chemistry, Prof. A. W. Stewart. New edition. *Macmillan and Co., Ltd.*—A School Course of Chemistry, Prof. J. R. Partington. *Methuen and Co., Ltd.*—Practical Physical Chemistry, Prof. K. Fajans and J. Wüst. Translated by B. Topley, with an Introduction by Prof. F. G. Donnan; The Electrochemistry of Solutions, Dr. S. Glasstone; Natural Terpenes, Dr. J. W. Baker; Photochemistry, Dr. D. W. G. Style. *Oxford University Press.*—Chemistry, Dr. E. J. Holmyard. (Makers of Science Series.) *G. Routledge and Kegan Paul, Ltd.*—The Materials of Life: a General Presentation of Biochemistry, T. R. Parsons. *University of London Press, Ltd.*—A First Chemistry for Schools, A. Brooks.

Engineering.

Edward Arnold and Co.—Hydraulics, Prof. F. C. Lea. New edition. *Ernest Benn, Ltd.*—The General Principles of Chemical Engineering, S. G. M. Ure; The Mechanical Principles of Mining Appliances, Prof. H. Louis; Mineral Deposits, Prof. H. Louis; Coal-cutting Machinery and its Applications, S. Mavor; Haulage and Winding, Prof. G. Poole; Motive Power and the Modern Steam Turbine, Sir Charles Parsons and R. Dawson; Insulated Electric Cables, C. J. Beaver. Part 2: Manufacture and Testing. Part 3: Installation; Electrical Measuring Instruments, Dr. C. V. Drysdale and A. C. Jolley. Part 3: Steady Current Laboratory Instruments; Part 4: Alternating Current Laboratory Instruments; Rotary Convertors, F. P. Whitaker. *Chapman and Hall, Ltd.*—Testing Radio Sets, J. H. Reyner; Charts and Notes on Marine Boiler Design, H. C. Walker; Switchgear Practice, H. E. Poole; Electrical Engineering Practice, J. W. Meares and R. E. Neale. Vol. 3. New edition. *Crosby Lockwood and Son.* —Modern Workshop Practice, E. Pull. New edition; Marine Aircraft: Elementary Naval Architecture, Capt. P. H. Sumner; Punches, Dies, and Tools for Manufacturing in Presses, J. V. Woodworth. New edition; Naval Architect's and Shipbuilder's Pocket-Book of Formulæ, Rules, and Tables, and Marine Engineer's and Surveyor's Handy Book of Reference, C. Mackrow. New edition, revised by L. Woollard; Boiler House Manual, B. Frisby; Gas Installations and Appliances, A. T. Gilbert; Purification and Disposal of Sewage, C. J. Nurse; Mechanical Handling and Storing of Material, G. F. Zimmer. With a Foreword by Sir John Purser Griffith. New edition; Chemical Engineering Applied to the Cement Rotary Kiln, Dr. G. Martin. *Longmans and Co., Ltd.*—Materials and Structures, Dr. E. H. Salmon; Builders' Materials, R. F. B. Grundy. *Methuen and Co., Ltd.*—Electric Light and Power, E. E. Brooks and W. H. N. James. New edition.

Geography and Travel.

Cambridge University Press.—Great Britain: Essays in Regional Geography by twenty-six authors. Edited by A. G. Ogilvie, with an introduction by Sir E. J. Russell. Second edition; Lands of the Eastern Caliphate, G. Le Strange. New edition; Cambridge School Geographies, E. D. Laborde. Book 4: The British Empire. *Jonathan Cape, Ltd.*—Green Hell, J. Duguid. *Chapman and Hall, Ltd.*—Surveying for Schools, S. W. Perrott. *Constable and Co., Ltd.*—Arabian Peak and Desert, A. Rihani; Things Which are Seen, Prof. A. J. Toynbee. *Macmillan and Co., Ltd.*—The Records of the Hudson's Bay Company. Vol. 1: Journal of Occurrences in the Athabasca Department. Vol. 2: Documents Relating to the Organisation of the Trade. Vol. 3: Diary of Overland Journey from York Factory to the Pacific Coast; The Handbook of Tanganyika, 1930. General Editor, G. F. Sayers. *Methuen and Co., Ltd.*—Tudor Geography: 1485–1583, Prof. E. G. R. Taylor. *G. P. Putnam's Sons, Ltd.*—Nonsuch, Dr. W. Beebe; A Year on the Great Barrier Reef, Dr. C. M. Yonge; Little America, Rear-Admiral R. E. Byrd; N. by E., R. Kent; The Holy Cities of Arabia, E. Rutter. Popular edition; Hidden Wealth and Hiding People, M. Terry. *G. Routledge and Kegan Paul, Ltd.*—The Travels of Marco Polo. Translated into English from the text of L. F. Benedetto by Prof. A. Ricci. With and Introduction by Sir Denison Ross; The Travels of an Alchemist: the Journey of the Taoist Ch'ang Ch'un from China to the Hindukush at the summons of Chingiz Khan. Translated, with an Introduction, by A. Waley; Travels in India, Capt. B. Hall. Selected and edited with a Biographical Introduction, by Prof. H. G. Rawlinson. *Royal Geographical Society.*—The Record of the Royal Geographical Society, 1830–1930, Dr. H. R. Mill. *Seeley, Service and Co., Ltd.*—The Island Builders of the Pacific, Dr. W. G. Ivens.

Mathematical and Physical Sciences.

Edward Arnold and Co.—Lecture Experiments in Optics, B. K. Johnson. *G. Bell and Sons, Ltd.*—The Scattering of Light, Prof. Sir C. V. Raman. (International Text-Books of Exact Science); The Physics of High Pressure, Prof. P. W. Bridgman. (International Text-Books of Exact Science.) *Ernest Benn, Ltd.*—The Ether of Space, Sir Oliver Lodge. *A. and C. Black, Ltd.*—Deductive Geometry, R. W. M. Gibbs; Earth and Sky: a Brief Account of the Earth's Situation in Space, with Some Account of its Internal Structure, C. H. Dobinson. *Blackie and Son, Ltd.*—Applications of the Absolute Differential Calculus. Dr. A. J. M'Connell; The Physics of Solids and Fluids, with Recent Developments. Selected chapters from Müller-Pouillet's "Lehrbuch der Physik" (11th edition, 1929), Prof. P. P. Ewald, Prof. T. Pöschl, and Prof. L. Prandtl. Translated by W. M. Deans and Dr. J. Dougall. *Cambridge University Press.*—The Mysterious Universe, Sir James Jeans; The Theory of Ruled Surfaces, W. L. Edge; Geometry of Four Dimensions, Dr. A. R. Forsyth. Two volumes; Radiations from Radioactive Substances, Sir Ernest Rutherford, Dr. J. Chadwick, and C. D. Ellis; An Outline of Wave Mechanics, N. F. Mott; Principles and Practice of Geophysical Prospecting, Edited by A. Broughton Edge and Prof. T. H. Laby; The Mathematical Papers of Sir William Rowan Hamilton. Edited by Prof. A. W. Conway and Dr. J. L. Synge. Vol. 1: Geometrical Optics. *W. and R. Chambers, Ltd.*—Navigation, W. J. Caird and H. McCallum. New edition. *Chapman and Hall, Ltd.*—Electrolytic Conduction, Prof. F. H. Newman. *Macmillan and Co., Ltd.*—Standard Four-figure Mathematical Tables, Prof. L. M. Milne-Thomson and Dr. L. J. Comrie. Edition A: with Positive Characteristics in the Logarithms. Edition B: with Negative Characteristics in the Logarithms; Astronomy: an Introduction, Prof. R. H. Baker; Progressive Trigonometry, Part 2: Plane Trigonometry, F. G. W. Brown; Lectures on Theoretical Physics delivered at the University of Leiden, Prof. H. A. Lorentz. Translated by Dr. L. Silberstein and A. P. H. Trivelli. Vol. 3: The Principle of Relativity for Uniform Translations (Special Theory of Relativity). *Methuen and Co., Ltd.*—Theoretical Physics, Prof. W. Wilson. Vol. 1: The Quantum Theory, Prof. F. Reiche. Translated by H. S. Hatfield and H. L. Brose. New edition; The Applications of Interferometry, W. E. Williams; Tables of Physical Constants, Dr. W. H. J. Childs; Mine Atmospheres, Prof. I. C. F. Statham and W. Payman. *Oxford University Press.*—A Manual of Greek Mathematics, Sir Thomas L. Heath; An Introduction to the Theory of Functions of a Complex Variable (Taylor Series), P. Dienes; A Monograph of Viscometry, G. Barr; Slide Rule Calculations, H. O. Cooper.

Medical Science.

Cambridge University Press.—Health at the Gateway, E. W. Hope. *Jonathan Cape, Ltd.*—De Mortuis, C. MacLaurin. *Cassell and Co., Ltd.*—Radium-Therapy: Principles and Practice, G. E. Birkett. *J. and A. Churchill.*—Public Health Practice in the Tropics, Dr. J. B. Kirk; Human Physiology, Dr. F. R. Winton and Dr. L. E. Bayliss; Recent Advances in Psychopathology, Dr. M. Culpin; Recent Advances in Microscopy. Edited by Dr. A. Piney. *Constable and Co., Ltd.*—Social Control of the Mentally Deficient, Dr. S. P. Davies. *Longmans and Co., Ltd.*—The Physiology of Muscular Exercise, the late Prof. F. A. Bainbridge. New edition, rewritten by Dr. A. V. Bock and Dr. D. B. Dill. *Methuen and Co., Ltd.*—Manipulation as a Curative Factor: Osteopathy and Medicine, Dr. Ethel Mellor. *Oxford University Press.*—The History of Paediatrics: the Progress of the Study of Diseases of Children up to the end of the XVIIIth Century, G. F. Still. *G. Routledge and Kegan Paul, Ltd.*—The Principles of Epidemiology, Dr. C. O. Stallybrass. *Charles Scribner's Sons.*—Riders of the Plagues, J. A. Tobey.

Metallurgy.

Ernest Benn, Ltd.—Industrial Steel and Iron: their Constitution and Properties, P. Oberhoffer. Translated by W. Austin. *Chapman and Hall, Ltd.*—Non-Metallic Inclusions in Iron and Steel, Dr. C. Benedicks and H. Löfquist; Stainless Iron and Steel, J. H. G. Monypenny. New edition. *Crosby Lockwood and Son.*—Heat Treatment in Forging Steel, B. Saunders.

Meteorology.

John Murray.—Temperature Chart (Wall Diagram), T. Saunders. *Oxford University Press.*—Climate, W. G. Kendrew.

Miscellany.

Edward Arnold and Co.—The Indexing of Books, Dr. J. W. T. Walsh. *Gurney and Jackson.*—Memories of Four-Score Years Less Two, 1851–1929, Abel Chapman. With a Memoir by G. Bolam. *G. G. Harrap and Co., Ltd.*—Industrial Britain: A Survey, Dr. A. Wilmore. *John Murray.*—The Science of Marking, Dr. Terry Thomas. *G. Routledge and Kegan Paul, Ltd.*—Forged, Anonymous, and Suspect Documents, Capt. A. J. Quirke.

Philosophy and Psychology.

George Allen and Unwin, Ltd.—The Education of Children, Dr. A. Adler; The Religion of Man. Being the Hibbert Lectures for the Year 1930, Rabindranath Tagore; The Structure of Thought, L. Fischer. Translated by W. H. Johnston; Number: the Language of Science, Dr. T. Dantzig. *Edward Arnold and Co.*—The Animal Mind, Prof. C. Lloyd Morgan. *Hodder and Stoughton, Ltd.*—The Sub-normal School Child. Volume 2: The Backward Child, Prof. C. Burt. *Longmans and Co., Ltd.*—Social Psychology, Prof. E. T. Kreuger and Prof. W. C. Reckless; Child Psychology, Margaret W. Curti. *Macmillan and Co., Ltd.*—The Faith of a Moralist, Prof. A. E. Taylor. 2 vols. (Gifford Lectures, 1926–1928.) *Methuen and Co., Ltd.*—A Modern Introduction to Logic, L. Susan Stebbing; The Social Contract of the Universe, C. G. Stone; Lectures on Ethics, Immanuel Kant. Translated by L. Infield. With an Introduction by Prof. J. MacMurray; Psychology: a Study of Mental Life, Prof. R. S. Woodworth. New edition. *Oxford University Press.*—A History of Psychology in Autobiography. Vol. I. *G. Routledge and Kegan Paul, Ltd.*—Intellectual Growth in Young Children, Susan Isaacs. With two Appendices by N. Isaacs; The Concentric Method in the Diagnosis of Psychoneurotics, Prof. M. Laignel-Lavastine; The Psychology of Intelligence and Will, H. G. Wyatt; Integrative Psychology: a Study of Unit Response, W. M. Marston, C. D. King, and Elizabeth H. Marston. *Charles Scribner's Sons.*—The Dynamic Universe, Prof. J. Mackaye.

Technology.

Ernest Benn, Ltd.—The Chemistry and Manufacture of Pigments and Paints, C. A. Klein and W. G. Aston; Modern Brickmaking, A. B. Searle. New edition; The Chemistry and Physics of Clays and other Ceramic Materials, A. B. Searle. New edition; The History of the Gas Industry, W. T. Dunn; The Manufacture of Gas, H. Hollings and others; Gas Calorimetry, Major C. G. Hyde and F. E. Mills; The Chemistry and Technology of Artificial Silks, A. J. Hall. *Chapman and Hall, Ltd.*—Electro Deposition of Chromium, D. J. Macnaughton. *Crosby Lockwood and Son.*—Woodcraft Design and Construction, G. H. Barker; The Modern Soap and Detergent Industry. Second edition, revised by Dr. G. Martin. Vol. 1: Theory and Practice of Soapmaking.

Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

retired on Aug. 1, 1912, having in 1911 been raised to the knighthood.

Long a member of the Institution of Naval Architects, Sir William Smith became a member of Council in 1887 and a vice-president in 1906. He undertook the design of the well-known Antarctic expedition ship *Discovery*; became vice-chairman of the Board of Trade Committee on the Load Line for Merchant Ships; for eight years was chairman of the Board of Studies in Civil and Mechanical Engineering for the University of London, and was also chairman of the Advisory Committee of the William Froude Experimental Tank at the National Physical Laboratory. He was also a member of the Technical Committee responsible for the restoration of H.M.S. *Victory*.

We regret to announce the following deaths:

Dr. Lewis Evans, founder of the Lewis Evans Collection of early scientific instruments at Oxford, on Sept. 25, aged seventy-seven years.

Mr. Daniel Guggenheim, an American financier and member of the mining firm of Guggenheim Brothers, who established in 1926 the Daniel Guggenheim Fund of £500,000 for the promotion of aviation, on Sept. 28, aged seventy-four years.

Sir Francis Watts, K.C.M.G., first principal of the Imperial College of Tropical Agriculture at Trinidad, on Sept. 26, aged seventy years.

News and Views.

There has recently been in progress at the Avonmouth Docks, Bristol, an experimental demonstration of the possibilities of a new system of hydro-electrical power development by means of the head due to the tides, which in the estuary of the Severn are of the order of 30-40 ft. Hitherto, the economical development of tidal power on commercial lines has been beset by the difficulty of obtaining uninterrupted functioning of the generating machine. The turbines, requiring a minimum head or pressure for working purposes in the neighbourhood of 10 ft., are necessarily inoperative during such times as the difference between the level of the impounded water and that in the outer channel is less than this. The periods are considerable and may absorb a third of the tidal time. The difficulty can be overcome by a complex system of auxiliary basins or reservoirs, but the cost of these is generally prohibitive. Under the new system, which is due to Mr. Paul Shishkoff and is being exploited by Hydro-Thermal Power Ltd., of Westminster, a portion of the power produced by the turbines under tidal action is converted into heat by means of a water friction brake, the heated water being stored under pressure in a steam accumulator. When the tidal head falls below the minimum required to drive the water turbine, power is generated by a turbo-alternator driven by steam from the accumulator. In this way the intermissions of tidal force are bridged over. The power system is, of course, of a dual nature, being partly by water and partly by steam, but it has the merit of being self-contained and is, indeed, quite simple in design. The experimental plant at Avonmouth is only of small calibre, with an ordinary continuous load of 16 kw. and a peak load of 32 kw., but its successful operation opens out a wide field of possible development for the Shishkoff system.

A very interesting and, it is hoped, a far-reaching development in the campaign against foot-and-mouth disease is indicated in an important new order issued by the Ministry of Agriculture under the Diseases of Animals Acts, making provision for the use of immune serum in the endeavour to check the spread of this most highly infectious and costly disease. The order provides that "The Minister may, for the purpose of preventing the spread of foot-and-mouth disease, treat with serum, as often as may be, in his opinion, necessary, any animals which may have been in contact with animals affected with foot-and-mouth disease or which have, in his opinion, been exposed to the danger of infection of that disease." This order marks a very big step forward, as it indicates strong reason to hope that one of the greatest difficulties hitherto met with in the spread of the disease and its control by serological methods has been overcome. That difficulty was due to the fact that there are several strains of the virus of foot-and-mouth disease, and hyper-immune serum found to be effective against one strain failed to produce any protection against the others. As the source of infection in Great Britain was varied, possibly European or even South American, serum proved to be effective in one case was quite useless in the next case. There are three known strains of virus, and the obvious aim has been to produce a serum effective against all three. It is believed that this has now been accomplished, and it is this trivalent serum that it is proposed to use. Fortunately it is being prepared on the Continent (Holland and Germany), so the establishment of an institute for its production, which would inevitably be a possible source of danger in Great Britain, will be unnecessary.

The passive immunity to foot-and-mouth disease produced by the new serum is only of ten days' duration, so the inoculation will probably have to be repeated once or twice in an outbreak. The slaughter policy of *affected animals* is not to be varied, for the serum is preventive, not curative, and it is essential that the animal producing virus be stamped out. There must be no possible risk of producing carriers. The great value of this new procedure will be that when an outbreak occurs animals in the vicinity can be immediately immunised, and it may be possible, if sufficient material is available, to establish an immune circle around the outbreak, and so enormously reduce the danger of its extension. Occasions have occurred in the past where most valuable animals have had to be destroyed, not because they were affected, but because they had been exposed to infection. It is to be hoped that, as the result of the new procedure, such animals may be saved.

Stockowners should be reassured that since the serum contains no living virus there can be no danger in its use. The order provides that the expenses incurred in its execution must be borne by the owner of the animals, and may be recovered summarily as a civil debt. The Ministry of Agriculture is to be congratulated on this forward step, and there is good reason to hope that it will be fully justified.

MR. WALTER GOODACRE, a past president of the British Astronomical Association and the director of its Lunar Section, recently gave the sum of £300 to the Association for the foundation of a medal and gift, to be awarded at intervals of a few years to a member of the Association, selected by the Council, in recognition of useful astronomical work carried out under the auspices of the Association. The first award has been made to the Rev. T. E. R. Phillips, a past president of the Association and the director of its Jupiter Section. Mr. Phillips has for a long time been a most active planetary observer and draughtsman; he has brought out several memoirs on Jupiter, in which he has laid special stress on the rotation periods of different markings on the planet, and has detected several instances of abnormal motion. He wrote most of the descriptive articles on the planets in the new edition of the "Encyclopædia Britannica".

MR. PHILLIPS was president of the Royal Astronomical Society 1927–29, and was awarded its Jackson-Gwilt medal a few years earlier. He has also given much time to the observation of variable stars and double stars. He applied harmonic analysis to the variable star observations, and his results suggested their division into two groups which were differentiated by the relations between the first and second harmonics. Mr. Phillips's observatory is at Headley, near Epsom, Surrey. His two chief instruments are an 18-inch reflector bequeathed by the late Mr. N. E. Green to the British Astronomical Association, and an 8-inch refractor lent by the Royal Astronomical Society; the reflector has been remounted in an open lattice-work tube, which is found to give improved definition. The medal and gift will be presented by the president of the Association, Capt. Ainslie, at the annual general meeting on Oct. 29.

EARLY this month an expedition from the University of Cambridge will sail for Mombasa to carry out biological investigations of certain little-known lakes in Kenya and Uganda. The particular objectives will be Lakes Rudolf and Baringo in Northern Kenya and Lake Edward in Uganda. This follows upon interest in the ecological aspects of the great African lakes which was started by the Government fishing surveys of Lakes Victoria and Albert in 1927–28, and Miss P. M. Jenkin's recent work on the smaller lakes in the Kenya rift valley. The collections resulting will be deposited in the British Museum (Natural History), and since the lakes to be visited have never been examined thoroughly, it is anticipated that a number of new forms of life will be revealed. Work will be done on the chemistry and physiography of the lakes, and the ecology will be studied in as much detail as possible. Another side of the work will be the examination of high-level beaches around the rift valley lakes. This is expected to provide evidence concerning the previous land and water distribution during the African pluvial periods, additional to that already found by Mr. L. S. B. Leakey in Kenya and Mr. E. J. Wayland in Uganda. The expedition is being financed by the Royal Society, British Museum (Natural History), Royal Geographical Society, British Association, Percy Sladen Memorial Fund, Gloyne Fund, and the Cambridge Balfour Fund. It will be under the leadership of Dr. E. B. Worthington, and other members from Cambridge will be Mr. L. C. Beadle as zoologist and Mr. V. E. Fuchs as geologist and surveyor.

ON Sept. 25 the honorary freedom of the Borough of Kendal in Westmoreland was conferred on Sir Arthur Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, in recognition of his high scientific attainments and contributions to knowledge. Sir Arthur was born on Dec. 28, 1882, in Kendal, where his father was headmaster of the Friends' School in Stramongate, a school in which John Dalton served for a time as assistant master. An appreciation which had been sent by Sir Oliver Lodge was read by Mr. H. C. Wilson, of Kendal, in presenting Sir Arthur to the Mayor. Sir Oliver referred to Eddington's mathematical work on the constitution of the stars and said that he is well known for his interpretation and extension of Einstein's work. Special tribute was paid to his gift of popular exposition. Sir J. J. Thomson, Master of Trinity College, Cambridge, also sent a tribute, in the course of which he said that "Sir Arthur is one of those rare cases where great literary is combined with great scientific ability". Sir Arthur, in replying, said that he was glad that "Kendal has recognised scientific work as service of public importance, not in any material sense . . . but perhaps in some fuller sense".

IN the course of its report, the Royal Commission on Agriculture in India dealt in detail with the possible scope and duties of the Imperial Agricultural Research Institute at Pusa, and recommended that a director possessing both administrative ability and experience in agricultural research should be obtained from Great Britain. The India Office has offered the appointment to Dr. B. A. Keen, of the Rothamsted Experimental Station, Harpenden, who will leave England on Oct. 7 on a year's leave of absence, which is being granted him by the Lawes Agricultural Trust with the concurrence of the Ministry of Agriculture. Dr. Keen joined the Rothamsted staff in 1913. At the outbreak of War he was commissioned to the Suffolk Regiment and served in Gallipoli and Palestine. On his return to Rothamsted in 1919, he became head of the Soil Physics Department, and in 1923 he was appointed to the new post of assistant director, which he still occupies. In 1924 he was elected a fellow of University College, London.

AT the Forestry Sub-Section of the British Association meeting at Bristol in September, Mr. Alexander

Howard, in a paper entitled "Our British-grown Hardwood Trees and Timbers", directed attention to the present heavy fellings and the almost total absence of replantings of the fine hardwood species of Britain —oak, ash, beech, elm, and so forth. Mr. Howard pointed out that the existing and often magnificent examples of these species in woods on private estates in Britain had resulted from the energetic and patriotic planting of the proprietors in the seventeenth and eighteenth centuries. Such plantings fell into abeyance during the nineteenth century, as the country and the nation's statesmen were no longer interested in hardwood timbers, owing to changed economic conditions. The latter-day imposition of heavy death duties has not only precluded the descendants of the former planters from carrying on the good work, but is resulting in the break-up of big estates, coupled with the felling, on an increasing scale, of large numbers of the magnificent trees and woods which have for so long made England famous as a beauty spot among the nations. Mr. Howard faces the fact that although the private proprietor may hope to make a profitable investment in planting coniferous woods, he can no longer hope to do so by planting hardwoods. The folly of the present system of taxation lies in the fact that timber represents so much capital which, on realisation, is being squandered by the recipients as soon as received.

REFERENCES are sometimes made in daily newspapers to the planting of trees by small-holders. Anyone conversant with this matter is aware that the mere planting of trees is but the first step: the results of such planting will depend on the technical supervision the trees receive during at least the first forty years of their lives; and the period in the case of hardwoods may well be longer. Mr. Howard points out that the Forestry Commission has limited its work mainly to softwoods and has as yet done little towards the replanting of hardwoods. His suggested remedy for the present position is to have a Government Forestry Department, which would have power to control all matters relating to forestry, to recommend expenditure, and to regulate all forests, without itself carrying on the trade of either planting, rearing, cultivating, felling, or selling. He considers that such a department might be in a very much better position. But under existing conditions in Great Britain, to which forestry practices in other countries have at present little application, a Government department, the sole work of which was to control all matters relating to forestry, recommend expenditure, and regulate all forests, would produce little of practical value. Mr. Howard states that: "Every man, woman, and child might be said to be a potential planter. All that is required is assistance and encouragement from the Government." If by this it is intended to imply that, given the money, the people will plant and look after trees, and that the results will be successful in the future, it is to be feared that Mr. Howard is unduly sanguine.

M. EM. TOUCHET, vice-president of the French Astronomical Society, makes a strong appeal in *La Nature* for Sept. 1 for the collaboration of amateur photographers in helping to get interesting and instructive photographs of lightning flashes and allied phenomena. The best methods of doing this were discussed by the French Society on Mar. 5 last and a résumé is given of the conclusions reached. Lightning is photographed in order to get a notable picture or for purely scientific purposes. In the latter case, the film should be changed after each flash. When a movable film is available, as when a cine camera is used, very instructive pictures can be obtained. Sometimes also the camera is rotated at a given rate about a vertical axis and excellent results obtained. Photographs are in existence showing successive flashes following exactly the same path. The size and kind of the camera used are not of great importance. M. Touchet says that a photograph taken with any kind of apparatus is better than no photograph at all. For example, it is most regrettable that although globular lightning has recently been seen hundreds of times, yet there is no authentic photograph of it in existence. With almost any portable cine camera an excellent photograph of it could be taken. Mathias has shown that at certain seasons and in certain mountainous regions these phenomena occur fairly often.

To obtain good stereoscopic photographs of lightning it is necessary to have two observers at stations about 200 metres apart. They can use electric torches for signalling to one another, or better, fix up telephone communication. Some good photographs have been taken in this way, the lightning standing out in relief. A table is given for the best length of base line to use for given focal lengths. Although with movable films it is possible to see roughly the true nature of the flash, we are still quite ignorant of its method of propagation. In general, the discharges are multiple; the first discharge blazes the way and the rest follow in the hot and ionised channel it has left. Traces of this channel are clearly shown by photographs. Between earth and cloud the discharges are nearly always multiple. In many cases the discharge is practically an 'electric arc' for an appreciable time and produces serious mechanical and calorific effects. Flashes between clouds, however, are generally simple. Lightning has often been observed curving towards the earth, and this has been attributed to the stratification of the atmospheric layers. There are many problems to be solved and the help of amateur photographers can be of the greatest assistance to meteorologists. The French Astronomical Society, Hôtel des Sociétés savantes, 28 rue Serpente, Paris, will gladly receive photographs of lightning, and those of scientific interest will be published in *La Nature*.

THE Bird Sanctuaries in the Royal Parks in and about London continue to do good work for the public as well as for the birds, and it is regrettable that a small minority of the people still abuses the privileges. The stealing of the eggs of Magellan geese in the Hyde Park and Kensington Gardens Sanctuary will be resented by none more than the public themselves. The Annual Report of the Sanctuaries Committee for 1929, now

again published in pamphlet form by H.M. Stationery Office (price 6*d.* net), gives many examples of improvements in the reserves. Undergrowth generally has been thinned to aid ground-feeding birds, clumps of brambles and nettles have been planted in Kensington Gardens, thickets in Greenwich Park, currant bushes, barberries, and teasels in Richmond Park, all to provide more food and cover to bird visitors. The lists of nesting birds and migrants show how great variety may be seen even in the heart of London. When the sun-bathers forsake the Serpentine, their places will be taken by immigrant ducks from the far north: there were 250 tufted ducks and more than 50 pochards last winter. Even a little auk from the open ocean visited the Round Pond. In these havens of peace, the struggle for existence goes merrily on: Magellan geese attacked all and sundry, herring gulls devoured the chicks of mallard, and mallard caught, drowned, and ate too venturesome sparrows. It is a lesson for those who would protect indiscriminately all the birds in a sanctuary or in a country.

IN a recent paragraph we referred to the work of the National Central Library (formerly the Central Library for Students), which endeavours to correlate in Britain the efforts of individual libraries to meet the needs of serious students. Readers may be reminded that this and several other British libraries take part in a much more extensive correlation scheme inaugurated by the International Institute of Intellectual Co-operation of the League of Nations. For several years this body has been endeavouring to collect information regarding the national and central libraries of different countries, with the view of creating a liaison between existing services. This was accomplished at the end of 1928, when a co-ordinating service of libraries was established by the International Institute. In order to increase the value of the co-ordination, at the request of an international congress of librarians held in 1929, there has just been issued a "Guide des services nationaux de renseignements du prêt et des échanges internationaux" (Paris: Institut International de Coopération Intellectuelle, 1930). In this appear concise notices of the centres of bibliographical information in every country where they exist or are in process of organisation, and in addition the addresses are given of all the bureaux for the international exchange of publications. Fifty-five nations or States are represented in the lists, an indication of the possibilities of this newly founded international service.

DURING the visit to Edinburgh of the French branch of the Franco Scottish Society on Sept. 26, the French Ambassador unveiled, at the Royal Edinburgh Hospital for Mental Diseases, a bust of Dr. Phillippe Pinel, the Paris physician who gained undying fame by his reformation of the old barbarous methods of treating the insane. Pinel was born on April 20, 1745, studied at Toulouse and Montpellier, and then went to Paris to study botany, zoology, and anatomy. He became known as a translator and editor of medical works, was made physician-in-chief at Bicêtre in 1792, and later held a similar position at the hospital of Salpêtrière. The reforms he introduced in both institutions led to the award of the Legion of Honour, and he was admitted a member of the Institute of France. He died on Nov. 25, 1826.

THE Council of the Television Society has recently taken steps to co-ordinate the experimental work of the members in such a manner that certain well-defined lines of collective research or group experimenting can be undertaken. A Research Committee has been formed to direct and assist members who desire to take an active interest in the work of the Society and in the advancement of the study of television. A survey is to be made of the membership, with special reference to technical qualifications and facilities of members to assist in experimental work; and educational institutions, universities, and commercial firms are to be approached to give facilities for group research. The Committee has undertaken to formulate definite group experiments, to be divided amongst members in such a way that their work, when completed, will form a definite contribution to our knowledge of the subject. These results will be edited and published in the Society's *Proceedings*, to be issued three times a year. As a preliminary step, the Committee has decided to consider a joint demonstration to be given at the annual exhibition of the Society to be held in April of next year.

THE Ministry of Agriculture desires that full use should be made by mycologists and plant pathologists in Great Britain of the facilities offered by the Imperial Bureau of Mycology. This Bureau has been supported financially by contributions from the governments of the Dominions, India, the Sudan, Iraq, and most of the Colonial Dependencies. The British government has hitherto not made any financial contribution, its aid having taken the form of the provision of a government building for use rent-free by the Bureau. A new and more commodious building has been erected to house the Bureau, near the Herbarium at Kew (at Ferry Lane, Kew), and arrangements are being made by which substantial financial aid shall be given in future by the three home governments, which will enable the Bureau to extend the scope of its activities. The Bureau is directed by Dr. E. J. Butler. For the purpose of dissemination of information, it publishes the *Review of Applied Mycology*, which gives a monthly survey of all current literature dealing with phytopathology and economic mycology from every part of the world. Imperial mycological conferences are held, under the auspices of the Bureau, at intervals of five years. It undertakes the identification and study of fungus and bacterial plant pathogens; and it maintains a museum of tropical plant diseases and a lending library for the use of mycologists.

As the result of a conference between the railway companies of France and the Minister of Public Works, a uniform system of electric signalling has been adopted and will be used on all the railways in France. The installation of the new electric visual system to replace the many mechanical systems in use will begin next year and will cost about £500,000. There are

important innovations made in the colour of the lights. The 'line free' signal, which is indicated at present by a white light, will in the future be signalled by a green light, thus bringing it into line with the colour used in all other countries. An orange-yellow colour indicates that the driver is to go slow. Violet will be used in shunting operations and to signify direction. The 'slacken speed' signal is given by two yellow lights placed horizontally followed by two yellow lights placed vertically. Red remains as the danger signal. The present use of mechanised systems which vary in different regions of France causes difficulty when engine-drivers are called upon to run trains over systems to which they are not accustomed. Trouble due to this cause was acute during the War. As the new signalling apparatus has been already tested on the Est, the État, and the Orleans lines, no difficulty is anticipated. An identical electrical system of luminous signals will be used in the day-time and at night.

AN instructive official table in connexion with international statistics of electric supply is published in the *Electrotechnische Zeitschrift* for June 12. It is compiled from the data collected by the international conference of high tension supply networks. The data show notable contrasts. In Switzerland, practically the whole population has electric supply available, whilst in Japan there is only about 20 per cent of the population similarly situated. England consumes 4·4 tons of coal per year per head of the population, which is the largest for any of the countries given. In Switzerland nearly 70 per cent of the available power is harnessed, whereas in Norway there is only about 15 per cent. The total maximum load per head of the population is credited to Norway, and Canada and Switzerland come next. The total capital cost of the generating and distributing systems in England is 222 million pounds, whilst in Canada it amounts to 157·5 million pounds. In the latter country, only about a third of the total is invested in distributing plant. The reason for this is that a very large fraction of the total energy is taken by large industrial consumers situated near to the generating stations. It is hoped that next year fuller international electrical statistics will be given. This is the first year of their publication and not many countries have sent in data.

THE principal international passenger traffic to and from Spain and Portugal, mainly for the capitals Madrid and Lisbon, passes through the frontier town of Irun near San Sebastian, where luggage is examined by the customs officers. From this town the main line follows the coast to San Sebastian and then turns off from the sea and gradually rises through the foothills of the Pyrenees to an altitude of 2000 feet, where the first ridge of the mountain is pierced by a tunnel which emerges at Alsasua. The section from Irun to Alsasua has been electrified by the North Spanish Railway; the Pajares mountain section and the suburban railways of Barcelona have also been electrified with direct current at 1500 volts. In the *Brown Boveri Review* for August there is an account of the express locomotives that have been built for the Irun-Alsasua section of the railway. Each locomotive is capable of developing 2700 h.p. at the tread of the wheels and is capable of hauling a passenger train weighing 400 tons (exclusive of the locomotive) at a speed of 40 miles an hour up an incline of 1·65 per cent. Special vacuum brakes are used and the braking force for the whole locomotive equals 177,000 lb. weight. There are six driving axles driven by six series wound motors which can be connected in various ways for altering the speed. Pantograph collectors with double bows are used to collect the current. Regenerative braking is also employed so that when going down hill electric power is generated by gravity. All the mechanical part of the locomotives was built by the Spanish Babcock and Wilcox Co. to the design of Swiss engineers.

MR. E. SHINWELL, M.P., the Secretary for Mines, has appointed Prof. Henry Louis to hold a local inquiry into the possibility of developing the production of gold and other minerals in Merionethshire.

DR. H. H. MANN, assistant director of the Woburn sub-station of the Rothamsted Experimental Station, is shortly leaving England for south Russia, to advise as to the possibility of the extension of the tea-growing industry. Before joining the Rothamsted staff, Dr. Mann was engaged in tea research in India, where he became recognised as one of the leading experts in the cultivation and management of the tea plant. He is expected to be away until December.

IN an article in NATURE of Sept. 20, p. 456, referring to the production of artificial pearls by Linnæus, the question was asked whether his experimental shells are still in existence. A correspondent has pointed out that the shells and also specimens of artificial pearls made by Linnæus are included in the Linnean Collection of Shells in the possession of the Linnean Society of London, and were among the exhibits from the Linnean Collections arranged in connexion with the Fifth International Botanical Congress held in August last.

PART 1. (Medical Tables) of "The Registrar-General's Statistical Review", 1929, has been issued (London: H.M. Stationery Office, price 7*s*. 6*d*.). The birth-rate for 1929, 16·3 per 1000 persons living, was the lowest that has been recorded. The death-rate was 13·4 per 1000, against 11·7 for the previous year, the rise being accounted for by the high mortality occasioned by epidemic influenza and the severe weather in February and March. The same cause increased the infant mortality to a rate of 74 per 1000 live births, or 9 per 1000 above that for 1928. The death-rate from cancer was 1437 per million living, against 1425 for the previous year, being the highest crude rate recorded. The rate for suicide was 126 per million, the highest figure on record. Deaths from accidental injury by mechanical vehicles on roads increased from 4492 in 1927 to 5251 in 1928 and 5799 in 1929, of which 1162 were caused by motor cycles.

THE new catalogue of the Wild-Barfield Electric Furnaces Ltd., Holloway, N.7, describes electromagnetic steel-hardening furnaces which have an

efficiency of about 90 per cent. This high efficiency is obtained by means of a special form of fan incorporated in the oven. At 100° C. this fan increases the rate of heating thirteen times and at 250° C. four and a half times. This effects great saving in the running costs. In the old days, steel was tempered by reheating the hardened steel until it assumed a certain colour due to the gradual formation of a film of oxide on it; the thicker the film the deeper the tint. Modern methods of tempering consist in reheating the steel either in a bath of oil, lead or salt, or in an air tempering oven. The last method is the cleanest and safest in operation. There are no fumes and the running costs are lower owing to the absence of salt or oil replacements. The introduction of forced circulation by a paddle fan makes it not only possible to heat the charge very rapidly but also to secure almost uniform heating. It is claimed that these furnaces can operate within 1° C. to any required temperature without attention.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:- An assistant in the Mechanical Engineering Department and two graduate assistants in the Mathematics Department of the Municipal Technical College, Coventry—The Director of Education, Education Department, Council House, Coventry (Oct. 6). An assistant analyst in the Health Department of the Municipality of Singapore—Peirce and Williams, 1 Victoria Street, S.W.1 (Oct. 6). A full-time lecturer in mining in the County Technical Institute, Worksop—The Principal, County Technical Institute, Worksop (Oct. 8). An assistant Government analyst, Hong Kong—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Oct. 8). A lecturer in experimental psychology in Otago University, Dunedin, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 10). A clinical assistant at the Radium Institute—The Secretary, Radium Institute, Riding House Street, W.1 (Oct. 10). An assistant radiologist at the Middlesex Hospital—The Secretary-Supt., Middlesex Hospital, W.1 (Oct. 11). A bacteriologist and a senior bacteriological assistant under the Devon County Council—The County Medical Officer, 4 Barnfield Crescent, Exeter (Oct. 11). Two temporary drainage inspectors under the Ministry of Agriculture and Fisheries for technical work in connexion with land drainage—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Oct. 13). A senior technical officer in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Oct. 15). A radiologist to the Royal Infirmary, Edinburgh—The Chairman, Royal Infirmary, Edinburgh (Oct. 20). A lecturer in the Department of Botany, King's College, London (special subject, plant physiology)—The Secretary, King's College, Strand, W.C.2 (Nov. 1). A Pilkington fellow in cancer research in the University of Manchester—The Registrar, University, Manchester (Nov. 15). A graduate for physics and mathematics in the County Technical and Secondary School, Workington—The Principal, County Technical and Secondary School, Workington.

Our Astronomical Column.

New Map of Mars.—*L'Astronomie* for September contains a new map of Mars, drawn by E. M. Antoniadi from his own studies of the planet, chiefly those made with the 33-inch refractor at Meudon. The map is a pictorial one, representing the telescopic aspect of each region, the gradations of light and shade being carefully reproduced. The map is in five portions: three of these have the equator in the centre, and extend to latitude 70° north and south, the projection being that of Mercator; each map covers 120° of longitude, the centres of the maps being at longitudes 310°, 70°, and 190°; the other two portions are circular, extending from latitudes 60° north and south to the poles. A large number of names are inserted, including those of many of the 'canals'.

M. Antoniadi rejects the view that the canals are arranged geometrically; he shows many of them as broad irregular stripes, others (notably Laestrygon and Antæus) as chains of lakes. Dotted lines indicate regions which have been observed to change either in shape or in tone during the period of his observations; these include five regions designated Nix (snow), but the so-called 'Dawes Ice Island' is not among them. The Solis Lacus is shown large and elongated, with some darker patches in it; five broad canals connect it with the surrounding dusky regions.

This is probably the most elaborate and detailed map of Mars that has been produced. There will doubtless be differences of opinion among observers as to some of the details, but few will dispute the artistic merit of the delineation. A new season of Martian observation will shortly commence, as the planet is in opposition next January in high north declination. This map may encourage new observers.

Galactic Rotation and the Spiral Nebulæ. The researches of the Mt. Wilson observers and those of Prof. de Sitter have established a strong case for the conclusion that the large recessional velocities of the spiral nebulæ are approximately proportional to their distances. Dr. J. H. Oort, who was one of the foremost workers on the problem of galactic rotation, contributes a paper to *Bull.* No. 196 of the Astronomical Institute of the Netherlands, in which he obtains a solution for the solar motion relatively to the nebulæ, which he compares with the solar motion derived from his solution of galactic rotation; the two prove to be in close accord, which tends to confirm his elements for the rotation, and also to give some additional weight to the assumption regarding the recessional motion of the spirals.

There is evidence of the existence of several clusters of spirals; such cases have been used not individually but in combination, the mean of such a group being given a higher weight than a single nebula. Dr. Oort is in doubt whether to treat the Magellanic Clouds as extra-galactic objects or not. Including them, he finds 360 km./sec. for the solar motion relatively to the nebulæ, directed towards galactic longitude 57°, N. latitude 2° (longitudes reckoned from the ascending node of the galaxy on the equator of 1900). Excluding the Clouds, he finds 380 km./sec. towards longitude 58°, N. latitude 4°. The recession of the nebulæ is found to be 140 km./sec. at Prof. de Sitter's unit of distance, which is 1,060,000 light-years; de Sitter and Hubble found 153 km./sec. and 151 km./sec. at this distance respectively. The previously adopted motion of the sun due to galactic rotation was directed towards longitude 57°, latitude 0°.

Research Items.

Chinese Alchemy.—The September number of the *Scientific Monthly* contains an interesting paper by Dr. Tenney L. Davis and Mr. Lu-Ch'iang Wu, of the Massachusetts Institute of Technology, on the development of alchemy in China. This contains some quotations from a paper by Ch'i-Ch'ao Liang which appeared in Chinese in 1923, dealing with the five elements, yin and yang, etc. The change in the meanings attached to these conceptions which arose under Taoist influences is (as in previous writers) supposed to have been the beginning of alchemy in China, which occurred, according to the explicit statements of the very reliable Ssu-ma Ch'ien (first century B.C.), during the reigns of Huang Ti (259-210 B.C.) and Wu Ti (156-87 B.C.). The earliest purely alchemical treatise in Chinese is considered to be that by Wei Po-Yang, who flourished about A.D. 142, extracts from which are quoted from a text recently printed. "In many respects it bears a strong resemblance to the later alchemical writings of the Europeans." Mr. Lu-Ch'iang Wu promises an English translation of Wei Po-Yang's work, and it is to be hoped that this will appear in due course.

Corn Customs in Wales.—The distribution of corn customs in Wales is the subject of a study by Mr. Iorwerth C. Peate in *Man* for September. Many people still living can remember customs relating to reaping the last sheaf of the corn in harvest. Six, eight, or more reapers standing in a circle hurled their sickles at the last tufts of corn, which had previously been divided into three and plaited by the chief reaper. If it were not cut down by one of the sickles thrown at it, it was cut by the head reaper. It was then taken to the farm and hung on a beam, where it remained until the next harvest, when it was destroyed. It was necessary that it should reach the beam dry, a matter of difficulty, as the farm women threw water, beer, milk, or other liquid at the carrier, who kept the sheaf concealed. The carrier's companions endeavoured to protect him by each pretending themselves to be the carrier. If successful, the carrier took the place of honour at the harvest feast; if unsuccessful, he paid a fine to the women, or was the butt of the harvest supper. Alternatively, the carrier might take the sheaf to the field of a neighbour where the harvest was still in progress, and throw the sheaf down before the principal reaper's sickle, immediately running away. The reapers threw their sickles at him and pursued him. If he were caught, he was bound with straw ropes and left in the field or thrown into a stream or drenched with pig-wash. These customs were not found in the central moorland area of Wales but coincide in distribution with the chief wheat-growing areas of the country. In most districts the custom died out in the latter half of the nineteenth century, owing to the religious teaching which followed on the revival of the eighteenth century, receiving its last blow in the great revival of 1859.

Some Bird Changes in Canada.—In the extreme south-west corner of Saskatchewan, Lawrence E. Potter has been observing birds for close on thirty years, and has found in that relatively short space considerable change in the avifauna (*Canadian Field Naturalist*, Sept., p. 147). Of few birds can it be said that there is an increase in numbers. The house-sparrow first appeared in 1907; the shelter and waste grain due to the settlement of the country induce the western meadowlark and the red-winged blackbird occasionally to stay over the winter; and the mourning dove has increased during the past ten years. Sometimes the numbers rise and fall without any apparent reason: magpies were fairly common in 1901–4; for six years thereafter they vanished altogether, and since their reappearance in 1910 they have multiplied so as to become a pest. On the other hand, the coming of the black-billed cuckoo in 1912 and its disappearance in 1924 coincided with the coming and going of unusual numbers of the tent caterpillar. In general, conditions of settlement have been found to be unfavourable to wild duck, birds of prey, sharp-tailed and sage grouse, and wading birds; and unaccountably the barn swallow has become very scarce. An interesting link is revealed in the connexion between bitterns and beavers. From about 1908 to 1918 beavers became very common and the American bittern flourished, for it found the shallow water caused by the beaver dams good feeding-places. But the beavers were wiped out about the latter date and they have never regained their former numbers; and the bittern has correspondingly decreased and is now rather rare.

Aphis Harvest of the Red Wood Ant. A few simple observations made by Fridthjof Ökland upon the use made by the red wood ant (*Formica rufa*) of the excreted juices of aphids, show clearly the importance of the relationship to this species of ant (*Biol. Zentralbl.* Bd. 50, p. 450, 1930). The author captured 200 ants on each of three species of trees, birch, pine, and fir, 100 as they marched up the tree trunk, and 100 as they marched down. The former were hungry ants on the way to their aphid pastures, the latter were fed ants returning. The difference in weight between the two groups represented the amount of aphis juices imbibed by 100 ants at one visit the dry weight of this difference averaged about 100 mgm. Observation showed that an ant paid about five visits a day, so that the amount of 'aphis-sugar' collected by an ant per diem would be 5 mgm., or during the summer months 500 mgm. Now the number of the inhabitants in a nest of the red wood ant have been reckoned at 150,000-200,000 individuals; suppose, on the safe side, we take the number to be 100,000, and that of these one-fifth are 'milk-gatherers'. Then the quantity of 'aphis-sugar' collected by a colony would amount to 10 kgm. a season, and the daily amount from one tree would be about 60 gm.—by no means an insignificant loss to the tree. Moreover, comparison with hive bees indicates that the aphis-sugar crop of an ant colony of several nests would be not less than the honey crop of a colony of hive bees.

Polar Limits of Tree Growth.—The Polish plant geographer, Dezydery Szymkiewicz, in his travels in high northern latitudes, has paid particular attention to this point, to which he devotes a paper in the *Acta Societatis Botanicorum Poloniae*, vol. 7, No. 1, 1930. His general conclusion is that trees are no more susceptible to low temperatures than other plants and that, as a result, there is no thermal limit to the northward spread of the tree habit. On the other hand, the desiccating effect of the cold dry winds prevalent in northern latitudes increases with the elevation of the foliage of the plant above ground level, and it is those arctic winds which are responsible for the absence of trees in the regions of frequent frost. The polar limit of tree growth, he therefore concludes, is really a maritime limit, and if the land masses were differently arranged, trees would be found nearer the poles.

The Movement of Continents.—The forces which, according to Wegener's theory, move the continents have been taken to be those due to the combination of the gravitational and centrifugal forces on the

continents and on the denser viscous magma on which they float. These give a resultant directed towards the nearer pole for a continent the centre of gravity of which lies above that of the displaced magma, and towards the equator if it is below. Dr. U. P. Lely, of The Hague, describes, in the issue of the *Physikalische Zeitschrift* for Aug. 1, experiments on the behaviour of a small piece of wood placed on the surface of water in a cylinder rotating about its axis, which was vertical. His results have led him to conclude that in the case of an elongated continent there is also a couple which may tend to set the long axis either parallel or at right angles to the meridian. In the case of Europe-Asia the couple is zero, of South America and Africa it is small, but in the case of North America it is large, and the American continent is bending at the equator. Dr. Lely considers that an examination of the directions in which the axes of elongated sunspots set should lead to important conclusions as to the distribution of density in such spots.

Meteorites in the Philippines.—The Director of the Weather Bureau of the Philippines, the Rev. M. Selga, has collected together in *Publications of the Manila Observatory*, vol. 1, No. 9, 1930, all the available information regarding meteorites in the Philippines. Seventeen cases are discussed, including twelve falls, two actual findings, and three sets of spurious examples. The earliest fall dates from 1618 and the latest from 1928. It is shown that the Mexico meteorite, which has been recorded as falling in Mexico in 1859, fell near the town of that name in the province of Pampanga; specimens are preserved in Paris, London, and Chicago. The Calivo meteorite fell in 1916 and analyses are now presented for the first time. The meteorite is a brecciated siderolite with 19 per cent of nickel-iron. The stony material is said to be mainly enstatite, but is clearly variable. One analysis gives 27·92 per cent of magnesium oxide, whereas another shows only 1·20 per cent, alumina and lime being high in this sample. A detailed petrographic examination appears to be called for, to complete the investigation. Reference is also made to the tektites found by Beyer in the province of Rizal since 1926. These occur in neolithic deposits and their composition places them between the australites and billitonites; the name *rizolites* is proposed for them. Their composition, form, lack of crystallites, and distribution all favour a cosmic rather than a terrestrial origin.

Sound Test Gramophone Records.—An addition to the number of gramophone records of scientific interest mentioned in NATURE of Nov. 9, 1929, Vol. 124, p. 741, has been made by the Parlophone Company's recent issue of two further sound test records. Each of these gives under normal conditions any one of a series of eight pure tones, covering in intervals of an octave a range of seven octaves, the lowest tones being respectively 32 and 50 vibrations per second. The playing duration of each tone is 40 seconds.

Rotatory Dispersion.—The issue of the *Physikalische Zeitschrift* for July 15 contains a summary by Dr. G. Kortüm, of the Chemical Institute of the University of Würzburg, of present-day knowledge of the optical activity of substances, and of the empirical and half empirical theories which have been advanced to connect the observations with the chemical properties of the substances. The general character of the optical rotation on the two sides of an absorption band is in keeping with the classical theory of Drude, but the constants calculated from the observations of rotation are not identical with those given by refraction and absorption measurements. The newer theories seek to connect the rotation either with the relation between the oscillations of the electrons or with the asymmetrical arrangement of the atoms within the molecule. They have, in the different forms in which they have been presented, met with a qualified success, and the recent observations of optical rotation in the ultra-violet are likely to provide means of testing them more severely. A list of more than 130 references is given.

Spectra of the Rare Earths.—The July issue of the *Journal of Research* of the U.S. Bureau of Standards contains a partial analysis of the spectra of lutecium, by W. F. Meggers and F. B. Scribner. This element is the heaviest of the rare earths, the spectra of which have been little studied, and has atomic number 71. As with hafnium, which was also under investigation recently in the same laboratory, auxiliary information, such as that provided by the Zeeman effect, was practically absent, and the classification of lines had to be carried out by their different behaviour under arc and spark excitation, and by the numerical relations between their wave-numbers. The normal states of neutral, singly ionised, and doubly ionised lutecium atoms have been found to be represented by ^2D, ^1S, and ^2S spectral terms, respectively, and there is evidence for the completion of the inner shell of f-type electrons, which is only partially filled in lighter rare earths, from the absence of certain terms from the first spark spectrum (Lu II). The closely allied problem of the correlation of the spectroscopic and magnetic properties of the rare earths has also been discussed recently by Prof. A. Sommerfeld in a paper in the *Sitzungsberichte* of the Vienna Academy of Sciences (vol. 139, p. 11).

Determination of Blood Cholesterol.—The determination of the blood cholesterol in clinical investigations is assuming growing importance and a simplified method has been described by Emily M. Day and A. Bolliger (*Australian Jour. Exper. Biol. and Med. Sci.*, vol. 7, pts. 1 and 2, 1930, p. 41). One cubic centimetre of blood or plasma is spread on two filter papers, No. 40 Whatman, 7 cm. diameter, and is dried in the air or in an incubator or paraffin oven. When dry, the filter paper is folded and placed in a dry, clean test tube 6 in. × ⅝ in.; chloroform (B.P. suffices) is added, sufficient to keep the filter paper well covered. The test tube (or tubes if several determinations are being made) is then put in a beaker or tin containing carbon tetrachloride up to about the same level as chloroform in the test tubes. This carbon tetrachloride bath is put into a water bath which is heated until the chloroform boils gently. Should the carbon tetrachloride start to boil, the heating is reduced; in this way the boiling of the chloroform is perfectly controlled. The chloroform is allowed to boil for 15 minutes; should it evaporate to the paper level, more is added. The chloroform extract is then poured into a graduated or volumetric flask and is made up to a known volume, conveniently 15 c.c., with several chloroform washings of the filter paper in the test tube. The cholesterol is estimated in an aliquot part of the extract, preferably 5 c.c., by adding 2 c.c. acetic anhydride and 0·1 c.c. concentrated sulphuric acid, and comparing the colour developed with that of a standard, similarly treated, in a colorimeter. The standard solution consists of 1 c.c. of a stock solution containing 0·1 per cent cholesterol made up to 15 c.c. with chloroform. The mixtures are allowed to stand in the dark for 10 minutes before being placed in the colorimeter. Calculation: $x = \frac{\text{Standard}}{\text{Reading}} \times 100$ mgm. per cent cholesterol. Comparison with other methods shows that the errors are within ± 5 per cent, even if only 0·2 c.c. of blood is extracted.

New Building for Mining Department of the University of Leeds.

THE new mining building which was officially opened by Viscount Chelmsford on Sept. 30 marks the first stage in the reconstruction scheme rendered necessary by the growth of the University of Leeds. Its erection has been made possible by the generosity of the Yorkshire Coal Owners' Association, which contributed £25,000 to the general building fund of the University, and of the Miners' Welfare Committee, which gave £10,000.

The main building is of three stories, and while the accommodation it provides is considered adequate for the immediate future, there exists considerable scope for extension should the need arise. The front of the building consists of Portland stone, and has been built to conform with the general architectural plans for the new University building scheme. The roof of the building is flat and is intended for use in the testing of surveying instruments and for latitude and azimuth observations.

On the top floor is a large well-lighted drawing office, a spacious room meantime used as a museum, a students' common room and departmental library, a research laboratory, and a large lecture theatre. In the museum numerous mining exhibits, historical and modern, are to be found. The wide corridors in both the top and middle floors are also utilised for the convenient display of geological specimens from many parts of the Empire and other exhibits of considerable importance to the successful teaching of mining practice.

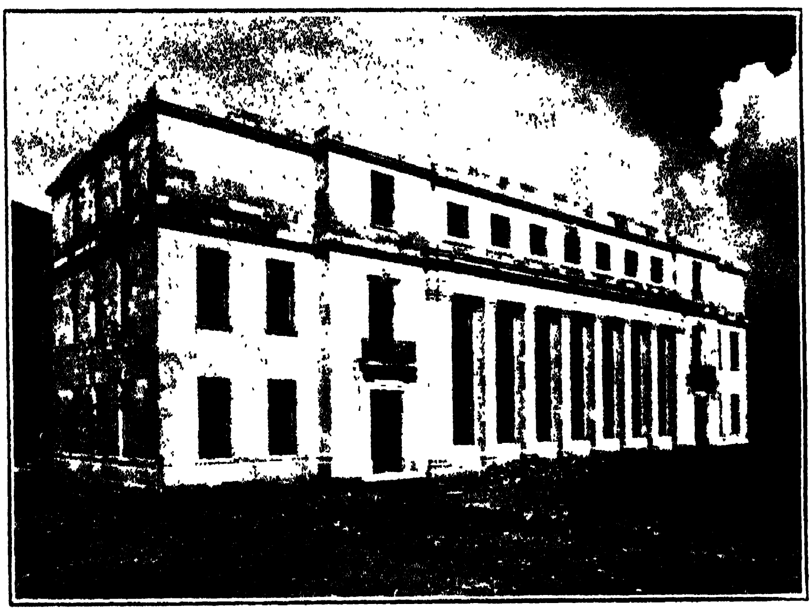


FIG. 1. Mining Department, University of Leeds.

The first or middle floor is apportioned into laboratories for wet and dry assaying, a gas-analysis laboratory, a dark room for photometric and safety-lamp work, a balance room, two research laboratories, and the departmental offices. The balance room is conveniently situated between the assaying and the research laboratories. One of the latter, and the research laboratory on the top floor, are to be occupied by a section of the Fuel Research Board for the physical and chemical survey of the West Yorkshire Coalfield. The other, and larger, research laboratory is fitted with all services necessary for the investigation of any physical or chemical problem associated with modern mining practice. It has so far been used by that branch of the Safety in Mines Research Board dealing with improvements in self-contained breathing appliances for use in mines. Entrance to any one of the laboratories on the first floor can be made only from the main corridor, a feature especially desirable in research work.

The ground floor comprises the main laboratory, crushing laboratory, sampling room, machinery room, ore bins, workshop, and stores. There are four independent means of access to this floor, two being at the front and two at the rear of the building. The main laboratory largely occupies the ground floor and is entirely given up to work on the preparation of coal and ores for the market. Working models of the principal appliances used in coal-cleaning and ore-dressing operations are installed. Adjacent to, but entirely separate from, the main laboratory is the crushing laboratory. Here an ore is treated, progressively if need be, by jaw crushers, rolls, stamps, and ball mills. The sampling room is completely isolated from the remainder of the building so as to reduce the risk of contamination during the grinding and subsequent treatment of coal or ore samples.

The principal units housed in the machinery room are: (1) a 25 h.p. vertical 2-stage air-compressor complete with all accessories required for testing purposes; (2) 32 h.p. motor-generator set with auto-transformer starter and six Reyrolles distribution panels; (3) full-size air-driven turbine chain coal-cutter kindly presented by Messrs. Anderson Boyes and Co.; and (4) two air-driven jigging-conveyor engines with lengths of troughs and accessories kindly presented by the British Jeffrey-Diamond Company.

In the basement, two 20-in. diameter Sirocco fans are installed together with about a hundred feet of fan gallery for experimental ventilation work. The fans are so arranged that they can be operated either singly, in series combination, or in parallel combination. A series of compressed-air pipe lines of various diameters is fitted along one of the walls of the basement, the arrangement incorporating different forms of metering devices, the whole being laid out for experimental work in compressed-air power service.

A special feature of the building is the ready accessibility of all services. In all there are twelve services, namely, a.c. two-phase, a.c. single-phase, d.c. power, electric lighting, water at mains pressure, water at constant head low pressure from the large capacity tank on the roof, domestic hot water, waste water, gas, compressed air, heating, and steam. Each service conduit system is painted a different colour, and the diagram giving the key to this colour scheme hangs in the main laboratory. In the laboratories the main services required are carried openly, along the top of, but are quite independent of, the benches. Tappings are arranged at intervals commensurate with the particular requirements. The cupboards below benches are all small standard-sized units and are readily removable or interchangeable. The general arrangement of the services is

thus one which facilitates their efficient maintenance and permits of ready extension whenever necessary.

All the electrical apparatus is earthed and adequately protected. Transformers for the supply of two-phase and single-phase a.c. are situated outside the main building, the distribution panels only being housed in the crushing laboratory. Reyrolle B.E.S.A. plugs (15 amp. and 5 amp.) are fitted throughout the laboratories for a.c. power and Reyrolle standard are used for d.c. The building is heated chiefly by the modern panel system, the panels being fitted on the walls or ceilings. Coke-fired boilers, separately housed in the basement, provide the hot water for heating and other purposes both in the Mining and the Fuel Departments.

Conference on Soil Science Problems.

THE Imperial Bureau of Soil Science, formed in May 1929 to assist workers on soil science throughout the Empire by providing technical information and promoting personal contacts between them, held its first Conference on Soil Science Problems on Sept. 16–18, at Rothamsted Experimental Station, Harpenden, with which it is in close association. The first day was made the occasion of the annual visit of Empire agricultural officers to the Station. The visitors, who included representatives from Australia, Canada, Ceylon, Gold Coast, India, New Zealand, Nigeria, Sierra Leone, South Africa, Straits Settlements, Federated Malay States, Sudan, Trinidad, Uganda, and Great Britain, were entertained to lunch, following a tour of the farm in which the classical and modern experiment plots were demonstrated. During the luncheon, the Conference was formally opened by the Right Hon. W. G. A. Ormsby-Gore; and later, an inspection of the laboratories was made and the work of the various departments demonstrated in groups, according to the individual interests of the specialist workers present.

The work of the Conference began on the following day, Sir A. D. Hall presiding, and a discussion on the mechanical analysis of soils was opened by Prof. G. W. Robinson (Bangor), who gave an account of the results of his work in comparing methods proposed by the International Society of Soil Science. He showed that similar figures were obtained by different methods with the majority of the soils examined. The main points of the discussion that followed were: The application of the proposed methods to tropical soils and the advisability of choosing a method suited to each particular class of soil; modifications in technique affecting the degree of dispersion of the soil by the omission, with some soils, of acid and peroxide treatment; and the proposed use of sodium hypobromite or chlorine peroxide for the oxidation of organic matter prior to analysis.

Mr. A. W. R. Joachim (Ceylon), who opened the discussion on available phosphorus and potash, spoke with particular reference to the reliability of laboratory tests for availability, such as the Dyer citric acid test and the physiological methods of Mitscherlich and Neubauer, suggesting that more use might be made of data for exchangeable potassium as an index of potash availability. During the discussion, reference was made to the desirability of eliminating errors due to seasonal effects and faulty sampling of the soil, and to the need of trustworthy, rapid, chemical methods to replace the tedious physiological tests. The suggestion was also made that the undoubted popularity of the latter methods on the Continent, and particularly in Germany, could be partly attributed, first, to a lower state of soil fertility than is prevalent in Great Britain; secondly, to unbalanced fertiliser additions, in the past, to soils in the same area, due in some cases to War shortage of one or other of the fertiliser components; thirdly, to legal difficulties involved in the sale of mixed fertilisers; and lastly, to conditions of land tenure.

A discussion on soil reaction and lime requirement was then opened by Mr. P. E. Turner (Trinidad) with an account of his work on the correlation of pH measurements of the soil with its degree of saturation with lime. This led to a discussion, principally on the correlation of pH values with other factors and the significance of soil reaction, especially in relation to the tolerance of specific plants.

At the afternoon meeting, the chairman, Dr. A. C. D. Rivett (Australia), opened a discussion on the work of the Imperial Bureau of Soil Science. Sir David Chadwick, secretary of the Executive Council of the Imperial Agricultural Bureaux, referring to the need of unity among research workers of the Empire which presaged the inauguration of the Bureau at the Imperial Agricultural Research Conference of 1927, said that the financing of the Bureau from a common fund derived from contributing governments marked a new departure in the constitution of the Empire. The work of the Soil Bureau for the year was then outlined by the Director, Sir John Russell. In the general discussion that followed, recommendations were made, many by overseas representatives, with the view of increasing further the usefulness and efficiency of the Bureau's activities. Finally, a proposal that the Bureau should hold annually a one-day informal conference was adopted.

The morning of Sept. 18, devoted to a discussion of soil survey, with Sir Thomas Middleton as chairman, began with an address on the soil resources of the Empire, by Sir John Russell, in which he said that no basis sufficiently broad to allow the comparative study of regions so widely scattered as those of the Empire has existed until recent years. The grouping of soils is determined, first, by climatic factors, and secondly, by geological factors. Topographical features also play an important part; but as first approximate generalisation, similar climatic conditions may be said to produce similar soil types and a tendency to form similar agricultural conditions. This is well seen in comparing the great regions of the British Empire and should serve as a basis for a valuable survey of the soil's resources. In concluding, he said that there is among manufacturers of the Empire a general working towards mutual agreements to reduce unnecessary competition and over-production; the agricultural scientific workers of the Empire are now organised through the Agricultural Bureaux to pool their information and ensure the maximum result for their efforts: it remains to bring about an organised agriculture for the Empire, based on sound soil and agricultural surveys, to ensure the best use of Imperial resources. A discussion on the position of soil survey in the Empire was then opened by Dr. F. J. Martin (Sierra Leone) with a description of a survey undertaken by him which resulted in an extension of rice-growing areas in Sierra Leone. Examples of similar extensions were brought forward during the general discussion. Sugar cane crops have been considerably extended in India through irrigation, by carrying out survey work which distinguishes between areas that would or would not respond to irrigation. The need for further work of that kind, especially in north-west India, and for

the examination and correlation of official data already available, was stressed.

Among other recommendations put forward in the next discussion, on the classification, mapping, and profile examination of soils, opened by Dr. W. G. Ogg (Edinburgh), were: That uniformity in the classification of soils could be furthered by discussions between surveyors of a large area at a central station; the more extended use of aerial photography in survey work; the use of single value factors and the data derived from examination of the clay fraction of the soil as aids in classifying soils; and the advisability of co-operation between soil surveyors and geologists.

The last discussion, on methods of field experimentation, presided over by Dr. P. J. du Toit (South Africa), began with an account by Dr. J. Wishart (Rothamsted) of plot layout in manurial experiments based on the statistical methods in use at Rothamsted. In further discussion he was able to put forward the advantages of the randomised block and Latin square methods over the older systematic arrangements. Errors in the analysis of yield data in fertiliser experiments on cacao or coconut trees due to lack of uniformity of seed or size of roots were instanced, and this led to a discussion on the most suitable size of plot to be adopted for tree crops, and to the further question of eliminating errors in pasture fertilisation experiments with grazing animals.

The first evening of the Conference was spent at a social gathering at Rothamsted, the second at a joint meeting of the British Empire Section of the International Society of Soil Science and the Soils Sub-Committee of the Agricultural Education Association. Prof. J. Hendrick (Aberdeen) deputised for Prof. N. M. Comber (Leeds) at this meeting, when the Russian Soils Congress and the organisation of the British Empire Section were dealt with in a partly informal discussion.

International Bibliography.

THE Institut International de Bibliographie was founded in 1895 by an international conference held in Brussels in response to the need to index the growing volume of recorded information. As the result of a thorough investigation of the problem, the logical principles of classification were developed, and it became possible to devise a classification, known as the Universal Decimal Classification, which is sufficiently extensive and flexible to index the literature of the world.

The Institute commenced to issue various bibliographies, of which the most important was a classified index to the literature of applied science with the title "Index technique". This publication is still being continued as the "Meddeelingen of the Nederlandsch Instituut voor Documentatie en Registratuur", and, though little known in Great Britain, is perhaps the most useful index of its kind.

The ninth annual conference of the Institute, held at Zurich on Aug. 21-25, was attended by delegates and members from all parts of the world. The British delegates were Sir Charles Sherrington, Sir Frederic Nathan, Dr. J. G. Priestley, and Dr. S. C. Bradford. In the absence of the president, Prof. A. F. C. Pollard, through illness, the chair was taken by M. W. Janički, the president of the newly formed Swiss section of the Institute. In a message to the conference, Prof. Pollard recommended that each national section of the Institute should prepare a list of the current periodical literature of its country, showing which literature has been indexed by the Decimal Classification and which awaits indexing, with the view of gradually building up complete classified national bibliographies.

A number of interesting papers were communicated. M. Paul Otlet recommended the establishment of a new scientific publication called "The Bibliographical Year", which should give an account of the advancement in bibliographical science. Sir Frederic Nathan read a paper in which he showed that the Association of Special Libraries and Information Bureaux arose spontaneously as the result of the pressing need for the supply of information to research workers, and gave an interesting account of the Association's activities; its Directory of Information Bureaux and Sources of Information, its Inquiry Bureau, the setting up of its Panel of Expert Translators, and culminating in its recent decision to recommend the general adoption of the Decimal Classification as a means of co-ordinating bibliographical undertakings.

M. B. Bourrel, director of the bibliographical information department of the Société des Transports en Commun de la Région Parisienne, gave an account of the application of the Decimal Classification to transport undertakings. In a succeeding communication M. Léon Walters, assistant director of the International Municipal Union, Brussels, considered the problem of classification from the point of view of municipal and local administration archives. Next, Dr. Walther, librarian to the Technical High School at Aix-la-Chapelle, dealt with the application of the Decimal Classification as a standard system from the point of view of scientific libraries, and traced the important developments in the use of the classification now taking place in Germany. The unequivocalness and completeness of the classification, as well as a possible simplification of the system by the deletion of certain auxiliary signs, was discussed by Dr. Hanauer, librarian to the Allgemeine Elektrizitätsgesellschaft.

Dr. Predeek, director of the library of the Technical High School, Charlottenburg, illustrated the usefulness of addressograph machines as means for printing catalogue titles and providing the subsequent reprints needed for a bibliographical service. M. W. Janički gave an interesting account of the historical development of bibliographical service in Switzerland. His compatriot, M. E. Mathys, librarian to the General Management of the Swiss Federal Railways, read a paper on the collection, cataloguing, and subject-matter indexing of professional literature, in which he discussed the establishment and running of information bureaux and inquiry offices, and showed the necessity both for national and international co-operation. Dr. Koch-Hesse, of Berlin, then illustrated the application of small-film photography to bibliographical purposes.

In a paper on the development of scientific bibliography in Great Britain, Dr. S. C. Bradford, Keeper of the Science Library at South Kensington, indicated the remarkable growth of institutions using the Universal Decimal Classification in Great Britain, from one to twenty-eight in four years. He showed that a complete bibliographical service comprises: (1) the survey of the literature being published, (2) its collection in the library, (3) the cataloguing and subject-indexing of the collected material, (4) the supply of bibliographies to research workers, (5) arrangements for the service of the books, either by reference, loan, or the issue of photo-copies—none of which departments had been organised satisfactorily up to the present. Dr. Bradford suggested that the material for a complete survey of the world's published literature would be provided if the principal library in each country should issue a weekly catalogue of all the publications of its country classified decimally. Such a catalogue would correspond to the list of accessions of the library, but would

need to be complete, up-to-date, and not necessarily to contain more than the publications of its own country. These weekly classified catalogues could then be used by the special librarian, both for book selection and as the actual author and subject catalogue-titles for his catalogues. The lists could also be amalgamated into a union catalogue of the world's literature. For the latter purposes, standard cataloguing-rules are needed as much as a standard classification. The divergencies in the cataloguing rules of different libraries were illustrated by the single example of the *Comptes rendus* of the French Academy, which was found to be catalogued under a different heading in each of the eight catalogues of large libraries consulted.

The Subject-Matter Index in the Science Library, to which are added all scientific references that are classified by the standard classification, has now grown in three years to more than one and a half million cards. This considerable repertory has been supplemented by gathering together as complete as possible a collection of miscellaneous scientific bibliographies, so that the Library is in a position to supply, so far as other work permits, really extensive bibliographies on scientific subjects in answer to inquiries.

As the result of the conference, the Commission of the Decimal Classification, which has control of the tables of the classification, has now been strengthened by including a delegate from each of the national sections of the Institute and from four of the principal State libraries, by the appointment of sub-commissions which will have charge of the improvement and extension of the different sections of the tables, and by the creation of a small executive committee with power to make small extensions that may be urgently required. Any modifications of the classification, which experience may show to be needed, will now be forthcoming without delay.

One of the most important decisions of the conference was that from next year the *Meddeelingen* of the Nederlandsch Instituut should be extended to include pure science and printed in a new form, bimonthly, under the title *Repertorium Technicum*. Each entry will bear the number which indicates its subject in the Decimal Classification, but, so that the bibliography may be useful to those who do not wish to employ the decimal classification, a small subject-index will be added to each part, and at the end of the year these indexes will be combined in an alphabetical index in three languages. An index of authors will be issued every year, or every two years. The bibliography will also be printed on loose leaves, so that, when it is not desirable to mount the titles on cards, the pages can be filed under the first decimal number on each page, in order to bring together entries on cognate subjects. In addition to references to articles, the *Repertorium* will be also a world-list of the more important technical books, so that it should be indispensable to librarians and research institutions of all kinds. The annual subscription will be £3.

In view of the simplicity and power of the methods of the Institut International de Bibliographie, it is astonishing that during the last thirty years or more so little use has been made of the bibliographical facilities provided by the Institute, the only explanation of which can be the almost complete lack of propaganda. Now that at last the methods of the Institute are beginning to be known, progress has already become rapid. As Sir Charles Sherrington remarked at the conference, scientific men are becoming aware of the need for guidance in the indexing of their publications, and the Institut International de Bibliographie is showing them the way.

S. C. BRADFORD.

University and Educational Intelligence.

BIRMINGHAM.—Under the will of the late treasurer of the University (Mr. Hugh Morton), the University will receive the sum of £20,000, to be applied at the discretion of the Council, in addition to £5000 for the foundation of two scholarships, one in English and the other in law. Of the ultimate residue of the estate, one half will accrue to the University, the other half being divided between the General Hospital and Queen's Hospital.

CAMBRIDGE.—The Vice-Chancellor announces that the late Miss R. M. Clark left to the University Observatory a legacy of £100.

Mr. H. W. Florey, of Gonville and Caius College, has been reappointed Huddersfield lecturer in special pathology.

ST. ANDREWS.—Payment has been received of a sum of £3000 bequeathed to the University by the late Dr. William J. Matheson, of Florida, U.S.A., for the institution of additional bursaries or scholarships in chemistry in the United College. It is proposed that a residential entrance scholarship in chemistry be instituted and that the existing Matheson Bursary should be made tenable for one year.

The new hall of residence for men students, St. Salvator's Hall, came into use on Oct. 2. Chattan House, hitherto occupied as a residence for men students, has been redecorated and furnished to receive women students who could not be accommodated in University Hall and its adjoining overflow houses. At the beginning of this session there will be about 220 students (including men and women) housed in residences under the management of the University.

THE next series of lectures and demonstrations on tropical hygiene, which are intended for men and women outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers, on Oct. 8-10, 13-17, from 11 A.M. to 12.30 P.M. Syllabuses and full particulars can be obtained on application to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

PROSPECTUSES for the coming session have now been issued by technical colleges in London. The Imperial College of Science and Technology has a department of aeronautics which offers complete courses of lectures and laboratory work for graduate students and facilities and personal supervision for researches in every branch of the subject. The Battersea Polytechnic provides full day and evening courses in preparation for the University of London degrees in science and engineering and includes a Domestic Science Department and Training College, and a Department of Hygiene and Public Health. In six years its students are known to have obtained posts as follows: 189 as engineers, 167 as chemists or scientific assistants, 246 as health visitors or sanitary inspectors, etc., 504 as domestic science inspectors or teachers, 48 as art and handicraft teachers and designers. The Chelsea Polytechnic includes day schools and colleges of science and technology, pharmacy, metallurgy, housecraft, and chiropody, and evening classes in science, technology, and domestic subjects. The school of chiropody has a staff of 15 teachers and offers a two-year full-time course as well as a one year course (for older students) and a post-certificate one-year course. The Sir John Cass Technical Institute has departments of pure science, applied chemistry (including brewing and malting, gas manufacture, and petroleum technology), metallurgy, and navigation.

Historic Natural Events.

Oct. 5, 1091. Thunderstorm in England.—The "Anglo-Saxon Chronicle" records that "a marvellous sore tempest fell in sundry parts of England but especially in the town of Winchcombe, where (by force of the thunder and lightning) a part of the steeple of the church was thrown down, and the crucifix with the image of Mary standing under the rood-loft was likewise overthrown and shattered in pieces; then followed a foul, a noisome and a most horrible stink in the church". Five hundred houses were blown down in London, and Bow Church was unroofed. In Old Sarum the steeple and many houses were thrown down.

Oct. 5, 1570 (or 1571). Storms on English Coast.—There was a great storm of wind and rain in which many ships were lost and much damage was done on land. About midnight the Thames rose so high that it invaded the houses and a woman was drowned as well as many houses and cattle. The sea broke in between Wisbech and Walsoken and drowned a number of villages over a space of ten miles. At Yarmouth a great part of the bridge was carried away and the 'haven house' was carried six miles into the marshes and set down upright with the haven man and his wife. A ship was driven on a house, and some of the sailors climbed out on the roof. Bourne was overflowed to the midway of the height of the church, and boats were rowed over St. Neot's church walls. The water broke into the Wash and permanently flooded a great deal of low ground, destroying the dykes. The Stratford Avon ran so violently that it drove back the waters of the Severn, causing great floods and loss of cattle. A great part of the bridge by Magdalen College, Cambridge, was broken down and in all parts of the country many trees were uprooted.

Oct. 5, 1858. Donati's Comet.—On this date Donati's Comet was in conjunction with the bright star, Arcturus. The curved tail of the great comet, not unlike a gigantic quill pen, was then about 35° in length, and the head or nucleus was a brilliant object. The comet, discovered at Florence by Donati on June 2, was a striking naked-eye object seen from the northern hemisphere during September and October. It was last seen from the Cape of Good Hope Observatory on Mar. 4, 1859. The period is of the order of 2000 years.

Oct. 5, 1864. Storm Wave at Calcutta.—During a cyclone which swept over Calcutta the sea, rising ten feet above the highest spring tides, covered the whole of the level country at the mouth of the Ganges, causing a death roll of 45,000.

Oct. 5, 1881. The Tongking Typhoon.—The most frightful storm on the coast of Annam on record struck Tongking during the morning. The wind caused an abnormally high tide and heavy sea in the river; during the afternoon the waves broke through and washed away the banks, flooding the whole countryside. During the night the storm increased in intensity until there was 6 feet of water in houses three or four miles from the shore. Two thousand houses, 200 churches, and nearly 100 junks were destroyed; there was great loss of life and the whole district was ruined. The s.s. *Quinta* went ashore on the coast of Hainan and was a total loss.

Oct. 8, 1530. Floods in Italy.—Following three days of bad weather, with thunderstorms and heavy downpours of rain, a great flood of the Tiber invaded Rome, destroying 600 houses and causing the loss of 12,000 lives. At about the same time there was a great inundation of the sea in Venice.

Oct. 8, 1726. Aurora.—Descriptions of this notable aurora are given in *Phil. Trans.*, 1726. As seen from the south of England, the display began about 6 P.M., spread from the northern horizon to all parts of the sky, and, after culminating in activity about 8 P.M. (when a short-lived corona appeared near the zenith), died away after 2 A.M. on Oct. 9. The formation of the corona was preceded by pulsating streamers and cones of light which shot up towards the zenith, first, from an arch in the northern sky and, later, from all parts of the horizon. The display seems to have been similar and but little inferior to that of Mar. 6, 1716, which aroused great interest. It was surmised by one observer that the origin of the phenomenon was "a thin Cloud composed of a Sulphureous Exhalation, hanging over us in the Air, at a considerable Height" that took fire; further, that "they are, doubtless, of great use to the Peace and Safety of the Earth, by venting some of that pernicious Vapour and Ferment that is the Cause of those terrible Convulsions, which Earthquakes are accompanied with". According to Wolf, a sunspot maximum fell during 1727.

Oct. 8, 1871. Great Fire of Chicago.—In 1871 the greater part of Chicago was built of wood, which was very dry after an almost rainless summer. On Oct. 8 a fire broke out near the lumber district west of the city, and spread rapidly under the influence of a strong wind. Except for the San Francisco fire of 1906, this was the greatest fire of modern times; in 27 hours 17,450 buildings were destroyed and 100,000 people rendered homeless, while 250 lost their lives. The destruction would have been even more complete but for opportune rain on Oct. 10.

Oct. 10, 1780. Hurricane in Barbados.—Barbados was devastated by a hurricane which began on the morning of Oct. 10 and continued for 48 hours. In the afternoon of the first day all the ships were driven from their anchors to sea. In the night Bridgetown was laid nearly level with the earth, and by daylight not one building on the island was undamaged. Most of the livestock and 4326 persons perished, and the loss was estimated at more than a million sterling. It was officially reported that a 12-pound gun was carried by the wind and waves from the south to the north battery, a distance of 140 yards. Other islands in the Lesser Antilles suffered equally; in Martinique 9000 lives were lost and in St. Lucia 6000, and the British and French warships, of which there were many in those waters, were badly damaged. The course of this storm was afterwards worked out in detail by Reid from the logs of those ships.

Oct. 11, 1737. Destructive Indian Earthquake.—A violent earthquake and hurricane visited Calcutta and the surrounding district. It is said that the lofty steeple of the English Church sank into the ground without breaking. The water of the Ganges rose 40 feet above its usual level. About 20,000 ships were lost, while 300,000 persons, it is estimated, were killed.

Oct. 11, 1918. Earthquake in Porto Rico.—The epicentre of this earthquake lay in the north-eastern portion of Mona Passage, a deep submarine valley, the slopes of which are so steep that they appear to be fault-formed. A few minutes after the earthquake a sea-wave about 16 feet high swept over the north-west coast of the island. During the half-century before, this coast had been subsiding, and the earthquake and sea-waves may have been caused by a displacement along one side of the submarine valley.

Oct. 11–12, 1737. Cyclone in Bengal.—A great cyclone crossed the Bay of Bengal and entered the mouth of the Ganges, where a cyclonic wave rose 40 feet above the usual level of the river. It is stated that this wave drowned 300,000 men.

Societies and Academies.

London.

Institute of Metals (Annual Autumn Meeting at Southampton), Sept. 11.—**J. C. Hudson**: The effects of two years' atmospheric exposure on the breaking load of hard-drawn non-ferrous wires. The losses in strength after two years' exposure are very small; the majority of non-ferrous materials are very resistant to atmospheric corrosion. Brass is an exception, as its strength is adversely affected by the copper redeposition that accompanies atmospheric corrosion.—**W. H. J. Vernon** and **L. Whitby**: The open-air corrosion of copper. (2) The mineralogical relationships of corrosion products. Complete agreement with the formula of the corresponding mineral has been realised in products after seventy years' exposure and upwards. Basic copper sulphate (under most conditions the major constituent) then coincides in composition with brochantite, $CuSO_4 . 3Cu(OH)_2$; basic copper chloride (in products near the sea-board) with atacamite, $CuCl_2 . 3Cu(OH)_2$; basic copper carbonate (usually present but in minor proportion) with malachite, $CuCO_3 . Cu(OH)_2$. After shorter periods of exposure the basicity of the product is lower than that of the corresponding mineral.—**E. Voce**: Silicon-copper alloys and silicon-manganese copper alloys. A survey of these alloys, studying their mechanical and physical properties in the cast, drawn, and rolled conditions, with the view of developing and extending their uses.—**E. Vaders**: A new silicon-zinc-copper alloy. The range of the α-solid solution phase at the copper end of the diagram has been determined; the 90 per cent copper alloy can take up 4·5 per cent silicon into solid solution. Alloys with 2-5 per cent silicon and 70-90 per cent copper have valuable properties. The best alloys within this range are those with 80-82 per cent of copper; these can be forged hot, rolled, and extruded, and give good castings, which have a dense uniform structure free from shrinkage cavities even in the thickest parts.—**H. C. Dews**: The effect of phosphorus on the strength of Admiralty gun-metal. Phosphorus up to approximately 0·05 per cent has little effect on the mechanical properties or structure. Above 0·05 per cent phosphorus causes the appearance of free Cu_3P and at the same time a reduction in the mechanical properties.—**F. Hargreaves**: Heat-treatment, ball-hardness, and allotropy of lead. From quenching and ball-hardness tests on lead of high purity, it is suggested that lead is allotropic, the suggested critical points being 187° C. and 228° C., approximately. The hardness varies greatly with the heat-treatment. Very marked changes take place in the hardness immediately after quenching. The presence of 0·005 per cent tin inhibits these marked changes, and they do not take place in commercially pure lead.

Paris.

Academy of Sciences, Aug. 25.—**Georges Urbain**: Notice on Achille Le Bel.—**Louis Blaringhem**: An autofertile hybrid of *Ægilops ovata* and *Triticum dicoccum*.—**A. Yersin**: Some observations on atmospheric electricity in Indo-China.—**Cl. Chevalley**: A theorem of Hasse.—**Georges Durand**: The application of the ideas of convexity and of contingent to obtaining certain criteria of enumeration.—**Nikola Obrechkoff**: Series of functions.—**A. P. Rollet** and **L. Andrès**: The cæsium borates. Evidence has been obtained of the existence of three cæsium borates, possessing 5, 3, and 1 molecule of boric anhydride to 1 molecule of Cs_2O.—**L. Bert** and **P. Ch. Dorier**: A new method of synthesis of cinnamic alcohol and its homologues.—**R. Weil**: New observations on quartz.—**M. Blumenthal, P. Fallot**, and **A. Marin**: Geological observations on the limestone of the Spanish Rif of Djebel Musa at Xauen.—**Th. Biéler-Chatelan**: The quaternary polysynthetic glacier of Monti Simbruini (Central Apennines). The limits of its extension.—**H. Hérissey** and **J. Cheymol**: Vicioside. This substance has been isolated from the vetch by methods similar to those described by Ritthausen, but the presence of galactose, found by this author after hydrolysis, could not be confirmed: the only sugar produced was *d*-glucose.—**Louis Emberger**: A climatic formula applicable in botanical geography.

Sept. 1.—**L. Filippoff**: The astronomical determination of the period of the disappearance of Atlantis. Atlantis existed during the Quaternary period and disappeared about 7256 B.C.—**S. Carrus**: The determination, without the square sign, of various expressions relating to skew curves by means of two arbitrary functions capable of defining the radii of curvature and of torsion of the curve.—**Serge Tchounikhin**: Simplicity of the finite group and the orders of its classes of conjugated elements.—**L. S. da Rios**: The theory of vortices.—**H. Pélabon**: New copper oxide rectifiers. In a preceding communication the author has suggested the existence in the active layer of an unsymmetrical condenser consisting of a copper armature, a semiconductor (cupric oxide) separated by an insulating layer of cuprous oxide. To test this view, a condenser has been formed of a metal, a semiconductor of pure copper oxide moulded into pastilles, separated by a semi-insulating layer of gold powder in suspension in varnish, the whole being placed under pressure. This arrangement possessed unilateral conductivity and acted as a rectifier for alternating currents.—**E. Rinck**: The equilibrium in the fused state between calcium, sodium, and their chlorides.—**J. Barbaudy** and **A. Lalande**: Some properties of absolute alcohol.—**Albert Portevin** and **Pierre Chevenard**: The change of composition of the cementite constituent in the course of reheating special steels.—**A. Nowakowski**: The study of certain cellulose and glucose esters by means of the X-rays. The results obtained are in good agreement with the conclusions which may be drawn from the cellulose model suggested by Sponsler and Dore and by Meyer and Mark.—**Paul Remy-Genneté**: The action of hydrogen and of hydrocarbons on barium. Barium slowly combines with hydrogen at the ordinary temperature, but methane and acetylene after a month in contact show no trace of absorption, and it is suggested that this fact might form the basis of a method of analysis. Carbon monoxide does not react with barium.—**M. Prettre, P. Dumanois**, and **P. Laffitte**: The inflammation and combustion of mixtures of pentane and air. In a previous paper it has been shown that there are two visible stages of combustion of pentane in air, one at 270°-300° C. and the other at 660° C. The effect of antidetonant substances on the lower temperature phase of the combustion has now been studied. The antidetonants included benzene, tin tetrethyl, and lead tetrethyl: the effect of adding these substances to the pentane was to reduce and finally to suppress the luminosity of the low temperature stage of combustion.—**Ch. Courtot** and **V. Ouperoff**: Study of the action of aluminium chloride on the arylalkyl, alkyl, and hydro-aromatic ketones in the presence of tertiary aromatic amines.—**Louis Emberger**: The stage of vegetation.

Official Publications Received.

BRITISH.

Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1930–31. Pp. 132. (London.)

Battersea Polytechnic, Battersea Park Road, London, S.W.11. Calendar of Evening and Afternoon Classes for Session 1930–1931. Pp. 31+14 plates. Free. Technical College for Day Students, and Day School of Arts and Crafts: Calendar, Session 1930–1931. Pp. 48+16 plates. 3d. Domestic Science Department and Training College: Full Time Day Instruction, Afternoon and Evening Classes, Session 1930–1931. Pp. 34+9 plates. 3d. Department of Hygiene and Public Health, Session 1930–1931. Pp. 24+6 plates. 3d. (London.)

Transactions of the Institution of Chemical Engineers. Vol. 7, 1929. Pp. 218. (London.)

Geological Survey Department, Tanganyika Territory. Short Paper No. 5: Water Supplies for Cattle along the Kondoa Irangi-Handeni Stock Route. By F. B. Wade. Pp. 24+6 plates. (Dodoma.)

The Proceedings of the Physical Society. Vol. 42, Part 5, No. 235, August 15. Pp. iv+355–606. (London.) 7s. net.

Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3. Prospectus of Day and Evening Classes for Men and Women, Session 1930–31. Pp. 69. Chelsea School of Art. Prospectus, Session 1930–31. Pp. 8. Chelsea College of Physical Education. Prospectus, Session 1930–31. Pp. 11. Chelsea Polytechnic: Chelsea School of Pharmacy. Prospectus, Session 1930–31. Pp. 18. Chelsea Polytechnic: Chelsea School of Metallurgy. Prospectus, Session 1930–31. Pp. 15. Chelsea School of Cookery, Housecraft and Dressmaking. Prospectus, Session 1930–31. Pp. 8. Chelsea School of Chiropody. Prospectus of Day and Evening Courses, Session 1930–31. Pp. 8. (London.)

Department of Tsetse Research, Tanganyika Territory. Annual Report on Experimental Reclamation for the Year ended March 31st, 1930. Pp. 21+4 plates. (London: The Crown Agents for the Colonies.) 1s. 6d.

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1929. By Dr. Joseph Pearson. Pp. F16+4 plates. (Colombo: Government Record Office.) 50 cents.

Madras Agricultural Department. Year Book 1929. Pp. 47. (Madras: Government Press.) 12 annas.

Tenth Annual Report of the Scientific and Industrial Research Council of Alberta, 1929 (Report No. 25.) Pp. 65. (Edmonton, Alba.: W. D. McLean.) 35 cents.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 60, January to June 1930. Pp. 268. (London.) 15s. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1319 (Ae. 455): Moments and Forces on a Yawed Model Aeroplane. By W. G. A. Perring and C. Callen. (T. 2930.) Pp. 3+2 plates. 4d. net. No. 1321 (Ae. 458): Maximum Lift Coefficient of R.A.F. 30 All-moving Rudder. By F. B. Bradfield. (T. 2941.) Pp. 4+3 plates. 4d net. No. 1327 (Ae. 460): Wind Tunnel Tests of Seven Struts. By A. S. Hartshorn. (T. 2935 and A.) Pp. 12+6 plates. 9d. net. No. 1311 (Ae. 450): Wind Tunnel Tests on Gloster [illegible] -rmarine Wing Radiators. By Dr. R. G. Harris, L. E. Caygill Fairthorne. (T. 2624.) Pp. 14+5 plates. 9d. net. (London: [illegible] tionery Office.)

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections 1929–30. Vol. 31. Pp. 62. (Leicester.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. Edited for the College by Dr. S. Graham Brade-Birks. No. 27, 1930. Pp. 256. (Wye.) 8s. 6d.; to Residents in Kent and Surrey, 4s. 6d.

University of Manchester. Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1930 31. Pp. 337. (Manchester.)

World Agricultural Tractor Trials, 1930, under the Auspices of the Royal Agricultural Society of England in conjunction with the Institute of Agricultural Engineering, University of Oxford. Official Report on Tests and Catalogue of Machines taking part in the Public Demonstration at Ardington, near Wantage, Sept. 16th-19th, 1930. Pp. 109. (Oxford: Institute of Agricultural Engineering). 1s.

[illegible]

[illegible] the Colonies.) 1s.

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-fifth Session, 1930–1931. Pp. 440+xxx. (Glasgow.)

Ceylon Journal of Science. Section G: Archaeology, Ethnology, etc Vol. 2, Part 2. August 15th. Edited by A. M. Hocart. Pp. 73-147+plates 37-77. (Ceylon: The Archaeological Commissioner; London: Dulau and Co., Ltd.) 3 rupees.

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 5, No. 2. Rédigé par E. S. Russell. Pp. 139-284. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

U.S. Department of Agriculture. Technical Bulletin No. 190: A Study of the Lesser Migratory Grasshopper. By R. L. Shotwell. Pp. 35. 10 cents. Circular No. 123: A Comparative Study of Dusting by means of Airplane and Ground Machine for the Control of the Blueberry Maggot. By F. H. Lathrop and C. B. Nickels. Pp. 15. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 4: The Whale Shark, *Rhineodon typus*—Description of the Skeletal Parts and Classification based on the Marathon Specimen captured in 1923. By E. Grace White. Pp. 129-160+plates 4-12. (New York City.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 6, Juillet. Pp. 305-347. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Transactions of the American Institute of Mining and Metallurgical Engineers (Incorporated). Coal Division, 1930: containing Papers and Discussions presented at Meetings held in New York, February 1928, February 1929, and February 1930. Pp. 724. (New York City.) 5 dollars net.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 164: First-Order Triangulation in Southeast Alaska. By Walter F. Reynolds. Pp. vi+157. (Washington, D.C.: Government Printing Office.) 40 cents.

Smithsonian Miscellaneous Collections. Vol. 83: The Skeletal Remains of Early Man. By Aleš Hrdlička. (Publication 3033.) Pp. x+379+93 plates. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: United States National Museum. Bulletin 150: Revision of the Fishes of the Family Liparidae. By Victor Burke. Pp. xii+204. (Washington, D.C.: Government Printing Office.) 45 cents.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 95: Contributions to Fox Ethnology, II. By Truman Michelson. Pp. vii+183. 75 cents. Bulletin 96: Early Pueblo Ruins in the Piedra District, Southwestern Colorado. By Frank H. H. Roberts, Jr. Pp. ix+190+55 plates. 75 cents. (Washington, D.C.: Government Printing Office.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104a: Supplement, Oceanographische en Meteorologische Waarnemingen in dem Indischen Oceaan, September, October, November (1856 1914). Tabellen, Waarnemingen Noord van 0° (1856–1923). Pp. iii+36. (Amsterdam: Seyffardt's Boekhandel.) 1.25 fl.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 134: Wood-boring Insects which attack Furniture and Buildings. By E. I. McDaniel. Pp. 12. Special Bulletin No. 196: Cantaloupe Production in Michigan. By J. B. Edmond, A. B. Strand and F. J. McNall. Pp. 51. Special Bulletin No. 198: Combine Harvester Threshers in Michigan. By E. C. Sauve. Pp. 19. Special Bulletin No. 199: Studies in Swine Feeding, Parts 1, 2, 3. By W. E. J. Edwards. Pp. 36. Special Bulletin No. 200: Hogging off Corn. By W. E. J. Edwards. Pp. 17. Special Bulletin No. 201: The Influence of Sugar and Butterfat on Quality of Ice Cream. By P. S. Lucas, Toshihide Matsui and D. E. Mook. Pp. 22. Special Bulletin No. 202: The Propagation of the Highbush Blueberry. By Stanley Johnston. Pp. 22. Special Bulletin No. 203: Spraying Materials and the Control of Apple Scab. By W. C. Dutton. Pp. 32. Technical Bulletin No. 106: The Fruiting Habits and Pruning of the Campbell Early Grape. By N. L. Partridge. Pp. 48. (East Lansing, Mich.)

Cornell University: Agricultural Experiment Station. Bulletin 502: An Economic Study of Food consumed by Farm and Village Families in Central New York. By Faith M. Williams and Julia E. Lockwood. Pp. 52. Bulletin 503: The Molting Factor in judging Fowls for Egg Production. By Dean R. Marble. Pp. 42. Bulletin 504: A Partial Sociological Study of Dryden, New York, with Special Emphasis on its Historical Development. By Gladys M. Kensler and Bruce L. Melvin. Pp. 65. Bulletin 508: Lead-Arsenate Experiments on the Germination of Weed Seeds. By W. C. Muenscher. Pp. 10. Bulletin 509: Results of Sweet-Corn Suckering Experiments on Long Island. By H. C. Thompson, H. S Milles and P. H. Wessels. Pp. 11. Memoir 128: Studies on Fungicides. 1: Concepts and Terminology, by H. H. Whetzel and S. E. A. McCallan, 2: Testing Protective Fungicides in the Laboratory, by S. E. A. McCallan; 3: The Solvent Action of Spore Excretions and other Agencies on Protective Copper Fungicides, by S. E. A. McCallan. Pp. 79. (Ithaca, N.Y.)

Transactions of the San Diego Society of Natural History. Vol. 6, No 7: Notes on some Species of *Epitonium*, Subgenus *Nitidiscala*, from the West Coast of North America. By A. M. Strong. Pp. 183-196+plate 20. Vol. 6, No. 8: Two new Subspecies of Birds from Sonora. By A. J. van Rossem. Pp. 197-198. Vol. 6, No. 9. The Races of *Auriparus flaviceps* (Sundevall). By A. J. van Rossem. Pp. 199-202. Vol. 6, No. 10: Comment on the Marsh Sparrows of Southern and Lower California, with the Description of a new Race. By Laurence M. Huey. Pp. 203-206. (San Diego, Cal.)

Det Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, Bind 9, Nr. 2: The Species of the Genus Larix and their Geographical Distribution By C. H. Ostenfeld and C. Syrach Larsen. Pp. 107. (København: Andr. Fred. Høst et fils.) 5.00 kr.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 10. Pp. 399-418+plates 77-80. 0.80 yen. Section 3: Botany. Vol. 2, Part 4. Pp. 345-380. 0.60 yen. Vol. 2, Part 5. Pp. 381-412+plates 18-21. 0.80 yen. (Tokyo: Maruzen Co., Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 260: Notes on Helium Spectrum in the Presence of the Electric Field. By Yoshio Ishida. Pp. 49-61+plates 1-11. 45 sen. No. 261: On Tea Tannin isolated from Green Tea. By Michiyo Tsujimuro. Pp. 63-69+plate 12. 15 sen. Nos. 262-263: Experimental Studies on Adsorption by Means of X-Rays, by Moriso Hirata; High Voltage Phenomena in Insulating Oil, Part 2 (Abridgment), by Takeshi Nishi, Kiyoki Ohtsuka and Yasuo Arakawa. Pp. 71-103+plates 13-18. 60 sen. No. 264: Fine Structures in the Band Spectra of Hydrogen and Helium examined under High Resolution. By Sunao Imanishi. Pp. 105-115+plates 19-20. 20 sen. (Tōkyō: Iwanami Shoten.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 3, July. Pp. 265-304. (Tokyo and Sendai: Maruzen Co., Ltd.)

CATALOGUES.

A Catalogue of General Literature, including a selection from the Library of the late Charles Whibley. (No. 452.) Pp. 40. (Cambridge: Bowes and Bowes.)

Apparatus for Testing Petroleum and its Products. Pp. 52. (London: A. Gallenkamp and Co., Ltd.)

The Nickel Bulletin. Vol. 3, No. 9, September. Pp. 281-312. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 3.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at "The Manchester" Limited, Royal Exchange, Manchester), at 7.—B. D. Porritt: Some Aspects of Standardisation.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Crispin: The Development of the Bridge.
TEXTILE INSTITUTE (at Manchester), at 7.30.—J. Smeaton: Textile Specifications and their Preparation.

SATURDAY, OCTOBER 4.

ROYAL SANITARY INSTITUTE (in the Assembly Room, Town Hall, Hereford), at 10.—Councillor Mrs. Luard: The Place of Women in Local Government.—G. H. Jack: The Preservation of the Countryside.—Councillor J. R. Barker: The Health Authority and the Milk Supply.
BIOCHEMICAL SOCIETY (in Biochemical Laboratory, Cambridge), at 3.—E. L. Smith and V. Hazley: (a) Action of Antimony Trichloride with Cod-liver Oil and its Unsaponifiable Fraction; (b) A New Technique for the Antimony Trichloride Colour Test.—B. C. Guha: Observations on the Newer Factors Necessary for the Normal Growth of the Rat.—K. H. Coward, F. J. Dyer, K. M. Key, and B. J. E. Morgan: A Quantitative Method for the Biological Estimation of Vitamin A.—B. Woolf: The Addition Compound Theory of Enzyme Action.—Dr. M. Nierenstein, J. C. Pool, and N. V. Price: Pyrogallase, a New Enzyme.—T. Moore: The Distribution of Vitamin A and Carotene in the Body of the Rat.—B. H. E. Cadness and C. G. L. Wolf: Urinary Proteases.—A. N. Drury and L. J. Harris: Vitamin B Deficiency in the Rat, Bradycardia as a Distinctive Feature.—W. Ramsden: Denaturation of Proteins by Urea.—R. P. Cook, Prof. J. B. S. Haldane, and L. W. Mapson: The Action of Carbon Monoxide on the Oxidation of Certain Substances by *B. coli communis*.—M. Stephenson and L. H. Stickland: Bacterial Reductions of Molecular Hydrogen.—A. Patey and B. E. Holmes: Preliminary Observations of a Biochemical Nature on the Tumour-Producing Filtrates from the Rous Sarcoma.—D. R. P. Murray: The Inhibition of Esterases by Excess Substrate.—Demonstration by R. P. Cook, Prof. J. B. S. Haldane, and L. W. Mapson: The Use of the Barcroft Manometer in Determining the Respiration of Tissues in the Presence of Mixtures of CO and O_2.
INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at the College of Technology, Manchester), at 4.—R. W. Stubbs: Presidential Address.
INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District) (at Beach House Park Pavilion, Worthing), at 4.45.—P. E. Harvey: Notes on Recent Works at Worthing.—B. V. Bradforth: The Storm-Water Problem at Worthing.

MONDAY, OCTOBER 6.

SOCIETY OF ENGINEERS (at Burlington House, Piccadilly), at 6.—Lieut.-Col. H. C. Hawkins: Some Impressions of America.
IRON AND STEEL INSTITUTE (Joint Meeting with the Cleveland Institute of Engineers) (at the Cleveland Technical Institution, Middlesbrough), at 7.30.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—J. Šarek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—L. W. Schuster: The Effect of Contamination by Nitrogen on the Structure of Electric Welds.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.
HALIFAX TEXTILE SOCIETY (at Friends' Meeting House, Halifax), at 7.30.—B. S. Rowntree: Unemployment.
INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 7.30.—Aluminium Review and Visit of the President.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (jointly with Chemical Engineering Group) (at Institution of Civil Engineers), at 8.—Dr. E. Hauser: Recent Results in Structural Research of Colloids in Science and Industry.

TUESDAY, OCTOBER 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—G. L. Copping: Power Plant Chimney Pollution.
INSTITUTE OF METALS (Birmingham Local Section) (in Chamber of Commerce, Birmingham), at 7.—T. G. Bamford: Chairman's Address.
IRON AND STEEL INSTITUTE (Joint Meeting with the Lincolnshire Iron and Steel Institute) (at the Secondary Schools, Doncaster Road, Scunthorpe), at 7.—F. Bainbridge: Developments in Fuel Economy at Skinningrove.—J. A. Jones: Chromium-Copper Structural Steels.
IRON AND STEEL INSTITUTE (Joint Meeting with the Sheffield Metallurgical Association) (at 198 West Street, Sheffield), at 7.30.—D. F. Campbell: High-Frequency Steel Furnaces.—W. H. Hatfield: Permanence of Dimensions under Stress at Elevated Temperatures.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 8.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

WEDNESDAY, OCTOBER 8.

ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street, W.C.2), at 6.30.—Report on Progress in Illuminating Engineering, and Display of Exhibits illustrating Recent Developments in Illumination.
TELEVISION SOCIETY (at University College), at 7.—J. H. O. Harries: Some Developments in Television based on Quantitative Analysis (Lecture).
INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).
INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 8.—Dr. S. J. Kohli: The Effect of Surface Conditions on Heat Transmission.
EUGENICS SOCIETY (at Linnean Society), at 8.30.—Dr. E. B. Turner and others: Quinquennial Health Assessments—(a) Unemployables; (b) National Health Insurance.

THURSDAY, OCTOBER 9.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (British Section) (at Royal Agricultural Hall), at 10 A.M.—H. Bradley: Some Physical Properties of Leather.—R. H. Marriott: The Origin of Ammonia in Lime Liquors.—G. E. Knowles: Study of Dyes Suitable for Dyeing Synthetic Tanned Leather.—W. R. Atkin: Effect of Heat on Chrome Alum Solutions.—E. C. Line: Some Applications of the Microscope in Leather Manufacture.
ROYAL AERONAUTICAL SOCIETY (in the Lecture Hall of the Royal Society of Arts), at 6.30.—C. R. Fairey: The Growth of Aviation.
INSTITUTE OF METALS (London Local Section) (at Society of Motor Manufacturers and Traders, Ltd., 83 Pall Mall), at 7.30.—W. T. Griffiths: Chairman's Address.
INSTITUTION OF WELDING ENGINEERS (at the Engineers' Club, Albert Square, Manchester), at 7.45.—J. Ryder: The Training of Operators in the Welding and Cutting Industries.

FRIDAY, OCTOBER 10.

ROYAL SANITARY INSTITUTE (in the Guildhall, Nottingham), at 4.30.—Alderman A. R. Atkey: River Pollution.—Dr. L. P. Lockhart: Industrial Medicine in Relation to Public Health.
IRON AND STEEL INSTITUTE (Joint Meeting with the Local Branch of the South Wales Institute of Engineers) (at the Royal Metal Exchange, Swansea), at 7.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. Dunlop: The Refining of Cane Sugar.
INSTITUTE OF METALS (Sheffield Local Section) (in Mappin Hall, Applied Science Department, University, Sheffield), at 7.30. Prof. F. C. Thompson: Some Observations on the Wire Drawing Process (Sorby Lecture).

SATURDAY, OCTOBER 11.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at the Technical College, Burnley). F. Griffiths: Belgian Moulding Sands in the Iron Foundry.

PUBLIC LECTURES.

SATURDAY, OCTOBER 4.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—W. C. Fletcher: Napier's Method of Constructing Logarithms and its Advantages for School Use.

MONDAY, OCTOBER 6.

UNIVERSITY COLLEGE, LONDON, at 2.30.—Sir Flinders Petrie: Egyptian History before the 18th Dynasty.
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Types of Pneumococci in Adults and Children and their Significance (Harben Lecture 1).

TUESDAY, OCTOBER 7.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Epidemiology; the Refining of Antipneumococcus Serum (Harben Lecture 2).
KING'S COLLEGE, LONDON, at 5.—Dr. J. W. Pickering: Blood Plasma and Platelets. (Succeeding Lectures on Oct. 14, 21, and 28.)

WEDNESDAY, OCTOBER 8.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Therapeutic Use of Vaccines and Antibacterial Sera (Harben Lecture 3).

THURSDAY, OCTOBER 9.

BEDFORD COLLEGE, at 2.—Prof. Wilson: General Physics.—At 5.—Dr. P. Hopkins: A Psycho-Analytic Study of Jeremy Bentham as a Type of Social Reformer.
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Rev. Dr. A. H. Gray: Christian Civilisation and Contraception.
UNIVERSITY COLLEGE, LONDON, at 5.30.—R. Engelbach: Recent Discoveries in Egypt.—Prof. H. Spemann: Introduction to the Theory and Practice of Experimental Embryology (in English). (Succeeding Lecture on Oct. 10.)

SATURDAY, OCTOBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Native Life in the Solomon Islands.

CONGRESS.

OCTOBER 15 TO 23.

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND MEDICAL GEOLOGY (at Lisbon).

SATURDAY, OCTOBER 11, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

An English Folk Museum.

THE discussion on folk museums which took place in the Anthropological Section of the British Association at the recent Bristol meeting was singularly opportune. Following within a week or two on Mr. Lansbury's announcement of the appointment of a committee representing the Office of Works and the Board of Education to consider the question of the institution of such a museum in London, it furnished the occasion for educating public opinion on the nature and scope of the folk museum as it presents itself to those who have this matter at heart; at the same time it set out the grounds upon which the plea of urgency is held to justify such a proposal at a time when the financial conditions in Great Britain are anything but favourable to an undertaking of this kind.

The communication from Sir Henry Miers with which the discussion opened, and from which we print extracts elsewhere in this issue, was an admirably lucid and comprehensive survey of the situation in regard to folk museums both in England and on the Continent. After defining what he understood by a folk museum and briefly describing the various types of collection which may be brought within the definition, he pointed out that the proposal to set up a folk museum for England is by no means new. On many occasions during the last twenty years or more, the formation of a national folk museum has been urged with some insistency. Nothing has been done. A number of museums now include collections of folk material of varying size and importance for scientific study; but there is nothing which can be regarded as in the nature of a national collection.

With the issue of the Report of the Commission on National Museums and Galleries, the situation has changed. It is the definite recommendation of the Report that a folk museum for England should be established, and it even goes so far as to suggest two possible sites—the Botanic Society's grounds in Regent's Park, soon to be vacated, and Chiswick House. The recommendation has brought to a focus the efforts of those who for so long have seen the desirability—perhaps it would not be too much to say the necessity—of action in this direction before it is too late. In consequence, the Folk Museum Committee of the Royal Anthropological Institute, strengthened by the co-operation of the Royal Society, the British Association, the Folk-Lore Society, the Royal Society of Arts, and the Museums Association, has carried matters to a point at which a specific proposal is under official consideration.

Now that the question has reached this stage, there are certain considerations which should be kept to the fore. First and foremost, there is the matter of urgency. This emerges clearly when the nature and scope of the proposed museum are taken into account. It is suggested that in the main it should be of the open-air type, such as that at Skansen, the prototype of all existing open-air museums. The museum will confine itself to the arts and crafts, the surroundings and accompaniments of the daily life in past ages of the peasant and artisan—what is generally, if inaccurately, called the working class population. It is considered, and quite rightly, that the life and culture of the middle and upper classes is adequately illustrated already in other institutions. An essential feature of the proposed museum, however, is that this material should be exhibited in its natural surroundings—the appropriate setting of the actual houses, the humbler buildings and cottages, of the different periods of English domestic architecture in which it was used, each article of furniture in its appropriate room, each implement, each utensil, in its proper place, as if ready to hand.

Barns and other outbuildings of the farm, the smith's forge, wind- and water-mill, and other material accompaniments of the social and economic life of the English village, must be included to fill in the picture. The maypole on the village green, and possibly the holy well, will illustrate other sides of country life, even perhaps on occasion to be supplemented by the performance of folk- and country dances. On the other hand, for purposes of instruction, as well as of display and safety, a number of objects will have to be exhibited in an annexe in conditions more nearly approaching those of the ordinary museum. In this additional building also might be housed such administrative offices as are required.

It is scarcely necessary to enlarge upon the nature of the objects which should and could be brought together in such a collection, or to dwell upon their value from a scientific and educational point of view in illustrating the culture and character of the English people in the past. It should be realised, however, and that very clearly, that the opportunity for forming such a collection is growing less and less almost day by day. Those who know the rural districts of England will have seen here and there obsolete implements and domestic appliances, sometimes carefully cherished by those who have known their use in their youth, sometimes still in use by the conservative. In one agricultural district the wooden plough is still considered the only type suited to the soil; the old-fashioned Devonshire labourer sometimes carries his mid-day cider in a wooden firkin; in another remote district rare examples of the solid-wheel cart and old-fashioned wash-tub are carefully preserved. But whether now still in use or carefully preserved, sooner or later they will all be consigned to the dust-heap as the older generation and its memories die away, unless they are rescued by a kinder fate. Countless objects of priceless value for the study of English culture have vanished this way in the past; and unless some effort is made it will be too late to save even a part of what remains.

The spread of education and the standardisation of implements, utensils, and domestic appliances generally in modern industrial and economic conditions are tending with increasing rapidity to eliminate all that is individual and characteristic in the humbler arts and crafts. Especially is this the case with the rural dwelling with all that it can tell us of the past and in its local peculiarities—a very real product of its environment, eloquent of the different types of soil and landscape to be seen in England. These buildings, however, are rapidly disappearing before improved sanitation and the erection of model dwellings by local authorities as well as the urbanisation of the countryside. A folk museum would scarcely be fulfilling its function if it afforded an incentive to further work of destruction in order to provide housing for its collections. Unfortunately, there can be no question that ample provision will be made for its needs without any effort on its own part. Indeed, it should serve to save a few of the buildings which are now, or soon will be, condemned and beyond any other hope of preservation. Although the number of buildings of which the museum will be able to make use is limited, if only on account of space, it may yet serve on occasion to supplement the great work which is being done by the Royal Society of Arts for the preservation of characteristic dwelling-houses throughout the country.

Nor does it follow that the institution of a national museum should preclude the development of local folk museums and collections of folk-material. Indeed, the Anthropological Section, stimulated by Sir Henry Miers' account of what is being done in Sweden and elsewhere in this direction, urged the delegates of the corresponding societies of the British Association at Bristol to use their best endeavours to promote museums of this type in their respective localities.

Sir Henry Miers referred both specifically and by implication to the question of a site. Upon this

point much of considerable moment may be said. It is abundantly clear that a museum of the type suggested requires a considerable area for its effective display. The buildings cannot be dotted about indiscriminately all over the site. They should be arranged in something approaching the normal relation of buildings in an English village. On the other hand, any incongruity in period and style should be obviated by siting or by screening. The area available must therefore be considerable. A minimum of fourteen acres is suggested; but Skansen has sixty acres.

As regards situation, if the museum is to serve any effective scientific and educative purpose, obviously it must be readily accessible. It should be in or near some big centre of population. This immediately rules out such a suggestion as the Forest of Dean, which had something to be said in its favour on other grounds. Chiswick House has the advantage of being within easy reach of central London; but, unfortunately, the grounds are largely given up to sports and the amount of land available is inadequate. It has the additional disadvantage that the buildings in which a part of the collections would have to be displayed are very definitely 'period' buildings and of a type which would be incongruous with a folk collection.

It is generally agreed that London is the most appropriate centre for an English national museum, but here, if Chiswick House be ruled out for reasons mentioned above, at present only two proposals have come under consideration. Of these, one is that a site should be obtained adjacent to the Zoological Society's new grounds at Whipsnade. The distance—some thirty miles from London—is not so great an objection as might at first be thought. With the improved facilities for transport which are promised, Whipsnade will not be difficult of access. Further, the folk museum might count on the visits of a considerable proportion of those who come to the Zoological Society's grounds. Apart from the setting it would provide, however, Whipsnade cannot vie with the advantages of the grounds in Regent's Park. The area of the Royal Botanic Society's site is eighteen acres, and greater than could be obtained at Whipsnade except at a prohibitive cost; St. John's Lodge, a fine house adjoining, is available for purposes of the smaller exhibits and administration, and provision could be made for the continuation of the research work which is now being carried on in the gardens. If Mr. Lansbury's desire is that the Royal parks should be of lasting benefit to the population at large, could any purpose more fitting be found than a museum of the people for the people?

Quantum Theory.

(1) *Introduction à l'étude de la mécanique ondulatoire.* Par Louis de Broglie. Pp. xvi+292. (Paris: Hermann et Cie, 1930.) 85 francs.

(2) *Einführung in die Wellenmechanik.* Von Prof. Louis de Broglie. Übersetzt von Rudolf Peierls. Pp. iv+221. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 13·80 gold marks.

(3) *Recueil d'exposés sur les ondes et corpuscules.* Par Louis de Broglie. Pp. 81. (Paris: Hermann et Cie, 1930.) 20 francs.

(4) *Quantum Mechanics.* By Prof. Edward U. Condon and Dr. Philip M. Morse. (International Series in Physics.) Pp. xiii+250. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 15*s.* net.

(5) *Elementare Quantenmechanik.* (Zweiter Band der Vorlesungen über Atommechanik.) Von Prof. Dr. Max Born und Prof. Dr. Pascual Jordan. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 9.) Pp. xi+434. (Berlin: Julius Springer, 1930.) 28 gold marks.

(6) *La nouvelle mécanique des quanta.* Par George Birtwistle. Traduction augmentée de 4 appendices par les traducteurs: M. Ponte et Y. Rocard. (Collection de monographies scientifiques étrangères publiée sous la direction de G. Juvet, No. 13.) Pp. vi+333. (Paris: Albert Blanchard, 1929.) 75 francs.

(7) *L'ancienne et la nouvelle théorie des quanta.* Par Prof. Eugène Bloch. (Cours de physique théorique de la Faculté des Sciences de Paris.) Pp. iv+417. (Paris: Hermann et Cie, 1930.) 90 francs.

(8) *Atoms, Molecules and Quanta.* By Dr. Arthur Edward Ruark and Dr. Harold Clayton Urey. (International Series in Physics.) Pp. xvii+790. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 35*s.* net.

IT is now five years since Heisenberg made the great advance in atomic theory by the introduction of non-commutative algebra, and a few months less since Schrödinger gave the mathematical form to the undulatory conceptions of de Broglie. At first the progress was so rapid that if anyone had been rash enough to compose a book, it would have been obsolete before it was in type, but during the last year or so there has been a lull in the developments. The consequence is a whole crop of books written by a number of authorities on the subject, some of which are reviewed here.

Before describing the details of these works, it is of some interest to consider what different types of presentation are possible. There is first the historical. This is probably the easiest to write, since the succession of the discoveries must always provide a possible order of treatment, even though it may later turn out to have been an illogical one; it is also a form that is acceptable to those who have themselves lived through the developments, since it serves to give them pleasant reminiscences of dead theories. On the other hand, there is a suggestion in this treatment of what we may read in many industrial reports, that " much capital has been sunk in the present process, and the directors do not consider that it would be profitable to scrap the existing machinery, even though more economical processes are already in existence ". The historical method also has the disadvantage of tending to upset the proportions. If it is followed here, it suggests that the quantum mechanics is a small addendum to the theory of spectra, whereas in fact the theory of spectra should occupy about the same position in quantum mechanics that planetary theory does in ordinary mechanics.

For the next generation there can be little doubt that it is no longer profitable to follow the historical method closely. What is wanted is something like the dynamical text-books, which enunciate the laws of Newton, without preceding them by an elaborate explanation of Galileo's experiments. There are still two choices open, according to where in the theory the emphasis is placed, whether on waves or on particles. This is a matter of taste, not of logic, and there will probably always be adherents of both sides. But we may perhaps discriminate between the tastes by an analogy from dynamics. Do we regard as the ultimate fact of dynamics that a particle's acceleration is proportional to the applied force, or that a dynamical system is a continually unfolding infinitesimal contact transformation? This is certainly an exaggeration of the distinction (and is perhaps a confession of partisanship on the part of the reviewer), but some writers do appear content to work out the relation of the new mechanics to classical Hamiltonian dynamics and leave it at that, whereas others make the attempt to get down to more primitive principles like those of Newton. Since atomic dynamics ought to be more primitive than molar dynamics, this last would seem to be the right policy, and the chief objection against it is that Newton's First Law must be replaced by a law expressing diffraction, rather a sophisticated idea to take as an axiom. So all we can say is that Nature itself offers us as starting-point the choice between two sophisticated ideas, that of diffraction and that of non-commutative multiplication, and everyone must choose for himself which he prefers.

(1) and (2) are respectively the French and German editions of the work of L. de Broglie, and they naturally follow the line of his own work and place the emphasis on the waves. The book begins with his well-known relativistic arguments and then passes on to Hamilton's association of dynamics with optics. There is then a good description of the general characters of waves, leading up to Schrödinger's equation. A special feature is the detailed working out of the separate behaviour of amplitude and phase, a separation that is not of much use in the actual discussion of problems, but helps in explaining the relation of the new mechanics to the old. The book then deals with electron diffraction and so proceeds to more complicated problems. A few actual cases are solved, but for the most part the work is devoted to an explanation of principles, including criticisms of those which have been tried and found wanting. The index shows that there are only two references to the word matrix—truly a striking difference from some of the other books under review. A novice would scarcely be able to start work on quantum problems without supplementing the present work by other reading, but he will gain insight into the wave aspects, and this will be a great help to him in getting a true, and not merely a technical, understanding of the subject.

(3) is a collection of five articles and addresses by the same author. They are of a semi-popular character, and are a pleasant and instructive exposition of his general outlook on the foundations of atomic physics.

(4) The work by Condon and Morse is much more of a text-book. It has the admirable quality of making the subject look simple and straightforward, and does not, like many other works, envelop it in an air of subtle mystery. After a general introduction it establishes Schrödinger's equation and works out a large number of examples connected with the spectra of atoms and molecules. Towards the end it explains the conceptions associated with matrices; this part is perhaps not quite so satisfactory, as it presents the theory in an earlier form and one which has not been found the best. We may also make another small criticism; it is rather surprising to find electron diffraction discussed in the very last pages of the book instead of the first. But these are minor defects, and, on the principle that the

learner wants much practice rather than much philosophy, the book can be strongly recommended as one which will give a very good working knowledge of the quantum theory.

(5) is a sequel to Born's well-known book on atomic mechanics. As such it is naturally concerned with the modifications of classical dynamics necessary in order to include the quantum theory, and indeed there is no mention at all of the wave equations. As an essay in how far can be gone without the use of partial differential equations it is brilliant, and contains full discussions of many problems which have not been given elsewhere, but as an exposition of the content of the quantum theory it must be judged a failure. We may even quarrel with the first word on the title-page, for to call the work "*Elementare* Quantenmechanik" is to give a very exaggerated idea of the difficulty of the other branches of the subject. The self-denying ordinance which has excluded wave equations severely limits the book's scope, for all continuous spectra are barred, and even the radial quantisation of the hydrogen atom is a very troublesome business, which can only be done by Pauli's method, a brilliant piece of work but one which can safely now be forgotten. In short, the only atomic problems that can be treated really well are those depending on the principle of angular momentum. But the book is to be followed by another part in which the wave methods are to be developed; this should redress the balance, and we can only regret that the two distinguished authors could not have issued both volumes together.

(6) is the French translation of Birtwistle's well-known book, which has already been noticed in the columns of NATURE (Oct. 6, 1928, p. 527). There are four appendices, added by the translators, on such things as the magnetic electron and the theory of metals.

(7) Prof. E. Bloch has issued in book form an excellent series of lectures on recent physics. It follows the historical sequence and traverses the whole field of recent experiments and theories, photoelectric effect, radiation, periodic table, and so on. It then turns to the new mechanics and covers the whole subject, again in historical sequence. It does not go so deeply into the matter as do the works previously noticed, but in view of the considerable space devoted to the description of experiments, that was not to be expected. It makes an admirable introduction to the whole of atomic physics.

(8) Messrs. Ruark and Urey's book, as its title implies, has a rather different purpose. Whereas the others stand for a new general dynamics, this is like a new astronomical dynamics, because its central interest is the structure of atoms and spectra. Two-thirds of the book is concerned with the old quantum theory, which still remains the most convenient way of summarising atomic structure, especially now that it is quite free from the confusion that used to arise in connexion with the exact values of some of the quantum numbers. This is excellent, and the only regret we may feel is that the authors could not find room for such things as a fuller description of Hund's theory of the ground states of atoms. The last part of the book is devoted to the new mechanics, and though it is perfectly sound it seems a little out of place; it is almost as though the Hamiltonian transformation theory were first introduced as an appendix to a book on the planets. But no doubt something of the kind was inevitable, for at the time of writing there was no book available from which this part of the argument could be quoted.

It will be seen that the new orientation of our physical ideas has led to a great variety of opinions as to what are the most important parts of the theory. There is no reviewer whose personal opinion would agree with all of them, but nevertheless they are all to be welcomed. Only so, by a synthesis of the conflicting opinions, can we hope to arrive at a universally acceptable view of the new dynamics. C. G. D.

More Antarctic Meteorology.

British Antarctic Expedition, 1907–1909. Reports on the Scientific Investigations. Meteorology. By Dr. Edward Kitson. Pp. 188. (Melbourne: Council for Scientific and Industrial Research; London: Official Secretary, Australia House, n.d.) 8*s*.

THE Australian Department of Scientific and Industrial Research has earned the thanks of the scientific world for its action in rescuing, discussing, and publishing the meteorological results of Sir Ernest Shackleton's Antarctic Expedition of 1907–9. The Department was led to this good deed by the report of a committee in 1927 to the effect that "first-class scientific work by Australian investigators was sometimes in danger of being lost to subsequent workers owing to the impossibility of securing its publication". Why the records kept so conscientiously and so laboriously on the *Nimrod*, at Cape Royds, and on the magnetic pole and south pole journeys, have hitherto remained undivulged (save for brief summaries in "The Heart of the

Antarctic"), is not clearly explained. They appear to have been left in Australia or New Zealand on the return of the expedition, and we are glad that the participation as observers of Shackleton's Australian associates has made it possible for their government at last to publish the results. We are grateful to Sir Edgeworth David, of Sydney, and to Sir Joseph Kinsey, of Christchurch, N.Z., for their acknowledged share in enabling Dr. Kitson to prepare the observations for publication and to show the bearing of the expedition's results on the meteorology of the Antarctic region and of the southern hemisphere.

This Dr. Kitson has done with the skill and care to be expected from the director of the New Zealand Meteorological Service, equipped as he is for the task by a lifelong experience of Australian meteorology. The delay of twenty years in publication deprived Dr. G. C. Simpson of much important information which would have facilitated his great work on the meteorology of Scott's last expedition; but, on the other hand, it has enabled Dr. Kitson to make use of that work and of the labours of Meinardus on the observations of the *Gauss* expedition, thus focusing attention on the problems dealt with by those masters of meteorology.

The period covered by the observations at the land station at Cape Royds on M'Murdo Sound was from March 1908 to February 1909, midway in time between the *Discovery* and the *Terra Nova* expeditions in the same region. The data are set forth in tables of hourly value of temperature and two-hourly values of pressure, wind, and clouds. Temperatures are given to whole degrees Fahrenheit, a sensible saving of space, for fractions of a degree are meaningless on spirit thermometers read in the conditions of Antarctic observing. Humidity observations, accumulated hourly with infinite trouble, have only been summarised in monthly means, the manifold uncertainties of wet-bulb readings below the freezing point not justifying the labour of detailed discussion.

It was natural for Dr. Kitson to discuss his results with particular reference to Dr. Simpson's great memoir, and the new data have suggested more than a few frank criticisms of the earlier discussion, to some of which there may possibly be occasion for rejoinders. Dr. Kitson considers that his data throw doubt on the reality of the diurnal variation of temperature in the winter months detected by Simpson. It appears also that Scott's station at Cape Evans was less influenced in its minimum temperature by the 'cold layer' than the *Discovery* winter quarters thirteen miles farther south, or Shackleton's station at Cape Royds six miles farther north, a somewhat surprising result which is explained by the position of the Cape Evans thermometer screen on a slight elevation. Dr. Kitson brings out the fact that the cold layer of air streaming off the Barrier and down the mountain slopes was more pronounced on the surface of M'Murdo Sound, even when free from ice, than at the shore station where turbulence caused by the descent of cold air from the slopes of Mt. Erebus produced mixture and so raised the temperature.

Dr. Kitson's main contribution to Antarctic meteorology seems to be the elucidation of the phenomena of the cold layer and the katabatic winds associated with it. He recognises the power of chilling by radiation and by contact with a cold ice-surface to produce a layer of intensely cold air on the Barrier or on large ice-floes fed by the descent of cold air from the Plateau under the influence of gravity. He does not, however, see in this action so dominant a factor in the general circulation of the atmosphere as Prof. Hobbs claims for it, or as Sir Napier Shaw is willing to concede. He inclines to the belief that this cold layer remains apart from the system of air circulation produced by balanced forces. He considers that the polar anticyclone, if such a term is applicable, is confined to the cold layer, which he thinks can never exceed a kilometre in thickness, and that above it there is a polar cyclone playing its full part in the normal circulation of the earth's atmosphere. This is very like the old view put forward and upheld by Buchan on the basis of his Ben Nevis discussions, that every sea-level anticyclone has a cyclone riding on its back.

Dr. Kitson lays stress on the parallelism of the Antarctic pressure waves with the sequence of pressure changes in Australia, suggesting a close relationship between the two. In his discussion of the general problem of southern hemisphere meteorology he travels somewhat far from Cape Royds and the *Nimrod* and lands himself in the rather dazzling region of sunspot cycles.

Dr. Kitson urges the importance of establishing permanent meteorological stations on the Antarctic continent, as the variability of climate from one year to another is greater there than in temperate regions and a long series of observations is necessary in order to arrive at normal conditions. On the other hand, he wisely deprecates the somewhat rash assertions that have been made by the promoters of Antarctic expeditions (not, we believe, by meteorologists and geographers as he implies) that results of practical importance to temperate countries will immediately follow the establishment of meteorological observations in the Polar regions.

All climate, he recognises, is due ultimately to the circulatory movements of the atmosphere as a whole, and every addition to our knowledge of the whole must increase our knowledge of every part. To this extent and no further can the establishment of new stations in the Antarctic be of practical benefit to humanity.

When the results of the Byrd expedition are available, and the long-looked-for observations on the *Endurance* in the Weddell Sea are made public, there will be a mass of Antarctic meteorological data which may be worth the while of a meteorologist of the first rank to discuss on its merits, without worrying about the views of earlier investigators or endeavouring to penetrate the precise meaning which they have locked up in such terms as wave, stroph, cyclone, and anticyclone.

Hugh Robert Mill.

A Chemical Engine.

Die chemischen Vorgänge im Muskel: und ihr Zusammenhang mit Arbeitsleistung und Wärmebildung. Von Prof. Otto Meyerhof. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 22.) Pp. xiv+350. (Berlin: Julius Springer, 1930). 28 gold marks.

In the course of evolution, animals have had to solve some exceedingly difficult problems of engineering; one of them, perhaps the most fascinating for us to study, was the elaboration of an internal combustion engine, made chiefly of water, working isothermally and without serious deviations from neutrality. The only ultimate source of energy in this world is the solar radiation, but the higher animals avoid part of the problem by utilising the energy stored in the organic compounds which the plants synthesise with the aid of the sun's radiation. For these animals, therefore, the problem is to convert the potential chemical energy of the food into useful mechanical energy in the limbs. The engine which does it is the skeletal muscle. It is not difficult to obtain mechanical energy from a fuel, given adequate oxygen—even man can do it—but muscle has a further remarkable property: even though it depends ultimately on an oxygen supply, it can work without oxygen for a considerable time. The sartorius muscle of a frog may be isolated and kept in pure nitrogen: it will then perform enough work to lift itself to the top of a mountain before it is exhausted. How is this done?

Prof. Meyerhof's book contains the answer, so far as we know it, in 318 pages of small print; and it is a matter for congratulation that he has managed, by skilful division and subdivision of the subject, to do it in so short a compass. For this is no elementary bird's-eye view, but a detailed account of the present position. The book contains ten divisions dealing with such aspects as respiration, metabolism, the chemical phenomena of activity in relation to the thermal and to the mechanical phenomena. Each of these is subdivided and again subdivided. Thus we find the topic of lactic acid production by minced muscles from added carbohydrates dealt with under III.*B*.1.*b*., and the relation between phosphagen breakdown in activity and the chronaxie of the muscle under II.*D*.3.c. Section II.*A*.2.*a*.*α*. deals with the dissociation constants of the hexosephosphoric esters. The list of contents is classified in corresponding detail. This arrangement, backed by an 8-page subject index, makes the book an excellent work of reference; yet this is accomplished without sacrifice of interest, for despite the detailed 'cataloguing' the text reads quite continuously. Matters of historical interest are referred to where they are appropriate, but no attempt has been made to give the full history of the subject.

The last four years have been particularly rich in discoveries in this field: facts have accumulated sufficient to overthrow the theories current in 1926, but insufficient to form the basis of new ones. Lactacidogen is gone: it turned out to be pyrophosphate. Most of the 'inorganic' phosphate of muscle is now known to be organic. Moderate activity in the absence of oxygen no longer makes a muscle acid—it now becomes alkaline or does not change at all. Lactic acid no longer initiates contraction; for a muscle may give twitch after twitch in nitrogen without any lactic acid accumulating. True, the muscle has been poisoned with iodoacetic acid, but it is not to be supposed that the muscle has invented a brand-new mechanism on the spur of the moment. The situation disclosed by Prof. Meyerhof in this book is indeed chaotic.

A considerable proportion of Prof. Meyerhof's theoretical treatment of the subject deals with the origin of the 370-400 calories of heat which accompany the formation of each gram of lactic acid in the muscle, and here we are moved to voice a protest. The heat of formation of lactic acid from glycogen in dilute aqueous solution may be calculated from the measurements of different workers, and it comes out to anything from 180 to 235 calories per gram of lactic acid. The uncertainty is chiefly due to the discrepant values for the heat of combustion of glycogen. The heat of neutralisation of lactic acid may be anything from 20 to 140

calories according as we use buffer salts or proteins for the neutralisation. Thus the combined heat of the two reactions may be anything from 200 to 375 calories—anything from one-half to the entire heat actually observed to accompany the process in muscle. For reasons which he gives in the text, Prof. Meyerhof takes the value 290 calories, but we feel that no amount of logic will compensate for uncertainty in the primary measurements.

The text includes 26 tables and 66 diagrams. The printing is well done, on good paper, but the binding is bad. There are two bibliographies; one contains 125 references to work performed in the author's laboratory, and the second contains 296 references to other work. There exists at the moment no treatise on muscle chemistry, in any language, so complete and up-to-date as this book.

Philip Eggleton.

Our Bookshelf.

Annales de l'Institut Henri Poincaré: recueil de conférences et mémoires de calcul des probabilités et physique théorique. Vol. 1, Fasc. 1. Pp. 74. (Paris: Les Presses Universitaires de France, 1930.) 35 francs.

The Henri Poincaré Institute invites leading scientific workers to lecture on recent progress in mathematical physics. The "Annales", of which the first number has just appeared, will contain a French translation of these lectures. In the present number we have Einstein on the unitary field theory, C. G. Darwin on the wave theory of matter, and Fermi on the theory of radiation.

Einstein's lecture is addressed to mathematicians, in the hope of interesting them in a theory as yet very incomplete, but offering magnificent possibilities of development. He cannot account for certain identities that he has discovered, and he appeals to geometers to come to his aid. There is no possibility of verifying the theory by experiment until a certain mathematical problem has been solved.

Problems in quantum theory can be treated by the wave mechanics of de Broglie and Schrödinger, or by more abstract methods based upon the general theorems of analytical dynamics. Darwin considers that wave methods have the advantage of enabling one to deal intuitively with phenomena too complicated for mathematical treatment. The object of his lecture is the development of this intuitive power.

In the third lecture, Fermi shows how a uniform method can be applied to problems of interference and of the Compton effect, of which the first set are usually treated by classical methods and the second by quantum mechanics. The starting-point is Dirac's concept of the atom and radiation as forming a single system, the energy of which is the sum of three terms, due respectively to the atom alone, to the electromagnetic field, and to the interaction of the two.

Future issues will contain lectures by Born, Debye, de Donder, Kostitzin, Lévy, Pólya, and Volterra.

H. T. H. P.

The Magneto Manual: a Practical and General Reference Work for Automobile Engineers, Aeronautical Engineers, Mechanics, Apprentices, Chauffeurs, Car-Owners, etc. By H. R. Langman. (Lockwood's Manuals.) Second edition enlarged. Pp. xii + 246. (London: Crosby Lockwood and Son, 1930.) 7*s.* 6*d.* net.

In many internal combustion engines the ignition of the explosive mixture is effected by means of an electric spark which is produced by a small machine called a magneto. The great demand for these machines for motor and aero engines has led to a very close study of the principles on which they work, and this has resulted in great improvements in their design. This book will prove useful to all engaged in motor engineering. The author wisely does not describe the functioning of any particular type of magneto, but confines himself to general remarks and a description of the outstanding features of the best types in everyday use. The trend of invention and industrial activity is in the direction of perfecting old types rather than the introduction of new types. In this edition a useful chapter has been added which gives a simple description of the theory of the high tension magneto. Many sketches are given depicting common faults. These should prove a help to driver owners of cars in maintaining their magnetos in good working order. The neon gas spark tester, the working of which depends on the low electric strength of neon, is described

Metalliferous Mine Surveying. By Thomas G. Hanton. Pp. xii + 224. (London: Crosby Lockwood and Son, 1930.) 15*s.* net.

The fundamental problem in mine surveying is the connexion between the surface and underground surveys and their relations to the boundaries of the property. In this book, which, unfortunately, the author did not live to see published, a successful effort has been made to present clearly and accurately modern methods of mine surveying with special reference to the correlation of the various parts of the work involved. Careful and practical descriptions of the instruments used are given, followed by details of survey practice and methods of preparing plans and sections and written records. Later chapters deal with stope surveys, estimation of ore reserves, and borehole surveying. The whole treatment is well proportioned, clearly written, effectively illustrated, and copiously provided with examples and calculations. Colliery surveying is not specifically dealt with, but the metalliferous mine surveyor has here a thoroughly up-to-date guide to all the leading features of his varied profession. The work was written by an Australian surveyor who had a wide experience, and his book represents the successful accomplishment of a difficult task.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Micelle Structure of the Wool Fibre.

THE real existence within the wool fibre of micelles which are impervious to water molecules and dyestuffs has only occasionally been suggested[1] and never demonstrated. Two independent lines of investigation have recently converged, not only to prove the existence of micelles, but also to give some idea of their shape and dimensions, and the manner of attack by certain reagents. In an earlier paper,[2] I was able to show that the size of the capillary spaces in the dry wool fibre is of the same order as the length of the *n* propyl alcohol molecule. Whereas wool fibres in methyl alcohol and ethylene glycol are easily extensible, in butyl and amyl alcohols they resist extension to a degree closely similar to that of the perfectly dry fibre. When, however, the higher alcohols are mixed with methyl alcohol or ethylene glycol, these latter reagents enter the fibre and cause it to swell, opening the pores until they are able to admit the larger molecules. This is well illustrated by a comparison of the properties of wool fibres in octyl alcohol, ethylene glycol, and mixtures of the two. The potential energy necessary to extend fibres 30 per cent of their length in the various media at 22·2° C. was determined and typical results are quoted below:

Medium.	Potential Energy (gm.cm per c.c.)
Octyl alcohol	$5{\cdot}17\times10^5$
Ethylene glycol	1·63 ,,
Ethylene glycol-octyl alcohol	1·72 ,,

The molecular concentration of ethylene glycol in the above mixture with octyl alcohol was only 60·8 per cent, and since the properties of the fibre in the mixture are almost identical with those in ethylene glycol alone, it seems clear that the pores of the swollen fibre are sufficiently large to admit the octyl alcohol molecule. This great increase in pore size is in striking contrast with the small increase in the over-all dimensions of the fibre. Swelling is greatest in water, but even in this case the increase in length of the dry fibre is only 1·1 per cent and the increase in diameter about 18 per cent. The co-existence of a large increase in pore size with a small increase in cross-sectional area affords a critical proof of the existence within the fibre of micelles which are relatively, if not entirely, impervious to molecules as small as the water molecule.

It has been found possible to extend the preceding argument to give a measure of the thickness of the micelles. Determinations of the potential energy required to stretch fibres were made in a series of mixtures of methyl- and octyl-alcohols. In the region of low concentration of methyl alcohol, the work required to stretch fibres at first decreased slowly with increasing concentration of methyl alcohol, as would be expected by analogy with the properties of wool fibres in atmospheres at various relative humidities. When, however, the concentration of methyl alcohol was great enough to produce a sufficient degree of swelling, octyl alcohol molecules could gain admission to the fibre, causing an immediate fall in the resistance to extension. Determinations of the increase in diameter of wool fibres in the critical mixture required to admit octyl alcohol, combined with the fact that the pore size must have been increased by the difference between the lengths of the *n*-propyl alcohol and octyl alcohol molecules, indicate that the thickness of the micelles must be of the order of 200 A. Knowing the increase in diameter of wool fibres in water, and making use of the preceding determination of micellar thickness, it can be shown that the pore size in fibres swollen in water is of the order of 40 A.

From a comparison of the changes in the elastic properties and size characteristics of wool fibres with water adsorption, I have previously deduced[1] that the micelles must be long in comparison with their thickness. Discrimination between the possible shapes which will fulfil this requirement was made possible from observations on the affinity of sodium sulphide treated wools for water. Known weights of purified Cotswold wool were treated with sodium sulphide solution for different times, the loss in weight being in each case ascertained after removing adsorbed sodium compounds by prolonged washing in distilled water. The amounts of water adsorbed by the dry, treated and untreated, wools were then determined at various humidities. A few typical results are given in the following table, the different wools being distinguished by indicating their loss in weight after reaction with sodium sulphide:

Relative Humidity. %	Percentage by Weight of Water adsorbed by			
	Untreated Wool.	Sodium Sulphide treated Wools.		
		13·0% loss.	46·0% loss.	56·7% loss.
24·2	6·80	6·77	6·75	6·93
73·5	17·00	16·82	16·94	17·24
91·3	24·83	24·75	26·01	25·47

It is a highly significant fact that wool treated with sodium sulphide until the loss in weight is as high as 57 per cent should show almost exactly the same affinity for water as untreated wool. In view of the proved existence of micelles which are impervious to water, there can be only one possible explanation of the results: that the ratio of surface to mass remains unaltered with loss in weight. Combining this requirement with those indicated above, it becomes clear that the most probable shape of the micelles is the lamella, and that attack by sodium sulphide is largely confined to the edges, leaving the surface mass ratio sensibly unaltered. In addition, these observations indicate that the disulphide link in wool, which is the point of attack by sodium sulphide, must lie in a plane making an obtuse angle with the large faces of the micelles. Finally, there is now an obvious explanation of Marriott's[3] observation that treatment of hair with sodium sulphide until it shows a 26 per cent loss in weight leaves the ratio of the nitrogen and sulphur contents unaltered.

J. B. SPEAKMAN.

The University,
Leeds, Sept. 27.

[1] *J. Soc. Chem Ind*, **49**, 209 T; 1930.
[2] *Trans. Faraday Soc.*, **26**, 61; 1930
[3] *J. Soc. Leather Trades Chemists*, **9**, 618; 1925.

Hyperfine Structure in Some Spectral Lines from Highly Ionised Atoms of Thallium and Bismuth.

IN working with spectra in the extreme ultra-violet at the physical laboratory in Uppsala, I have been able to observe a hyperfine structure in some spectral lines in the region 1400-800 A. The lines investigated are due to higher ionisation stages of thallium and bismuth. For thallium, hyperfine structure has been measured before in the arc spectrum and in the first spark spectrum, and for bismuth, in the arc spectrum.

The lines now observed have in some cases much larger wave-number differences than any before measured.

The spectrograph is of the same type as two others designed by Prof. Siegbahn and described in other places.[1] It has a concave speculum grating with a radius of 1·5 m. and 1060 lines/mm.

The method with grazing incidence is used, and the angle of incidence is about 7°. The dispersion at 800 A. is 2·6 and at 1400 A. 3·4 A./mm.

The spectrograph has a volume of about 30 lit. and the vacuum is obtained by two Siegbahn molecular pumps in parallel backed by an oil-pump. As light source is used a condensed spark with a condensor of about 0·3 μF in parallel with the spark. The charging current for the condensers is rectified by a kenotron.

It is possible to measure these small separations only when narrow lines of the proper intensity are obtained. It is, therefore, necessary to work with a very narrow slit and use different exposures for different lines.

The possible errors in wave-length differences are estimated to about 0·01 A., which corresponds to 1 cm.$^{-1}$ in wave-number.

Table I. gives the separations of some previous classified lines in Tl III[2] and Tl IV.[3] Some of these

TABLE I.—THALLIUM.

I.	λ (A.).	Δλ		Classification.
·7-7	1266·33	0·103	6·4	III. $s^2S_{\frac{1}{2}} - p^2P_{\frac{1}{2}}$
·7-7	1337·19	0·060	3·4	IV. $s^3D_3 \quad p^3F_3$
·2-3	1358·58	0·077	4·1	IV. $s^1D_2 \quad p^3F_2$
·4-2	1374·62	0·056	3·0	IV. $s^3D_1 \quad p^3D_2$
·7-7	1377·75	0·092	4·7	IV. $s^3D_3 - p^3P_2$
·7-7	1404·60	0·065	3·8	IV. $s^3D_2 \quad p^3F_3$
·2-3	1412·93	0·094	4·7	IV. $D_2 - p^3P_1$
·3-3	1434·71	0·070	3·4	IV. $s^1D_2 \cdot p^3D_2$

The values of the wave-lengths are from Carrol's[6] measurements.

lines are seen on the magnified plates reproduced in Fig. 1.

The separation measured for the level 6 $^2S_{\frac{1}{2}}$ of Tl III is 6·4 cm.$^{-1}$. From the spectrum of Tl II,

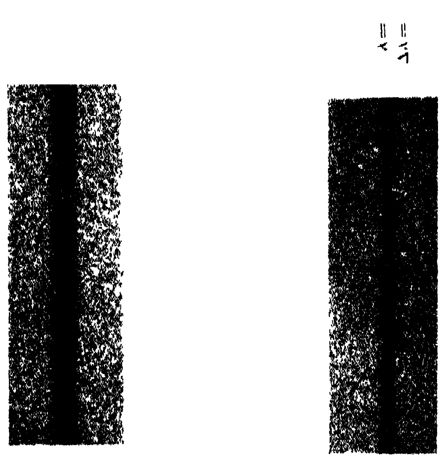


FIG. 1.—Thallium. Magnified 54 times.

Bacher and Goudsmit[4] have calculated a value between 7 and 8 for this level.

Table II. and Fig. 2 give the separations of four lines in the spectrum of bismuth: two doublets and two triplets. The two triplets are classified by Lang[5] in the way given in the table as belonging to Bi III. With respect to the fine structure, it would be very strange if this classification should prove to be correct.

According to Bacher and Goudsmit's theory, if the

TABLE II.—BISMUTH.

I.	λ (A.).	Δλ	Δν cm.$^{-1}$	Classification (questioned).
8-8	864·5	0·092	12·9	
		0·064	5·3	
2-2-3	1103·4			III. $6s^26pP_1 \cdot 6s^27sS_1$
		0·085	7·0	
10-10	1139·4	0·175	13·4	
		0·126	7·3	
6-5-5	1317·1			III. $6s^26pP_2 - 6s^26dD_3$
		0·099	5·7	

The wave-lengths are calculated from reference lines of oxygen, nitrogen, and carbon.

splitting of the triplet is due to one level only, it must have $j = 1$. Since the nucleus quantum number $I = 4\frac{1}{2}$, for bismuth, then the resultant $F = 3\frac{1}{2}, 4\frac{1}{2}, 5\frac{1}{2}$. The ratio of the separations in the triplets would be expected to be 11/9 = 1·22.

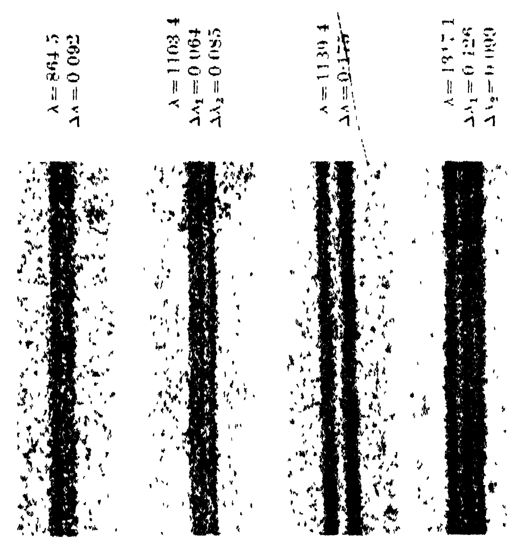


FIG. 2.—Bismuth. Magnified 51 times.

For the measured triplets the ratios are 1·32 and 1·28, and the separations within the errors of measurement are the same, though the larger separation for one is toward long, and for the other toward short wave-lengths. One would then expect them to correspond to transitions between 6 s 6 p $^3P_1$[(6 s 6 $p_{\frac{1}{2}}$)$_1$, Goudsmit's notation] and a more stable term 6 s^2 $^1S_0$ and a less stable term, for example, 6 s 7 s $^1S_0$ or 6 p^2 term.

It can be expected that the possibility of measuring the hyperfine structure in these regions will prove to be a good tool for classifying spectra from some highly ionised heavy atoms. This aid is much needed. In general, lines from many different stages of ionisation are mixed together and the possible error in wave-number increases rapidly as the wave-length decreases.

GUSTAF ARVIDSSON.

The Physical Laboratory of the
University of Uppsala,
Aug. 29.

[1] Ericson and Edlén: *Zeit. f. Phys.*, **59**, 656; 1930. Erik Ekefors: *Physik. Zeitschr.*, **31**, 737; 1930.
[2] McLennan, McLay, Crawford: *Roy. Soc. Proc.*, A, **125**, 50; 1929.
[3] J. E. Mack: *Phys. Rev.*, **34**, 17; 1929. K. R. Rao: *Phys. Soc. Proc.*, **41**, 361; 1929.
[4] S. Goudsmit, R. F. Bacher: *Phys. Rev.*, **34**, 1304; 1929.
[5] R. J. Lang: *Phys. Rev.*, **32**, 737; 1928.
[6] A. Carrol: *Phil. Trans.*, A, **225**, 375; 1925-26.

Rate of Growth of the Common Starfish, *Asterias rubens*.

IN the course of a study of the growths on the buoys and beacons in Liverpool Bay marking the entrance to the Mersey Estuary, young *Asterias rubens* have in nearly all cases been found clinging to the undersides of those structures. There is no doubt that these starfishes have settled as larvæ in this position and have grown *in situ* by feeding on coexisting mussels (*Mytilus edulis*), which have always been found in abundance. As definite observations on the rate of growth of the common starfish are necessarily rare and difficult to obtain, the following are of interest.

On May 30, 1930, the black beacon *Q*7 from the Queen's Channel was dry-docked and examined, and found to be carrying a large number of young *Asterias rubens*. About 1800 of these were collected, preserved in the laboratory, and afterwards measured to give the graph shown in Fig. 1. The measurement adopted

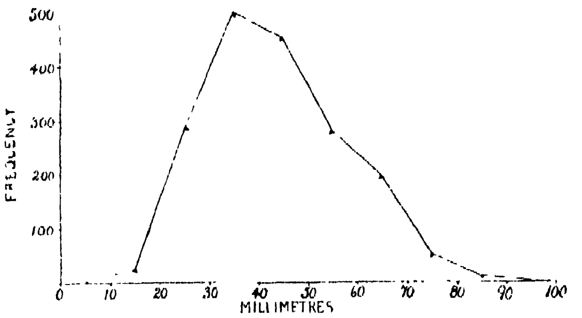


FIG. 1. Size-frequency in 10 mm. groups of 1800 *Asterias rubens* (aged not more than 1 year) from the black beacon *Q*7, Queen's Channel, Liverpool Bay, May 30, 1930.

to give a criterion of size is the length of the straight line joining the tips of alternate arms. The modal value in Fig. 1 is nearly 4·0 cm., while size ranges between 7 mm. and 9·4 cm., and the mean value is 4·2 cm. In life these specimens would measure in repose about 5 mm. more on the average. As the buoy *Q*7 was placed on station on April 3, 1929, the greatest age of these *Asterias* is about 13 months. The actual age is, however, rather less. Post-larval *Asterias* of only a few millimetres were obtained in 1930 on a buoy (*C*8 black) on July 25—and rather larger sizes in great quantities on other buoys at a later date—thereby proving that settlement occurs in this stage and giving also an indication of the date of settlement.

If post-larvæ be assumed to settle in general on buoys from about June onwards, then it is seen that a population of *Asterias* may attain a maximum size of about 10 cm. and a mean of 4·5 cm. in less than one year. But as *Asterias* probably spawns round about April in this locality, the actual age (from the time of fertilisation) of these small starfishes is approximately one year. It is an extremely interesting fact that minute post-larval *Mytilus* were obtained on another buoy (*Q*3 black) on June 27, 1930, at just about the right time to serve as food for the growing baby *Asterias*. The latter have not been observed actually eating the post-larval mussels, but there can be little doubt that this is the source of their sustenance. Young mussels were probably also largely the food of *Echinus miliaris* taken from the bottom of the Bar lightship along with 15 cm. *Asterias rubens*, large mussels, medium *Actinoloba dianthus* and other forms, also on June 27, 1930. These *Echinus*, it may be noted, were mostly the long-spined variety, and were similar in this respect and in size to those obtained on the coal hulk *London City* (see NATURE, 111, p. 146; 1923). As these sea-urchins could only attain access to the bottom of ships by the settlement of larval forms, and as this lightship was put out on Nov. 22, 1927, their age, as well as that of the larger *Asterias*, is not more than two years.

We are greatly indebted to Capt. Mace and Mr. A. L. Hulme, of the Mersey Docks and Harbour Board, who kindly supplied information regarding the records of the buoys mentioned above.

J. H. ORTON.
J. H. FRASER.
The University, Liverpool, Aug. 28.

Depreciated Morphology.

IN a recent review (NATURE, Sept. 6, p. 341), Prof. Elliot Smith reproves at some length an anonymous group of contemporary biologists whose attitude towards morphology is one of ill-concealed contempt. Escaping the discipline which alone attends the laborious drudgery of morphological research, they pour contempt on that field of biology which, in the past, has yielded all our richest fruits. Few biologists will read Prof. Elliot Smith's remarks unmoved. Some will learn, for the first time, that there is a race of upstarts - presumably experimental biologists - who not only ignore, but also despise, the foundations of their own beliefs. Others—perhaps no insignificant minority—will learn with dismay of the great gulf which protects the true morphologist from the taint of experimental corruption.

I venture to think that the picture is not quite so dark as Prof. Elliot Smith has painted it. Whether we use a macerating pot or an X-ray for the study of animal form, the goal remains the same—to show how the component parts of an animal (whether they be bones or molecules) are so shaped and so orientated to one another as to form a living organism capable of undergoing evolutionary change. To this end the morphologist (in the classical sense) has contributed, and is continuing to contribute, a more complete record of correlated facts than his younger colleagues in experimental laboratories can hope to do for many years to come. Nevertheless, the final goal will not be reached by those who restrict their conceptions of animal life to the facts revealed by a scalpel and a microtome, or by those who ignore all knowledge of the anatomical sciences. Until we can add to such facts as are described in Prof. Goodrich's distinguished volume a knowledge of the form and mechanism concealed within a muscle fibre and a gamete, the theories of the evolution of the vertebrate skeleton will necessarily remain vague and unsatisfying to certain types of mind.

Facts of real biological significance are drawn from an ever-widening field, and there is an inevitable tendency to specialise in apparently unrelated territories. To some extent this is inevitable, but whether we regard an organism as an intricate piece of molecular machinery or whether we prefer to examine the brain with a hand lens, it scarcely seems necessary to allow our predilection for one or other point of view to imply a negation or an implied criticism of the other. It is just as inconsistent to ignore the morphological significance of experimental data as it is to study the behaviour of an organism without reference to its form or evolutionary history. If experimental biologists are too fond of 'looping the loop', it is equally true that morphologists are not disinclined to creep about on all-fours.

It is to be hoped that experimental biology will never be regarded as the antithesis to morphology. There is no intrinsic virtue in experiment—it is solely an additional weapon of biological armament. The very name 'experimental' is a misnomer and might well be replaced by 'analytical', for this at least indicates an attitude of mind of those who attempt to analyse

living phenomena in terms of matter and energy, and who try to regard experiment and observation with strict impartiality. The only difference between such misguided folk and Prof. Elliot Smith's declining band of faithful warriors lies in the belief that the rich harvest of classical morphology would provide more palatable food, for the young, if leavened by a knowledge of physiological facts.

It is depressing to think that a study of living organisms inevitably entails severe morpholophobia and that the only cure is a return to the dead. In spite of anxious and widespread inquiry, I have failed to discover any genuine case of this unfortunate disease; perhaps it only affects the very, very young.

J. Gray.

King's College, Cambridge.

Ovoviviparity in Sea-Snakes.

Mr. Smedley's note on viviparity in the sea-snake (*Laticauda colubrina*) in Nature of Aug. 30, p. 312, needs some comment. My statement (which he quotes) that all sea-snakes are viviparous was not a reiteration of that of previous authors, but a confirmation, based upon personal knowledge of the group. In the light of fresh information, however, it requires some qualification.

The recent investigations of Miss Weekes have shown that true viviparity, with the formation of a placenta, first described in *Chalcides* by Giocomini in 1891, occurs in some Australian lizards (*Lygosoma* and *Tiliqua*) and snakes (*Denisonia*), and it would be well in future to restrict the term viviparous to those species in which some form of placentation can be shown to exist. Whether the sea-snakes are truly viviparous or not, is unknown, but that the majority of the species of the subfamily Hydrophiinæ produce their young alive is a well-established fact. All the members of that group are strictly aquatic in their habits and never seek the land, and no other form of reproduction therefore seems possible for them. With the *Laticaudinæ*, genera with broad ventral shields and partly terrestrial habits, it is different. I have recently examined a specimen of *Laticauda colubrina* with well-developed embryos enclosed in a thin semi-transparent covering, and also an example *Aipysurus eydouxi* with young less well developed and enclosed in a thicker capsule. From their position in the body of the mother it was evident that they were not yet ready for expulsion and that further development would have taken place before they were discharged. These species, therefore, appear to be ovoviviparous.

The eggs laid by Mr. Smedley's snake are no doubt similar to those deposited last month by the same species of snake in the Zoological Society's Gardens in London, and which are—in view of what has just been stated—eggs that have been prematurely laid in consequence of captivity. The fact that they were laid one by one at intervals of a few days, supports this conclusion.

Malcolm Smith.

London, Sept. 7.

Measurement of the Heaviside Layer Heights.

If the carrier wave of a wireless transmitter be increasing steadily in frequency, then a given receiving station will in general pick up two waves differing in frequency. One of these waves will have reached the receiver by the shortest path along the ground, while the other will arrive after having suffered reflection at the Heaviside layer. After rectification these two waves will give rise to a beat-note in the receiver. It is possible to arrange that this note shall have an audible pitch, and a determination of the latter may be used to obtain a measurement of the height of the layer. The resulting method possesses some advantages, such as simplicity, and is besides adapted to the obtaining of continuous records.

In practice, it is not possible to continue increasing the carrier frequency indefinitely, but this difficulty is overcome by alternately increasing and decreasing the frequency many times a second, the rate of increase being constant and equal to the rate of decrease. It is evident that, corresponding to the change over from increasing to decreasing frequency at the transmitter, there will occur at the receiver a short period during which the frequency of the beat-note decreases rapidly to zero and rises again to its former value. The duration of this period must be made small compared with the time during which the beat-note remains steady. This condition is satisfied in practice by ensuring that the time during which the carrier frequency is increasing (or decreasing) shall be large compared with the time difference of the two ray paths.

Preliminary tests of the method have been made, and an audible beat-note has been detected at a distance of seven miles from the transmitter, on a wavelength of 250 metres. The experiments are being continued with improved apparatus. The details of the method, and the results obtained, will be published elsewhere in due course. The work is being carried out under the auspices of the Radio Research Board of Australia.

D. F. Martyn.

Natural Philosophy Department,
University of Melbourne, Aug. 22.

The Spectrum of Trebly-Ionised Selenium.

The spectrum of selenium has been investigated (in Prof. Fowler's Laboratory at the Imperial College, in collaboration with Mr. J. S. Badami) from λ7000 to λ700, using different intensities of discharge, through capillary tubes containing selenium metal or the oxide. Between λ1400 and λ500 photographs have also been taken in this institute of the spark spectrum of selenium with a vacuum spectrograph designed by Prof. Siegbahn, having a grating of radius 150 cm., at tangential incidence. With the aid of these, the doublet system of trebly-ionised selenium, due to the configurations $4s^24p$, $4s^24d$, etc., and $4s4p^2$, has been identified. The characteristic separations are: $4p^2P_1 - 4p^2P_2 = 4378$; $5p^2P_1 - 5p^2P_2$ 1198; $4d^2D_2 - 4d^2D_3 = 389$, etc. Details of the analysis will be published shortly.

K. R. Rao.

Physical Laboratory,
University of Uppsala, Sept. 18.

British Museum (Natural History): General and Departmental Libraries.

With reference to a review, appearing in the Supplement to Nature for Oct. 4, of the list of place-numbers of societies issuing serial publications contained in the General Library of the British Museum (Natural History), I have been desired to point out that this List, being a *General* Library List, does not include the more special serials housed in the five Departmental Libraries of the Museum. This would account for the list's apparent weakness in specific branches of natural science, so justly commented upon by your reviewer.

A. Cockburn Townsend
(Assistant-Keeper in charge of the General Library).

British Museum (Natural History),
London, S.W.7, Oct. 3.

The preface to the volume noticed does not contain any reference to the five Departmental Libraries; but I accept unreservedly Mr. Townsend's correction of my comments.

The Reviewer.

The Nitrogen Industry and our Food Supply.*

By Dr. R. E. Slade.

FOR many centuries nitrogen was used as a fertiliser in the form of farmyard manure, and certain rotations of crops, which kept up the nitrogen in the soil, had been popular; but it was not until 1840, when Liebig first pointed out the true function of nitrogen, potash, and phosphorus, that fertilising became an art based on science. Liebig's work became widely known in a very short time. A little later Lawes and Gilbert started their experiments at Rothamsted, which definitely proved the part taken by nitrogen in agriculture.

From 1840 the use of nitrogen in the form of Chile nitrate steadily increased, and about 1880 sulphate of ammonia became available from by-product coke ovens, and by 1903 the world consumption of these two fertilisers had increased to 1,975,000 tons, equivalent to 351,000 tons of nitrogen.

In 1905 calcium cyanamide was manufactured on a commercial scale for use as a fertiliser, and in the same year the arc process for combining the oxygen and nitrogen of the air to form nitric acid was launched unsuccessfully in Canada. Two years later the arc process was established in Norway and calcium nitrate was put on the market as a fertiliser. Thus Crookes's dream of the commercial production of nitrogenous fertilisers from the nitrogen of the air was realised in less than ten years. But it was the Haber-Bosch process for the fixation of nitrogen which was to supersede all others and make it possible for us to produce all the nitrogen fertilisers we require now and as far in the future as we can see. In 1906–9 Prof. Haber investigated the chemical equilibrium between nitrogen, hydrogen, and ammonia when heated under a pressure over a catalyst. Then Dr. Bosch of the Badisch Analin u. Soda Fabrik successfully manufactured ammonia on a large scale by this process in 1913 to 1914.

The fixation of nitrogen in the form of ammonia is so much cheaper than by any other process that this process has very largely replaced the cyanamide and arc processes, and it has shaken the Chile nitrate industry to its foundations—so that the Chilean Government and the nitrate manufacturers have to revise their methods and their processes.

The production of nitrogen in various forms is shown in Fig. 1. The quantities are expressed in tons of nitrogen contained in the products. It will be noticed that the nitrogen industry had already achieved considerable importance in 1898, but it was not until 1921 that the synthetic nitrogen production became greater than the Chilean nitrate production.

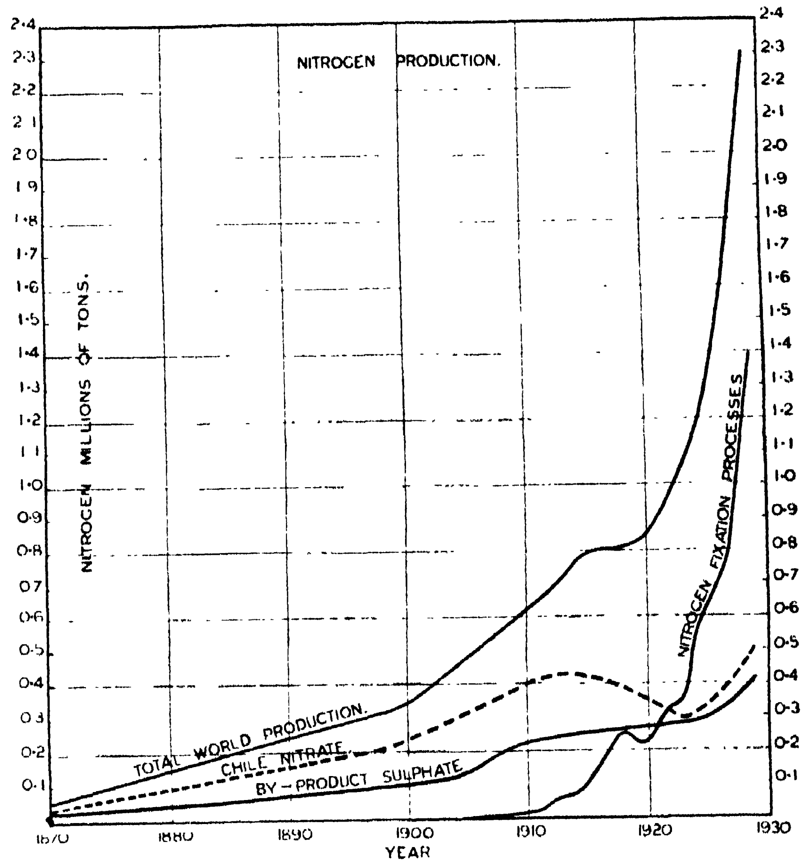


FIG. 1.

NITROGEN FERTILISERS.

The world's consumption in 1928 of nitrogen in the form of ammonium sulphate from synthetic ammonia and by-product coke ovens, cyanamide, nitrate of lime, nitro-chalk, and ammonia liquor was 1,442,000 tons and in the form of Chile nitrate 401,000 tons, making a total of 1,843,000 tons, of which 185,000 tons are used in industry and 1,658,000 tons are consumed as fertilisers. If fixed nitrogen is worth £50 a ton—which is about its price in sulphate of ammonia to-day—then the value of the nitrogen used in fertilising was £83,000,000.

Now, in an acre of typical English arable soil we have in the top nine inches a quantity of humus containing about 2500 lb. of nitrogen, and at certain times of the year changes take place in the soil making some of this nitrogen into nitrates, in which form it is available for absorption by the plant. The result of this is that in the spring about one per cent of the nitrogen in the humus is present

* From an evening discourse delivered at the meeting of the British Association at Bristol on Sept. 9.

in the form of nitrate; thus we have present about 25 lb. of nitrogen available for the plant. As this available nitrogen is used up by the plant it is partly replaced by more nitrate being formed from the humus, but during the time of greatest growth there is a considerable depletion of available nitrogen in the soil. Owing to the continuous breaking down of the humus, the nitrogen absorbed by the plant is often more than 25 lb., besides what is washed away by rain. The supply of available nitrogen may be increased by the addition of nitrates or ammonium salts—for the latter are rapidly oxidised to nitrates in the soil.

If we spread one hundredweight of sulphate of ammonia over an acre of ground, this adds 23 lb. of nitrogen to this area, or if we consider the top nine inches of the soil over this area of an acre, we add 1 lb. of nitrogen to each 120,000 lb. of soil. This is such a small amount that we might be doubtful whether it would be sufficient to make any appreciable difference to plants grown on this area. But we have seen that this quantity is of the same order as the quantity of available nitrogen already in the soil.

We will now inquire into the magnitude of the increased yields of crops which can be obtained by the use of nitrogen fertilisers. The figures given in Table I. are average increased yields of various crops obtained on good soil for the addition of each lb. of nitrogen in a fertiliser. They are the averages over many years and many different soils, so that they are the increased yields that may be expected for the addition of each lb. of nitrogen—if there is not a deficiency of potash or phosphoric acid in the soil.

Table I.

Crop.	Increase for 1 lb. Nitrogen. (lb.)	Nitrogen in Crop. (Per Cent.)	Efficiency. (Per Cent.)
Wheat (grain)	11·4	1·8	20·4
Barley (grain)	14·2	1·3	18·5
Oats (grain)	12·4	1·6	19·7
Potatoes (tubers)	94·0	0·3	28·2
Swedes (roots)	94·0	0·2	18·8
Mangolds (roots)	150·0	0·2	30·0
Hay	42·3	1·45	61·5

The nitrogen efficiency of the fertilisers in the last column is the percentage of the nitrogen in the fertilisers which appears in whole or part of the crop described in the first column.

In Table II. the increased yields are recalculated so as to show the increased crop obtained from one hundredweight of sulphate of ammonia in common units.

Table II.

Crop.	Increase for 1 cwt. of Sulphate of Ammonia.
Wheat	4·5 bushels or 2·41 cwt.
Barley	6·5 ,, or 3·02 ,,
Oats	7·0 ,, or 2·62 ,,
Potatoes	20·0 ,,
Swedes	20·0 ,,
Mangolds	32·0 ,,
Hay	9·0 ,,

If we feed grass to a cow giving two gallons of milk a day, we find that 1 lb. of nitrogen causes sufficient extra grass to grow to keep the cow alive one day and to give two gallons of milk. Since two gallons of milk contain 0·8 lb. of proteins or 0·128 lb. of nitrogen, we have 12·8 per cent of the nitrogen of the fertiliser appearing in the milk, or the efficiency with which the fertiliser is used via grass to make milk is 12·8 per cent.

The efficiency of meat production is lower, one pound of nitrogen fertiliser only producing 0·05 lb. of nitrogen in beef, or an efficiency of 5 per cent on the fertiliser.

Summing up these nitrogen efficiencies we have:

Fertiliser to grain	about	20 per cent.
potatoes	,,	30 ,, ,,
grass or hay	,,	60 ,, ,,
milk	,,	12·7 per cent.
beef	,,	5 per cent or lower.

It is not surprising that grass shows a higher efficiency than other crops, because the roots cover the ground more completely. I think that the efficiencies on the whole are very high; compare the energy efficiency of a high-class locomotive on the railways, which is not more than 8 per cent.

Food Production.

The food of a man in Great Britain is approximately:

Meat, fish	14·5 per cent.
Cereals	18·5 ,, ,,
Milk, cheese, etc.	24·5 ,, ,,
Potatoes and roots	25·8 ,, ,,
Sugar, fruit, etc.	15·5 ,, ,,

—and the nitrogen efficiency in growing these foods from fertilisers is probably about 17 per cent.

The amount of protein consumed per head is 86·5 gm. per day; this contains 14 gm. of nitrogen, so that if this food were grown by using fertilisers at an efficiency of 17 per cent we should require to use 82 gm. of nitrogen in fertilisers to produce the food for one person for one day; or the fertiliser required to feed one person for a year must contain 365 × 80 gm., or 29 kgm. of nitrogen. One ton of nitrogen in the form of sulphate of ammonia or nitrate of soda will therefore produce enough food for 34 people for one year.

Since the total amount of nitrogen consumed in fertilisers during 1928 was 1,658,000 tons, the amount of extra food produced from this fertiliser would contain enough nitrogen in the form of proteins to support 56,000,000 people; and there would be sufficient carbohydrates and fat associated with this protein to form a complete diet.

Sir Daniel Hall has shown that 2-2½ acres of land are required under cultivation to feed one person. Let us compare this with 1/34 tons of fixed nitrogen. If we assume that the total capital required to build a nitrogen factory is £70-£100 per ton year of nitrogen, inclusive of everything, then for a maximum of £3 invested we can support one person. It would be impossible to bring 2-2½ acres of land under cultivation at so low a capital cost. I do not think that land can usually be settled and cultivated at a less capital cost than £10 per acre, including roads and railways, houses, and agricultural machinery, so that to bring two and a half

acres under cultivation would need £25 capital as compared with £3 necessary to produce the fertiliser to produce the same amount of food. I would particularly like to direct attention to this calculation in some countries where governments are always ready to consider and finance schemes to build railways and roads to open up new country or to build irrigation schemes, although the capital to be invested for a given amount of food-producing capacity is often enormous.

STABILITY OF THE NITROGEN FIXATION INDUSTRY.

In fixing one ton of nitrogen and making it into fertilisers we use for all purposes about five and a half tons of coal, so that to provide the fertiliser to feed one person for a year we require $3\frac{1}{4}$ cwt. of coal. The population of the world (excluding China and Turkey) is now about 1940 millions, and 56 millions or 2·8 per cent are now being fed with food grown by nitrogen fertilisers. Of the nitrogen fertilisers consumed in the year 1928, about 1,000,000 tons of nitrogen was produced by synthesis, needing 5·5 million tons of coal. This quantity of coal is almost negligible when compared with 1500 million tons mined every year. The rest of the nitrogen was produced by by-product coke ovens or as nitrate of soda from Chile.

The population of the world increased by 10 millions each year from 1913 to 1928. If we had to feed this increase of population by increased nitrogen fertilisation, we should have to build each year a works which would fix 300,000 tons of nitrogen per year and would cost upwards of £30,000,000. In order to run the works we should require 1·6 million tons of coal per year. If we built a works of this size every year for a hundred years, we should then be consuming 160 million tons of coal a year for nitrogen fixation, or only ten per cent of the coal which is being used in the world to-day. At least two-thirds of the coal consumed in the fixation of nitrogen is used for power production, so we could reduce the coal required to one-third the value mentioned if other sources of power were available. There are still large areas of the world suitable for cultivation. It is therefore improbable that all the food requirements for the growing population of the world will have to be supplied exclusively from nitrogenous fertilisers for some time to come.

DISTRIBUTION OF NITROGEN FERTILISER.

Let us now investigate the use which the world makes of the nitrogenous fertilisers available at the present time. I have already mentioned that of the 1,843,000 tons of nitrogen consumed in 1928, 1,658,000 tons or 90 per cent was used in agriculture.

In Table III. are shown the quantities of nitrogen consumed in the different countries during the year 1928.

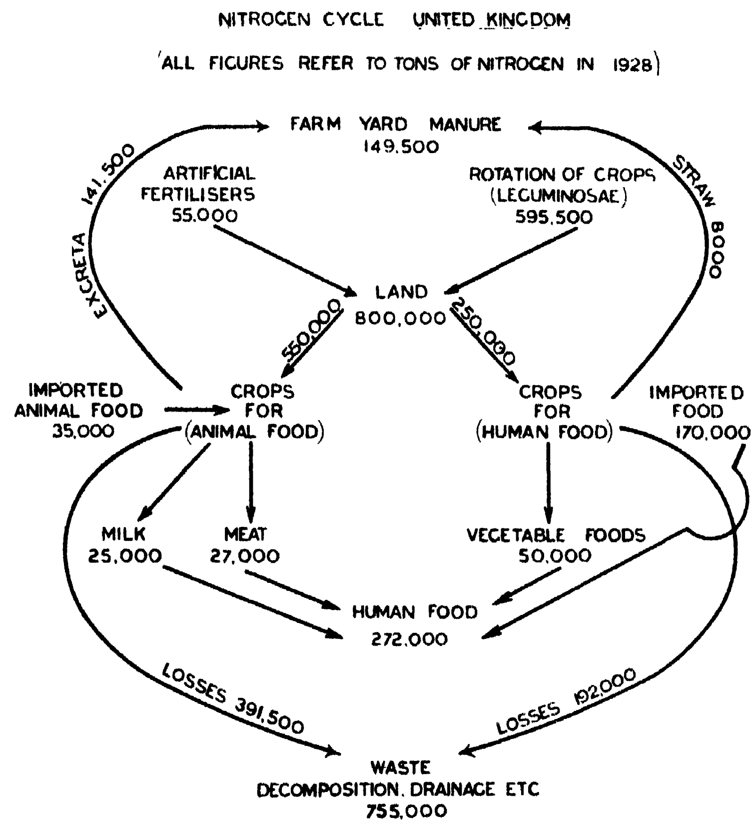


FIG. 2.

How much atmospheric nitrogen is combined by electric discharges? How much by bacteria? How much by our synthetic ammonia processes? How much humus changes to give nitrate? How much nitrate is washed away and how much goes into

TABLE III.

	Nitrogen Consumed.	
	Metric Tons, 1928.	Lb./Acre Arable.
Germany	615,200	22·3
France	166,900	6·7
Belgium	63,600	45·9
Czechoslovakia	33,800	5·0
Denmark	29,100	9·8
Holland	73,400	70·6
Italy	68,300	4·7
Poland	54,600	2·7
Spain	67,300	3·8
Great Britain	61,600	10·4
Total (Europe)	1,134,800	..
U.S.A.	383,600	2·4
Japan	113,300	16·8
Egypt	35,900	9·2
Other countries	175,600	..
Total (World)	1,843,200	..

the crop? What happens to that going into the crop and how much of it forms humus? What happens to the dissolved nitrogen going down the rivers into the sea? How much comes back to land in the form of fish? Again, how much nitrogen is liberated again from combination? Is there a dynamic equilibrium in this nitrogen cycle—or are we drifting in one direction? Are we gaining nitrogen in the air or are we losing it?

We cannot get answers to these questions. There is no doubt that, in the past, nitrogen was stored up in coal and in Chile nitrate, and this is being liberated now, but we do not know whether nitrogen is being stored up anywhere at the present time. In the diagram, Fig. 2, I have made an estimate of the principal movements in the nitrogen cycle of Great Britain for the year 1928.

The vegetable food-stuffs consumed by man are estimated to contain 50,000 tons of nitrogen. If these are grown with a nitrogen efficiency of 20 per cent, then 250,000 tons of nitrogen is required in the soil. Of this nitrogen it is assumed that 50,000 tons go into vegetable foods, 8000 tons into straw which forms farmyard manure, and the rest, 192,000 tons, are washed out of the ground by rain water and lost to the rivers and seas. It will be noticed that I have assumed that the wastage of nitrogen derived from humus is the same as the wastage of nitrogen from artificial fertilisers. I have no direct evidence for this—I have no evidence at all; but I cannot think of a more reasonable assumption. I have taken no account of the vegetable and animal life on the moors and mountains except so far as it provides human food. Probably I have neglected some other important factors, but I make no apology for offering this first attempt at a nitrogen flow sheet for Great Britain.

We are now getting much better statistics of agricultural production than formerly, and I believe that consideration of these statistics with other statistics now available has opened up new fields of study in agricultural economics. I have calculated the average amount of nitrogen obtained from an acre of crops in different countries. The figures in Table IV. are for the year 1928. They were obtained by calculating the weight of nitrogen in each crop for each country and then adding up the total amounts of nitrogen for each country. This weight of nitrogen is then divided by the area on which the crops grew and we get the weight of nitrogen in the crop in lb. per acre average over the whole country. By crop we mean the portion of the crop taken away for consumption by man or animals: for example, of wheat the grain, of potatoes the tubers, etc. The rest of the crop usually goes back to the land and is considered as part of the agricultural system of the country.

Since some crops give a larger yield of nitrogen, in the useful part of the crop, than others, the figures in the table are to some extent affected by the different crops and different proportions of each ... grown in the country. But so far as I can If we fe ... effect of the different crops grown is of milk a day, ...r importance, and as the production of ... the farmers' business, we are not far wrong in considering the first column as an index of the agricultural efficiency of that part of the country under crops. In the second column is given that part of the nitrogen in the crop which has been supplied by artificial fertilisers. It is assumed that on an average 25 per cent of the nitrogen supplied to the land as fertiliser is found in the useful portion of the crop. The third column is the difference between the other two columns and is the weight of nitrogen in the crop which has been supplied by the land. In countries with a good system of farming and a good rotation of crops this quantity is high. We see that the system of agriculture in Denmark produces more than twice as much as that in Canada, U.S.A., and Italy, and that in Great Britain we are a little better than Belgium and considerably better than Holland in our agricultural system, apart from the use of artificial nitrogen fertilisers. But since Holland uses seven times and Belgium four times as much nitrogen fertiliser per acre, these two countries obtain greater crops than those obtained in Great Britain, as is shown in the first column.

TABLE IV.

Year 1928.	Lb. per Acre.		
Country.	Total Nitrogen in Crops.	Nitrogen in Crops from Artificial Fertilisers.	Nitrogen in Crops from Humus.
Denmark	52·0	2·4	49·6
Holland	49·0	17·6	31·4
Belgium	47·2	11·5	35·7
Great Britain	40·2	2·6	37·6
Japan	34·2	4·2	30·0
Germany	32·5	5·6	26·9
Egypt	31·6	2·3	29·3
France	23·5	1·7	21·8
Canada	21·8	0·1	21·7
U.S.A.	20·8	0·6	20·2
Italy	20·5	1·2	19·3

In Holland one-third of the crops appear to be grown from nitrogen fertilisers. There seems to be no climatic or other physical reason why fertilisers should not be used to a greater extent in Great Britain. If we used as much per acre as in Holland, we should consume 420,000 tons of nitrogen per year; if as much as in Belgium, 272,000 tons; and if as much as in Germany, 132,000 tons. The reason that we do not use more fertilisers does not appear to be economic. The use of sulphate of ammonia yields 100-300 per cent on the money invested within a year. Consider the special case of the fertilisation of wheat. For some years the price of wheat and of sulphate of ammonia has been practically equal. Since 1 cwt. of sulphate of ammonia gives an increased yield of wheat of 2·4 cwt., even after paying for phosphatic and potash fertilisers, one hundred per cent will be earned on money spent on nitrogen.

Development of the nitrogen fixation industry has lowered the price of nitrogen fertilisers, so that we can expect the needs of the increasing population of the world to be met first by more intensive cultivation of land close to the markets for food rather than by extension of the cultivated area.

The Biological Method of Pest Control.

By Dr. A. D. IMMS, F.R.S.

PHYSICO-CHEMICAL methods of controlling noxious insects present the advantage that they generally check their activities sufficiently to enable the grower to produce a reasonably satisfactory crop. They are, however, at the best only palliatives the application of which entails an increase in costs of crop production. Furthermore, they usually need to be repeated year after year, because they fail to reduce a given pest population to a low enough level, in any one season, to prevent its subsequent recurrence or increase. For the most part, however, they are the best general control measures so far devised. Notwithstanding this fact, there are many insect pests that are not amenable to any method of artificial control. In attempting repression in such cases other means have to be sought, and a possible method often presents itself in the utilisation of the natural parasitic (and predaceous) enemies of specific pests. This procedure has come to be known as biological control, and it has produced the most encouraging results where pests have become accidentally introduced into lands they did not previously inhabit. Their natural enemies being left behind, such pests, unchecked by biological agents of this kind, quickly gain the ascendancy.

Biological control aims at restoring, so far as possible, the missing parasite factor. It has to be remembered that some of these introduced pests are numbered among the worst of the world's enemies of food supplies. Artificial control measures have, in many cases, proved impracticable and their application has involved vast expenditure of money to no real advantage. Biological control has consequently been resorted to as a sounder and, in the end, a less expensive measure. In a number of cases highly satisfactory results have been achieved, but the method is too immature to forecast its ultimate possibilities and its limitations with any certainty. Every year, however, brings fresh records of promising results, but it cannot be regarded as a universal panacea as the misinformed are too prone to view it.

The first essential for success is technical knowledge of the behaviour of specific parasites in relation to their hosts, from every point of view. Such knowledge forms the guiding principle in biological control work: it enables the most suitable parasites to be selected and the chances of failure or mistakes to be reduced. The collection of biological data of this kind is the work of highly trained entomologists, who must have the use of the equipment and technique pertaining to a subject which has its special requirements. They must also be field naturalists, capable of studying the ecology of parasites in different countries in relation to different conditions. A further necessity is experience in the transportation of delicate insects over many thousands of miles of land and sea, where drastic climatic changes may be encountered *en route*. At the destinations of these living cargoes fully trained specialists are likewise necessary. Familiarity with the handling, breeding, and liberation of parasites under favourable conditions can alone prevent loss of valuable material and wasted effort.

The more trade is fostered within the British Empire, the greater are the chances of the spread of pests from one land to another. The most efficient quarantine has so far failed to preclude this transfer taking place at one time or another. As already mentioned, it is largely against such introduced enemies that biological control offers promise of success. The basic food plants of Europe are grown in most of the Empire, and, consequently, parasites of the enemies of such plants have mainly to be sought out in Europe. These facts, taken in conjunction with the growing importance and demand for biological measures, have received timely recognition from the Empire Marketing Board. By providing financial aid it has enabled the Imperial Institute of Entomology to establish a special laboratory for the furtherance of the method at Farnham Royal, Bucks. A grant of £15,000 for capital expenditure led to the foundation, in 1927, of what is certainly the most adequate laboratory of its kind in the world. An annual maintenance grant for five years has led to its rapid development. That the creation of this laboratory has met a real need in Empire entomology is borne out by the number of requests for assistance that have already come in from various dominions and colonies. Its establishment renders the British Empire no longer so dependent upon the good-will of the United States for assistance in this direction. The Federal Government at Washington has fully realised the value of biological control and now expends more than £100,000 per annum on work of this character.

A general account of the aims and underlying principles of biological control has been recently published by the Empire Marketing Board in a *Bulletin*,* under the authorship of Dr. W. R. Thompson, the superintendent of the Farnham Royal Laboratory. In the same publication he gives a full and most interesting description of the organisation, facilities, and progress of the work of the Laboratory. During the brief existence of the latter more than 73 consignments of beneficial insects, containing over 285,000 living individuals, have been sent out to where demands came. These consignments represent about 24 species attacking about 17 different kinds of hosts. Also about 29,000 examples of Chrysomelid beetles have been shipped to Australia with the view of attempting to control St. John's wort by the aid of their phytophagous propensities.

This *Bulletin* is to be commended to all entomologists and to anyone interested in the practical applications of biology. In one respect it is unique,

* "The Biological Control of Insect and Plant Pests. A Report on the Organisation and Progress of the Work of the Farnham House Laboratory." Pp. 124+7 pl. E.M.B. 29. By Dr. W. R. Thompson. (London: His Majesty's Stationery Office, 1930.) 1s. net.

in that it explains the whole procedure of biological control and its underlying principles. It will obviously prove most helpful to have such information gathered together in so convenient and authoritative a form. There may be differences of opinion here and there on the theoretical side of the subject, but only one criticism of any importance need be raised. On page 25 an erroneous impression is conveyed with reference to the outstanding work of the Hawaiian entomologists and their methods. Probably in no part of the world has greater skill or care been exercised in biological control than in these Pacific Islands, and the successes achieved have been truly remarkable.

Radio Telephony at the Rugby Station.

PROGRESS is being made rapidly in the development of the Post Office radio transmitting station at Rugby. On the invitation of Sir Thomas Purves, Engineer-in-Chief to the Post Office, who is also president of the Institution of Electrical Engineers, many of the members of the Council of the Institution visited this station on Sept. 30 and were much impressed by the new developments.

In 1927, the first international telephone service designed for connexion with the ordinary telephone subscribers' system was started with one channel between the United States and England. There are now four channels and preparations are nearing completion for a fifth channel. Two of these channels use long waves and three short waves. The short wave systems are cheaper to erect, but they are not so trustworthy as the long waves. For the latter system, there are twelve masts, each 820 feet high, supporting the antennæ. The single side band telephone transmitter G.B.T. is the most powerful radio telephone transmitter in the world. Its wave-length is 5000 metres (60 kilocycles) and its output is equivalent to a broadcast transmitter of 1000 kilowatts. It is wonderful to notice how a current of several hundred amperes is apparently transmitted directly into the ether.

There are now a large number of smaller towers arranged in groups called 'arrays', the heights of which vary from 120 to 180 feet. These towers are used to support the antennæ for the short wave beam telephone services. The arrays are so arranged that the beam is projected in the direction of the great circle joining the transmitting to the receiving station. Three different frequencies are used, depending on the time of day the message is sent, and the message sometimes travels one way round this great circle and sometimes the other way.

The G.B.R. telegraph transmitter is the most powerful one in the world and works at 600 kilowatts and 16 kilocycles. The ninth harmonic of a tuning fork which oscillates at 1777·7 cycles is used to tune the circuit. In the final amplifier stages of G.B.R. each panel contains eighteen cooled anode valves.

By combining both short wave and long wave systems, the Post Office can now provide an effective service to America over the full twenty-four hours. It is not considered possible to operate long wave systems to greater distances than from England to North America. The solution of the problem of providing communication with the Dominions has been obtained by the use of short wave transmission.

In order to prevent unauthorised persons from 'listening in' to the private telephone messages which are now being sent almost continuously, a method has been devised of making the speech as transmitted quite incoherent to the would-be listener. The component parts of the speech are 'scrambled', that is, they are split up into portions by an electrical device and transmitted in this state, being finally rearranged in their correct form at the distant end. Demonstrations were given to the visitors, through the medium of a loud speaker, of the London side of conversations with New York through the long wave channel. The scrambled speech sounded absolutely meaningless. A somewhat different system of scrambling is adopted in the short wave system. In this case the frequencies of the various sounds are inverted, the high frequency sounds becoming low frequency and vice versa. The sounds produced by the waves in the intermediate stages remind one of barking dogs or crowing cocks.

The Rugby station is used for the ship and shore telephone service. The messages to the *Majestic*, the *Olympic*, the *Leviathan*, and other vessels, are sent out from here.

The electric power required to work the station is obtained from the system of the Leicestershire and Warwickshire Power Company by means of two underground cables, each capable of taking the full load of the station. The cables can be connected to either the Warwick or Hinckley power stations, so that the risk of a failure of the power supply is almost negligible. Short wave services to Australia, South Africa, Canada, India, and the Argentine are either complete or nearing completion. As the site covers 900 acres, there is plenty of room for extension.

Obituary.

PROF. W. D. MATTHEW, F.R.S.

PALÆONTOLOGISTS, zoologists, and geologists mourn the loss of Dr. William Diller Matthew, professor of palæontology in the University of California, who died on Sept. 24, aged fifty-nine years. For thirty years he shared the charge of the fossil vertebrates in the American Museum of Natural History, New York, and added greatly to the collection by his own discoveries in the western States. In 1927 he was appointed to the professorship at Berkeley, where he looked forward to extending the palæontological museum of the University of California by renewed activity in collecting fossils on the Pacific border of the American continent.

This important task, for which Prof. Matthew was so well fitted, has unfortunately been interrupted by his untimely death.

Matthew was born at St. John, New Brunswick, Canada, the son of Dr. G. F. Matthew, a well-known Canadian amateur geologist who added much to our knowledge of the oldest fossiliferous rocks of eastern Canada. He inherited the disposition for geological research from his father, and on leaving school proceeded to Columbia University, New York, where he eventually graduated as Ph.D. In the beginning, his inclinations were towards mineralogy and mining geology, and his first scientific paper dealt with topaz from Japan. For three or four years he spent his leisure in studying the crystalline and volcanic rocks of New Brunswick, and he published several valuable results. At the same time, he was an all-round naturalist, and his papers on some American species of the plant *Cuscuta* and on a trilobite *Triarthrus* show an early interest in the world of life. He attracted the notice of Prof. H. F. Osborn, who was then beginning to organise the great department of vertebrate palæontology in the American Museum of Natural History, and in 1897 he was selected as one of Prof. Osborn's assistants. Thus began his career as a distinguished student of extinct mammals and other higher vertebrates.

Matthew's first original research at the American Museum was a revision of the earliest remains of Tertiary mammals found in New Mexico, and his paper on the subject published in the Museum bulletin at the end of 1897 showed that these mammals belonged not to one but to two successive faunas, the Puerco and the Torrejon. It was the beginning of a long series of technical descriptions of the remains of Tertiary mammals which appeared in the Bulletin and Memoirs of the American Museum of Natural History, and is interesting as already displaying the keen insight into the bearing of the facts on wide problems which characterises all Matthew's writings. Cope had supposed that the bones of the two rows of the carpus and tarsus in the earliest Tertiary mammals were always directly opposite, and that interlocking began only in later groups. Matthew proved that such interlocking had already begun in the earliest Eocene.

As examples of his later publications may be specially mentioned those on the deer, early rodents, and cats. He showed that the deer must have evolved in the Old World, and that their succession in North America resulted from a series of immigrations. He described and discussed a group of Eocene rodents which may have been the primitive stock from which many later groups descended and diverged. He distinguished among the fossils from the Oligocene period onwards two parallel series of Felidæ, one ending in the existing true cats, the other in the sabre-toothed tigers which became extinct just before historic times. These and many other problems in the evolution of mammals Matthew discussed finally, with fullness of knowledge and experience, in a valuable paper entitled "The Evolution of the Mammals in the Eocene", in the *Proceedings* of the Zoological Society of London for 1927.

In a more general way Matthew was also interested in the extinct birds and reptiles. In 1917 he joined Mr. Walter Granger in a valuable description and discussion of the skeleton of a gigantic running bird, *Diatryma*, from the Eocene of Wyoming. With Mr. Barnum Brown he described Megalosaurian Dinosaurs from the Cretaceous of Alberta. He also described part of a skull of the only known horned Pelycosaurian from the Permian of Texas.

While occupied with this detailed research, Matthew meditated on many general questions which confront the geologist and palæontologist, and he summarised his ideas in two most suggestive publications. The first is entitled "Climate and Evolution", in the *Annals of the New York Academy of Sciences*, vol. 24, 1915. The second is a synopsis of lectures in palæontology in the University of California issued in 1928. Our knowledge of the evolution of the land vertebrates of past times is supposed to be scanty because those which inhabited the uplands and forests are scarcely ever represented among fossils. The early mammals are so imperfectly known because they lived in the forest regions of the north– Siberia, Canada, or Alaska—which have not yet been thoroughly explored. Dispersal and evolution are said to be due chiefly to geographical and climatic changes.

Matthew's scientific researches are recorded not only in his own publications, but also in other works of the American Museum, of which he was a most generous and unselfish helper. In later years he co-operated in interpreting the wonderful discoveries of fossil mammals in Mongolia, and in 1926 he himself visited China to further the research in progress there. Nor did he neglect the educational aspect of the Museum's activities. His handbooks on "The Evolution of the Horse", "Mammoths and Mastodons", and "Dinosaurs" are admirable examples of popular exposition.

Matthew's quiet, lovable personality, delightful sense of humour, and unassuming scholarship made him a welcome guest wherever he appeared in his many travels, and he had a multitude of friends. He retained his Canadian nationality to the end, and was elected a fellow of the Royal Society in 1919. A. S. W.

WE regret to announce the following deaths:

Mrs. Anna Botsford Comstock, emeritus professor of nature study at Cornell University, and wife of Prof. J. H. Comstock, emeritus professor of entomology in the same university, on Aug. 23, aged seventy-five years.

Rev. J. G. Hagen, *S.J.*, director of the Vatican Observatory for more than twenty years, on Sept. 5, aged eighty-three years.

Mr. E. M. Holmes, emeritus curator of the Pharmaceutical Society of Great Britain, an authority on materia medica and also on algæ, on Sept. 10, aged eighty-seven years.

Dr. E. Alberta Read, assistant chief of the microanalytical laboratory of the U.S. Bureau of Chemistry, Department of Agriculture, and distinguished for her work on histology, on Sept. 1.

No disaster of post-War years has so deeply touched the minds and hearts of English-speaking peoples as that which overtook the airship *R101* near Beauvais early last Sunday morning. The airship, considered by those responsible for its design, construction, and navigation, as well as by those men of science who have laboured for years to make lighter-than-air vessels proof against the vagaries of the elements which they have to encounter, as the embodiment of safety, within a few hours of its release from its mooring mast at Cardington was reduced to a blackened framework of metal, and most of its crew and all its passengers, including Lord Thomson, Secretary of State for Air; Sir Sefton Brancker, Director of Civil Aviation; the brilliant and intrepid Major G. H. Scott, and Col. V. C. Richmond, responsible for the design of the airship; Mr. M. A. Giblett, of the Meteorological Office, and a familiar figure at British Association meetings, each of whom in his respective sphere was an inspiration to his fellows, have perished with the vessel which was to carry them to Egypt and India in triumph. The vessel itself could have been replaced. The loss of these splendid lives is more than a national calamity: it makes the world poorer. The loss of the airship by itself would, while they lived, have merely spurred them to greater efforts to justify their faith in the future of this type of craft. But it will occasion no surprise if the country as a whole, with this culminating disaster in mind and deprived of the enthusiasm and driving force of these pioneers, will find adequate reasons for refusing to go forward with schemes for further airship construction while the risk to valuable lives is manifestly so great.

Sir Richard Glazebrook, chairman of the Aeronautical Research Committee, in a letter to the *Times* of Oct. 7, pays grateful tribute to the scientific influence and service of several of the men whose loss the nation now deplores. Lord Thomson, he says, has ever been most helpful in the work of the Research Committee: Sir Sefton Brancker's enthusiasm was most infectious, and his interest in problems bearing on civil aviation most stimulating. Col. Richmond was a member of Sir Richard's staff in the Aeronautical Department of the Imperial College some ten years ago, and he was a leading authority on airship construction. Major Scott knew all there was to know about airship navigation, and his experience would have been of great value in the development of airship traffic in the future. Squadron-Leaders Bishop and Rope had both done notable work. During the War, when the rapid gauging of munition parts was of vital importance, Bishop invented improvements in the method which secured greater accuracy and greater speed. Rope is the author of a well-known article on airship lift in the "Dictionary of Applied Physics". Mr. Giblett had devoted himself for some years to meteorological problems bearing on airships, and our knowledge of the motion of the air in gusts and the distribution of 'gustiness' in a wind is largely due to his researches at Cardington. "All these men", adds Sir Richard, "realised in a marked degree that the development of the airship depended on the combination of scientific ability and the experience gained in flight. They gave of their experience freely; they utilised, wisely and wholeheartedly, all we could give them from our stores of mathematical learning and scientific knowledge. And now they are gone; their work will live, and my Committee would wish me, I know, to express their sense of its greatness, their sorrow for our loss."

It is interesting to compare the speeches made by the Prime Minister and other representatives of the British Commonwealth of Nations at the opening session of this Imperial Conference with those made at the corresponding session in 1926. In 1926, the dominant personalities at the Conference were Mr. Baldwin and Mr. Amery, representing Great Britain, and Mr. Bruce, the Prime Minister of Australia, all of whom believe that preferential tariffs are essential for the realisation of Imperial economic unity and prosperity. Nevertheless, the subject of tariffs occupied little of the time of the Conference, other forms of Imperial preference receiving far more consideration, particularly the means by which the various countries of the Empire could most effectively apply their scientific workers and reserves of scientific knowledge to the tasks of developing the vast potential resources of the Empire and combating the diseases afflicting or threatening its peoples, domestic stock, and plant products. As proof of the earnestness of Great Britain in the matter, Mr. Baldwin was able to point to the creation of an Empire Marketing Board with ample funds at its disposal for the furtherance of schemes for marketing Empire products and for the prosecution of research. This approach to the problems confronting the Conference was sufficiently novel and promising to awaken the keen interest of most of the Dominion statesmen present, and encouraged the hope that at future conferences even more time would be given to the consideration of the impacts of science on Imperial affairs.

It is disappointing to find so little indication in the opening speeches that the principal representatives at the present Imperial Conference appreciate the significance of these impacts on our material progress or realise their potentialities as an Imperial consolidating force. Neither Mr. MacDonald nor any of the other Prime Ministers found it necessary to refer to the fact that science has hitherto been applied almost exclusively to solving the urgent and vital problem of production, and that now the governments of the Empire—indeed, all governments—are confronted with a new one, namely, that of re-equipping the machinery of State and reorganising the system of finance so that the peoples of the world can take full advantage of their immensely increased productive capacity, which they owe to the application of science in the production of foodstuffs, essential raw materials, and manufactured goods. It is surprising that Mr. MacDonald did not take advantage of the exceptional opportunity offered him as chairman of this Imperial Conference to open its proceedings with a

survey of the work already done to further Imperial co-operation in various fields. To this he might have added an invitation to the Dominions to co-operate more fully with Great Britain in the task of developing the non-self-governing dependencies of the Crown, a field of work which could provide a magnificent outlet for the energies and initiative of the products of the universities of the Dominions.

FURTHER, Mr. MacDonald might have expressed an opinion on the fruitful suggestion conveyed to him some months ago in a memorandum drawn up by Sir Basil Blackett as the outcome of a series of discussions on Imperial economic co-operation by an authoritative group of politicians, men of science, and financial experts, that an Imperial Economic Body, deriving its authority and its income from the governments of the Empire, should be set up by the Imperial Conference. This body, it was suggested, should have a permanent secretariat similar to that of the Secretariat of the League of Nations, its functions being to deliberate and advise upon all questions affecting the economic and social well-being of the Empire, and to promote efficiency in production and marketing (*a*) by the development of a common service of economic intelligence and investigation and (*b*) by the promotion of co-operation in the application and dissemination of the results of scientific research. This, of course, would involve the new body in the assumption of responsibility for the work of the four existing inter-Imperial bodies, namely, the Imperial Economic Committee (including the Empire Marketing Board), the Imperial Shipping Committee, and the Mechanical Transport Council. The suggestion that there should be such an Imperial Economic Secretariat also has the support of the Empire Economic Union, the research committee of which recently published an illuminating report on the trade relationships and economic position of the various countries of the Empire. Such a permanent secretariat is badly needed. With this continuously working for the furtherance of the ideal of Imperial economic co-operation, and regular yearly meetings of an Imperial Council at which the countries of the Empire were represented, there would be some hope of continuity of policy between successive Imperial conferences.

DR. A. W. HILL, Director of the Royal Botanic Gardens, Kew, in his thoughtful and interesting inaugural sessional address to the students of the School of Pharmacy, delivered on Oct. 1, dealt first with the Doctrine of Signatures which was so widely accepted by herbalists and physicians during the Middle Ages, a doctrine which, while containing much that was fantastic, contributed very materially to the study of plants and the recognition of their medicinal value. According to this ingenious doctrine, every plant bore on some part of it, leaf, stem, seed, etc., some sign or indication of the part of the body diseases of which it would cure, or in its juice a resemblance to one of the four humours, namely, blood, yellow bile, black bile, or phlegm, disorders that it would alleviate: thus the lungwort (*Pulmonaria*), spotted with tubercular scars, was a specific for consumption; the blood-root (*Tormentilla*), which derives its name from the red colour of its roots, was adopted as a cure for the bloody flux; while the bryony, the root of which resembles the foot of a dropsical man, was a remedy for dropsy. Even the great naturalist, John Ray, believed that by the wise dispensation of Providence such species of plants are produced in every country as are good for the diseases prevalent in that country.

DR. HILL wisely recommended the study of the work of early pioneers in botany and medicine, remarking that "we are too apt to think that there is little to be found out by delving into the literature of the past . . . but it is somewhat surprising to find how much the early investigators, herbalists, monks, and others knew of the properties and uses of plants and how much we can learn from their writings". One might add to these very true remarks that much valuable information would doubtless follow from inquiries into the reasons why herbs that had a reputation when the herbs themselves were used lost that reputation when modern preparations were employed. Dr. Hill then proceeded to deal with the importance of studying the physiological varieties of plants and ascertaining in what respects these varieties, though at present botanically indistinguishable, differ in their chemical constituents. The example selected by Dr. Hill was that of *Eucalyptus dives*, the volatile oils of four physiological varieties of which differ enormously in the proportion of piperitone, cineol, and phellandrene which they contain. Mr. Penfold, in remarks quoted by Dr. Hill, says: "I am unacquainted with any evidence which shows the medicinal value of Eucalyptus oils to be due to cineol". "It is only", said Dr. Hill, "by the exercise of the observant faculties and by making deductions therefrom that we are able to make any real contribution to knowledge."

THE Eighth International Congress of the History of Medicine, to which we directed attention in our issue of Aug. 23, p. 292, was held in the Accademia dei Lincei at Rome on Sept. 22-28, under the presidency of Dr. Pietro Capparoni, professor of the history of medicine at Pisa, with Prof. Castiglioni, who occupies the corresponding chair at Padua, and Prof. Bilancioni, of Rome, as vice-presidents. About 230 members were present, from sixteen different countries. The British delegate was Dr. J. D. Rolleston, who also represented the Royal College of Physicians and the Royal Society of Medicine; the Royal College of Surgeons and the University of London were represented by Prof. G. E. Gask; the Society of Apothecaries by Dr. Vincent Dickinson; the University of Manchester by Dr. R. Whitehead; and the Wellcome Medical Historical Museum by Capt. P. J. Johnston-Saint. The most notable figures in the Congress were Prof. Karl Sudhoff, of Leipzig, the doyen of medical historians, and Prof. Georg Sticker, of Würzburg, the leading living writer on the history of epidemiology, who both took an active part in the proceedings.

IN addition to the papers referred to in our previous reference to the International Congress of the History

of Medicine, mention may be made of the following communications: the relations between the Accademia di Cimento and the Royal Society, by Dr. Mosè di Segni; malaria in contemporary poetry from Virgil to Carducci, by Signora Anna Celli, the widow of the eminent malariologist; madder in the history of medicine, by Dr. G. R. Cameron; and the appearance of chlorosis in the sixteenth century, by Dr. Axel Hansen. The receptions included an audience and address by the Pope in the Vatican; visits to the Bibliotheca Casanatense and Bibliotheca Lancisiana, where there was an exhibition of manuscripts, incunabula, and other rare medical works; excursions to Lake Nemi and inspection of Caligula's galley, as well as to Monte Cassino, where a bronze was offered to the monastery in recognition of its services to medical science in the Middle Ages. On his way to and from the meetings, as well as on the rare occasions when he was unable to escape the temptation to play truant, the student of social hygiene could not fail to be impressed by the conspicuous absence of beggars, prostitutes, and drink advertisements in the streets of Rome, which in this respect set an excellent example to those of London, Paris, and other large towns. The next Congress will be held at Bucharest in 1932.

SCOTLAND is soon to possess a Scottish National Trust, which will play in the northern kingdom a part similar to that of the original National Trust, the activities of which are in practice confined to England and Wales; that is to say, it will constitute a body of trustees, governed by a council, to which benefactors may convey lands and properties, and which may from time to time take steps to secure properties in the national interest as funds permit. The Trust will be a registered company, limited by guarantee, with a council or board of control and such other administrative apparatus as its subsequent development may make necessary. Private individuals up to any number may become members of the Trust on payment of an annual subscription of one guinea, to which amount personal liability will be limited. The Trust is to be promoted by the Council of the Association for the Preservation of Rural Scotland, and a provisional council, of which the Duke of Atholl has accepted the presidency, has been formed. The move is a laudable one, but in view of the fact that a Government Committee has been investigating with thoroughness the possibilities of setting aside areas in Great Britain for the people, no harm would have been done had the promoters had the patience to wait for and perhaps benefit by the recommendations and suggestions of that Committee.

DURING the coming winter a course of lectures on "Native Races of the Empire" will be given under the auspices of the Royal Anthropological Institute. The lectures will be popular in character, following in this respect the course given last year on "Early Man". Each lecture will deal with the people of a single area. In addition to giving a general account of the people, the lectures will illustrate the bearing of the study of their culture on the problems of the administration of their affairs under European jurisdiction. The first lecture of the series will be given by Prof. J. L. Myres, president of the Royal Anthropological Institute, on Oct. 15, at 5.30 P.M. He will deal, among other matters, with the general aspect of the relation of anthropological studies to administration, under the title of "Native Races of the Empire: Facts and Problems". The second lecture will be given on Nov. 12, by Mr. A. M. Hocart, on "Spirit Worshippers of the South Seas"; and on Dec. 10, Lord Raglan will lecture on "The Tribes of the Anglo-Egyptian Sudan". Further lectures in the series will be given after Christmas on Jan. 15, Feb. 10, and Mar. 10. Subjects and speakers will be announced later. The lectures will be given in the Portland Hall of the Regent Street Polytechnic Extension, Little Titchfield Street, Great Portland Street, W. Admission will be free.

THE expedition by submarine across the Arctic Sea suggested some time ago by Sir Hubert Wilkins is now taking definite shape. Science Service, of Washington, D.C., announces that an American submarine, withdrawn from the United States navy, has been acquired and named *Nautilus*. It is a small vessel with a submerged displacement of 566 tons. The cruising radius on the surface is 3000 miles, or with emergency fuel, 5500 miles. It is believed that the vessel, stripped of its fighting equipment, will be able to travel at least 175 miles submerged. Lieut.-Commander S. Danenhower will be in command of the *Nautilus*, and Dr. H. U. Sverdrup, who served six years with the Norwegian *Maud* expedition, will be in charge of the scientific work. The course proposed is from Alaska to Spitsbergen. Dr. Sverdrup believes that during July and August the pack will prove to be so open that the submarine will be able to come to the surface every five miles if necessary. On the other hand, it is hoped that the ship will prove capable of breaking through young ice, the position of which can be ascertained by the intensity of the light under water. Some soundings are to be made throughout the voyage, as well as gravity and magnetic observations. Physical observations on the sea water will be taken at different depths.

THE presidential address of Mr. J. G. Lawn on "Periodical Variations in the Prices of Minerals and Metals" delivered in June to the Institution of Mining and Metallurgy, appears in the July issue of the Institution's *Bulletin*. Variations of prices of minerals is a subject which the professional mining engineer frequently overlooks, as to a large extent it lies outside his normal terms of reference. The price of working a mine must be more than balanced by the price received for its products. Fluctuations in working costs can be more or less allowed for by individual operators, and the mining engineer's experience comes into play very largely either in the budget for such allowance or in devising methods of keeping the figures below an economic danger-mark. But prices of products may be governed by national or international circumstances: they soar or are depressed according to conditions, political and otherwise, over which the average

single company has but little control. Thus, beyond an occasional glance at current figures, usually confined to the metals in which he is specially interested, the professional man gives scant attention to the matter.' Mr. Lawn dealt with his subject ably under three heads, the metals as money, the relative prices of metals, and periodical variations in prices of minerals and metals. He showed clearly that knowledge of this economic question is very much the concern of the mining engineer, as its obvious influence on operations at the mines themselves is to-day forced home in practically every undertaking. It is as well in these days of severe industrial depression that we are brought to realise that even an honourable profession may become a fool's paradise if the plain ' bread and butter ' facts of life remain long disregarded.

IN the August issue of the *Aeronautical Journal* appears the full report of a lecture given by Dr. J. W. Maccoll on modern aerodynamics research in Germany. The paper is valuable in that it gives a very comprehensive account of the intensive research in aerodynamics that has been conducted in Germany—especially on the problem of turbulence—during the past few years under the inspiration of Prandtl and Kármán. The earlier parts of the paper treat of the boundary layer theory and its application to laminar and turbulent motion, the experimental and theoretical investigations into the origin of these states, and the analysis of the characteristics and inner mechanism of fully developed turbulence. Workers in the subject will find this paper of great value because of the systematic arrangement and exposition of the enormous amount of work in this field that has been conducted in Germany. Incidentally, the essential empiricism of the present German school is very apparent in the nature of the assumptions that are made at each stage where the mathematical difficulties appear too severe.

THE tenth Annual Report of the Non-Ferrous Metals Research Association and the July number of the *Bulletin* of the Association have recently been issued. We have already referred to the finances of the Association and to the new headquarters, where much of the work will in future be concentrated. The experiments on ternary alloys of lead, which have brought about a marked improvement in cable sheathings for positions subject to vibration, such as on railways, have led to further developments in the making of water pipes and lead roofing. Another product of the research work of the Association is the aluminium brass for condenser tubes, and this material is now undergoing tests on a large scale in practice. The Report contains particulars of many other investigations, some of which have been conducted in central laboratories and others in university and other institutions in close touch with the Association. This policy of co-operation has proved to be of great value in the training of research workers, in addition to its immediate results. The information service, which is on an extensive scale, has already served as a model to other organisations, and such reports as that just issued supply adequate proof of the usefulness of the system of research associations under the scheme of the Department of Scientific and Industrial Research, provided that a competent staff can be secured, as in the present instance.

THE growing number of international organisations, more especially in the electrical field, has led the Institution of Electrical Engineers to appoint an International Relations Committee to discuss the question of the best way to co-ordinate British participation in them. The International Electrotechnical Commission (I.E.C.) is the oldest of these bodies and has done admirable work in its somewhat limited field, its specific purpose being to obtain agreement on standardisation questions. At the recent technical sessions of the I.E.C. held at Stockholm, an informal preliminary discussion on this subject was opened by Mr. P. Good, an English delegate. In comparing the other international bodies with the I.E.C., he pointed out that their primary purpose was the exchange of information and experience and the bringing in personal contact of those engaged in similar work in different countries. Recent experiences have shown that congresses of this kind have already reached the stage of being overburdened with papers which receive little attention, and some of them are not up to the standard of, or suitable for, international discussion. There is great need for co-ordination in the international field in order to avoid overlapping of effort. Mr. Good suggested the possibility of changes being made in some of the existing organisations or the merging together of them into a body which should be representative of the electrotechnical industry as a whole throughout the world. It would have the funds to promote continual international exchange of technical information and when necessary it could call conferences. An organisation of this nature would have to be governed by properly formed national committees, each of which would have the responsibility of seeing that the papers contributed by its members were of a standard which justified international consideration.

THE problem of measuring the temperature of the air is much more difficult than would be supposed by anyone who has not attempted it, because of the necessity for eliminating the influence of radiation, which affects the thermometer very readily but the air only in an indirect way. If any kind of self-registering thermometer is to be used, the Stevenson screen has long been the standard method in Great Britain. In that screen a reasonably free circulation of air is secured by the use of louvres, and direct radiation is at the same time prevented from reaching the thermometers; much stress is always laid on the importance of having the screen painted white. In a paper by Barkat Ali (Scientific Note No. 11 of vol. 2 of the "Scientific Notes" of the Indian Meteorological Department) the results of comparative observations made with three teakwood Stevenson screens, painted black, painted white, and unpainted, are summarised. The observations were made at Agra between May 15, 1925, and Feb. 28, 1926, that is to say, during a period including many days with solar radiation of an intensity never

experienced in the British Isles. The results were surprising. In place of the large differences that might have been expected during the daytime between the black and the white screens, even the mean maximum obtained in them differed only by 0·8° F. By grouping the observations to include only the days of little or no cloud and wind the difference was increased only to 1½°F.; the mean of the maximum and minimum was practically identical for all three screens. The observations appear to imply that in the British Isles white paint is almost unnecessary, but since the wood needs protection against the weather and white paint is not expensive, it is obviously preferable to use it, even though a substance like linseed oil might be more lasting and even cheaper; readings made in dark-tinted screens can, however, be accepted as reasonably accurate where figures from a whitened screen are not available, the more so as there are various other more important sources of error in a large proportion of the climatological statistics accumulated by private and official observers in Great Britain.

THE *Eugenics Review* (vol. 22, No. 2) contains a biographical sketch of Mr. Henry Twitchin, a wealthy benefactor of the Eugenics Society, who died on Mar. 19 last, by Major Leonard Darwin. Mr. Twitchin had given the Society £1000 a year for some years, but his bequest will probably have an annual value of more than £3000. He was born in Berkshire from farmer ancestors, and after a training in agriculture he emigrated to Western Australia as a young man and took up sheep-farming. In 1924 he sold his estates, comprising more than a million acres of pastoral leases, and, after thirty-four years in Australia, returned to England. His interest in sheep-breeding early led him to recognise the importance of the principles of heredity as applied to man. Mr. Twitchin was for many years in correspondence with Major Darwin on the subject of eugenics, and his views are summarised in extracts from some of his letters. From 1912 until the day of his death he showed increasing interest in the aims and work of the Eugenics Society.

IT is announced by Science Service of Washington, D.C., that the National Academy of Sciences has accepted a trust fund of £5000 presented by a group of officials of the American Telephone and Telegraph Company in honour of General John J. Carty, vice-president of the Company, who recently retired from active connexion with the scientific research of that body. The John J. Carty Medal and Award for the Advancement of Science which will be supported by this fund may be "either for specific accomplishment in some field of science or for general service in the advancement of fundamental and applied science". It is to be awarded without regard to race, nationality, or creed. The award has been established as a testimonial to General Carty's "noteworthy contributions to the advancement of fundamental and applied science and in appreciation of his great service for many years in developing the art of electrical communication". General Carty is a past president of the American Institute of Electrical Engineers and is well known for his interest in transcontinental and transoceanic telephony.

REFERRING to his obituary notice of Prof. H. W. Wiley, which appeared in NATURE of Sept. 20, Prof. Henry E. Armstrong writes to inform us that his visit to America, when he first met Wiley, was in the summer of 1897, not in 1903.

A COURSE of lectures on "Contraception and Allied Questions"—the first course on this subject to be given in Great Britain - is being delivered in the lecture hall of the Royal Institute of Public Health, 37 Russell Square, London, W.C.1. The first lecture, on Oct. 9, is by Rev. Dr. A. H. Gray, on "Christian Civilisation and Contraception." The subjects dealt with in the course are of special importance at the present time, particularly in view of the memorandum recently prepared by the Ministry of Health for the guidance of local authorities, and also the fact that the medical schools in Great Britain do not provide courses of instruction on the subjects. The course has been specially planned to meet the needs of medical practitioners and senior medical students, and their admission to the lectures is free.

THE following appointments have been made recently by the Secretary of State for the Colonies: *Colonial Agricultural Services*: Mr. C. A. Thorold, to be assistant mycologist, Kenya; Mr. V. Dawson, to be assistant agricultural instructor, Federated Malay States; Mr. H. D. Leighton, to be agricultural field officer, Federated Malay States; Mr. B. A. Lowe, to be assistant botanist, Federated Malay States; Mr. J. P. Maule, Mr. S. D. Ross, and Mr. J. West, to be superintendents of agriculture, Nigeria; Mr. J. R. Curry and Mr. N. R. Fuggles, to be district agricultural officers, Tanganyika Territory; Mr. H. M. Lloyd, to be entomologist, Tsetse Research, Tanganyika Territory; Mr. H. L. G. Milne, to be agricultural officer, Uganda. *Geological Survey*: Major N. R. Junner, director of Geological Survey, Sierra Leone, to be director of Geological Survey, Gold Coast. *Colonial Forest Services*: Mr. R. C. Barnard, to be assistant conservator of forests, Federated Malay States; Mr. T. F. Betts and Mr. J. H. Mackay, to be assistant conservators of forests, Nigeria; Mr. W. J. Eggeling, to be assistant conservator of forests, Uganda.

THE Board of Control has issued a *Circular* (No. 745) and *Memorandum* on the Mental Treatment Act, 1930, reviewing the provisions of this Act, which comes into operation on Jan. 1, 1931. The Act provides for various alterations in administration and embodies the following principles: (1) The preventive treatment of incipient mental illness by the provision of out-patient clinics and extended facilities for voluntary treatment. (2) A further advance in assimilating the treatment of mental illness to that of other forms of illness, (*a*) by provisions under which certain cases may be temporarily placed under care and treatment without 'certification', and (*b*) by the opportunities afforded of associating the general hospitals (municipal and voluntary) in the treatment of mental illness. (3) Extended provision for after-care and for systematised research into mental illness. (4) Dissociation of the treatment of mental illness from

the poor law. (5) Various important alterations in terminology reflecting the more enlightened view now taken in regard to mental illness.

THE publication of "A Survey of Scottish Coking and Furnace Coals" (Physical and Chemical Survey of National Coal Resources, Paper No. 15. London: H.M.S.O., 4s. net), by T. Gray, T. H. P. Heriot, and W. J. S. Killing, is a reminder of the sort of difficulties, all too common during the War, which might have been avoided by the more scientific study of national raw materials. In 1916, when the need for increasing the supply of steel became urgent, it was found necessary to investigate the supplies of coking and splint coals available in Scotland for the manufacture of pig iron. Prof. T. Gray, of the Royal Technical College, Glasgow, undertook the responsibility for this survey, which has now been published in response to numerous requests. It contains reports on 367 samples from all the Scottish coalfields, and records the suggestion for improving the coke from such coals by increased rate of carbonisation, now generally adopted, by the use of higher temperatures and narrower ovens.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior engineering assistant (Grade G) and an engineering assistant (Grade F) in the Borough Engineer's Department, County Borough of West Ham—The Borough Engineer, Town Hall, West Ham, E.15 (Oct. 20). Two veterinary surgeons, one with bacteriological and pathological knowledge and experience of laboratory technique, and one for meat inspection work, under the New Zealand Government—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 21). A part-time radiologist at the Selly Oak Hospital—The Medical Superintendent, Selly Oak Hospital, Birmingham (Oct. 22). An assistant radiologist at the Dreadnought Hospital, Greenwich—The Secretary, Dreadnought Hospital, Greenwich, S.E. (Oct. 27). A deputy director of the laboratories of the Public Health Department, Cairo, and a first bacteriologist in the laboratories of the Public Health Department, Cairo—The Under-Secretary of State, Department of Public Health, Cairo (Oct. 30). A geneticist in the Agricultural Department of Jamaica for work, partly, on the breeding of bananas immune from the Panama disease—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Oct. 31). A John Harling fellow in physics in the University of Manchester—The Registrar, The University, Manchester (Nov. 1). A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 1). Assistant surveyors in the Admiralty and in the Air Ministry—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Jan. 22). A director of the Natal Museum—The Secretary to the Board of Trustees, Natal Museum, Pietermaritzburg, South Africa (Jan. 31). An assistant in the Pathological Laboratory of the Cancer Research Department, Bristol Royal Infirmary—The Secretary and House Governor, Royal Infirmary, Bristol.

Our Astronomical Column.

New Comet or Asteroid?—U.A.I. Circ. No. 299 announces that M. E. Delporte has detected an interesting object (either planet or comet) on a plate taken at Uccle Observatory in the following position:

U.T. 1930.	R.A., 1925·0.	S. Decl. 1925·0.	Mag.
Sept. $29^d\ 0^h\ 7^m\ 6^s$	$23^h\ 41{\cdot}8^m$	$2°\ 30{\cdot}4'$	12·0

The daily motion is $-1^m\ 43^s$, N. 11′ 56″. This is unusually large for a minor planet, so if the object is a planet it has probably an interesting orbit not very far outside that of the earth. The object is well placed for observation, being not far from opposition.

Occultations at the Union Observatory, Johannesburg.—In recent years there has been a remarkable awakening to the value of occultations of stars by the moon for finding the errors of the lunar tables. One great advantage is that the points on the moon's limb are much more widely distributed than in the case of meridian observations; in the latter an elevated or depressed region on the limb may affect observations systematically. Dr. Innes was one of the first to inspire the new campaign, and the work has been energetically carried on at Johannesburg since his retirement. *Circ.* No. 32 of the Observatory (May 19, 1930) contains the observations and reductions (by W. M. Worssell) of 152 occultations observed in 1929; of these, 126 were observed between new and full moon, the remainder after full. The method of reduction suggested by Prof. Brown was to apply a constant mean correction to the moon's mean longitude, this being determined each year by the results of preceding years; the smallness of the residuals after applying this correction gives striking evidence of the excellence both of the observations and of Brown's lunar tables, once the mean error has been taken out. At Johannesburg, Brown's method is varied slightly; instead of applying a constant to the moon's mean longitude, one is applied to the times used for interpolating the moon's co-ordinates. Thus 12·7 sec. was added to the times for the first half of 1929 and 10·9 sec. for the second half. This has the advantage of correcting all three co-ordinates, longitude, latitude, and parallax, by a single operation.

Observations of Meteors in Japan.—*Bulletins* No. 173 and 174 of the Kwasan Observatory, Kyoto, announce that numerous meteors, presumably associated with comet 1930*d* (Schwassmann-Wachmann) were observed, chiefly by Mr. Nakamura, on ten nights extending from May 24 to June 19. The radiant moved during this period from R.A. $15^h\ 19^m$, N. Decl. 43° to R.A. $16^h\ 19^m$, N. Decl. 39°. Parabolic orbits were deduced for the meteors; the node varied with the longitude of the earth, but the inclination was nearly constant, about 27°, the argument of perihelion about 201°, and the perihelion distance close to unity. The cometary perihelion was a few millions of miles outside the earth's orbit, so the meteors are considerably scattered.

The same *Bulletins* announce that Prof. Issei Yamamoto is preparing a general catalogue of comets, which he hopes to publish next year. It will contain all comets for which orbits have been computed, and notes upon those for which the data are insufficient to deduce orbits.

Research Items.

The Pyramids.—In *Ancient Egypt* for June, Sir Flinders Petrie discusses the constructional difficulties in building the pyramids and offers some suggestions as to the means adopted by the ancient Egyptians in overcoming them. Their construction involved earth banking on an enormous scale and the employment of levies of thousands of men moving quickly by main force. The lever and roller were practically the only appliances used. The Great Pyramid shows no trace of enlargement and the passage system demands almost the full size from the first. The earth ramp needed for its construction must have been of great size, almost of the volume of the pyramid itself; otherwise the final slope would have been too steep, while a full front was necessary to get up the 50,000 blocks required for each of the lower courses; also, to maintain the sides of an earth bank to the height of 400 feet would entail a base as wide. The bank was heightened as the work proceeded by waves of stone-work and earth-work alternatively moving up the bank. The height of the ramp is a difficult question. It cannot have been carried to the full height of the pyramid. Probably earth bank and brick facing rose to not more than 300 feet. At this level the face would be 150 feet wide. Above this the raising must have depended on a support of stone in the form of a stone ramp with a platform zig-zagging up the side. A platform and ramp of 20 feet each would suffice for getting up the stone for the upper courses. It would scarcely be practicable to carry a regular ramp higher than 12 feet below the capstone. The last six or eight courses would be raised by direct levering in a safety pit. Lastly, the capstone itself would be levered up on stone blocking outside the completed faces, on a sort of pedestal of blocks, until it reached its proper level. From a platform thus outside the pyramid face it would be slid forward on rollers until finally in place. The staging of stone would then be taken off and the top courses trimmed down to the slope, about four feet at a time.

Pedigrees of Hereditary Disease.—In a paper entitled "Some Pedigrees of Hereditary Disease" (*Annals of Eugenics*, April 1930), Dr. Julia Bell makes a contribution to the records of polydactylism and syndactylism, and the association of blue sclerotics with fragility of bone. Among eight families the pedigrees show the transmission of the former defects through several generations. The data are not considered sufficient to permit any conclusion being drawn as to the sex incidence, but it is clear that such digital anomalies varied greatly in the intensity and mode of their inheritance, while a considerable number of cases investigated yielded no evidence of any familial incidence. Dr. Bell refers to the fact that while the association of polydactylism with retinitis pigmentosa and hypopituitarism is rare, this syndrome is found in all affected members of the family when the association does occur, and that the parents have no reason to suspect the existence in themselves of any hereditary taint. In the case of blue sclerotics, Dr. Bell points out that the highest incidence is to be found in females, which is an uncommon observation in the transmission of hereditary defects. The thin condition of the sclerotic which is the actual cause of the characteristic colour may occur without any associated anomaly of bone, but if fragilitas ossium is exhibited by any member of a family, that individual will invariably show the accompanying anomaly in the eye.

Salt-loving Beetles of the North.—Dr. Hans v. Lengerken has described the maritime and sub-maritime beetles of the shores of the North Sea and Baltic ("Die Tierwelt der Nord- und Ostsee". Begrundet von G. Grimpe und E. Wagler. Lieferung xvi. Teil xi.el: "Halophile und Halobionte Coleoptera". Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929). His large work recently published, "Die Salzkäfer der Nord- und Ostseeküste", shows Dr. Lengerken to be the principal authority on the subject and chiefly owing to his work the beetles of these coasts are thoroughly known. A surprising number love the salty districts, and, although not usually actually living in the sea, for the whole of their life they may be, and in many cases must be, in the proximity of salt water. Only one truly marine species is to be found in these regions, and this is *Haemonia* (*Macroplea*) *mutica* F. (Chrysomel.); the remainder live on the coasts and are either dependent on the presence of salt water in the near neighbourhood, 'halobionte', or live both in salty and un-salty districts, 'halophile'. Taking both together, there are 111 species recorded from the shores of the North Sea and Baltic. Most of these are predatory in their habits. After a short introduction, a table of distribution is given and the systematic portion follows in which the genera are diagnosed and the species recorded, with notes on their habitat and sometimes on their habits and life-histories. There are only nine figures in all, which is to be regretted, as those given are very good.

Fishes from the *Albatross* Expedition.—Mr. Henry W. Fowler and Mr. Barton A. Bean have finished a third instalment of the report on the fishes collected by the United States Bureau of Fisheries steamer *Albatross* entitled "The Fishes of the Families Amiidæ, Chaudidæ, Dulcidæ, and Serranidæ, obtained by the United States Bureau of Fisheries Steamer *Albatross* in 1907 to 1910, chiefly in the Philippine Islands and Adjacent Seas" (Contributions to the Biology of the Philippine Archipelago and adjacent regions. Smithsonian Institution. *U.S. National Mus. Bull.* 100, Vol. 10. 1930). This is the first report on the percoid fishes, limited to the more typical perchlike families, particularly the Amiidæ and Serranidæ, which are much the most numerous both in species and individuals. It has been known for some time that in certain species of the Amiidæ the males carry the eggs in their mouths. The authors now show that this condition is more or less general. The male at the breeding season can be recognised easily by its swollen chin, the eggs being carried about packed in a dense mass. Interesting illustrations are given of the heads of some of these males carrying eggs. There are also good figures of some of the more important variations in fishes belonging to the other families described. The report deals with more than 150 species and occupies 334 pages.

Production of Hybrid Apples.—In his public lecture delivered during the British Association meeting at Bristol on Sept. 4, Sir Daniel Hall essayed, with considerable success, the difficult task of making some of the interesting genetic work of the John Innes Horticultural Research Institute intelligible to the 'man in the street'. Cultivated strains of apples, unlike many kinds of orchard fruit, are relatively self-fertile within the strain, but he showed that the proportion of fruit set per blossom, and, still more, the number of fertile seeds per fruit, is markedly lower in such well-known varieties as Ribston Pippin, Blenheim Orange, and Bramley Seedling. In these varieties, less than 30 per cent of the pollen is viable and they are particularly deficient as male parents. These varieties of

apples have now been shown to be triploid varieties with 51 chromosomes, instead of the 34, with 17 in each sex cell, characteristic of the majority of the apples. With this discovery the puzzle is rather the relatively large amount of fertile seed obtained from crosses using the sex cells of these varieties. The work of Dr. C. D. Darlington and Mr. Moffat seems to have shown a reason for this; whilst 17 chromosomes is the basic number for the genus *Malus*, as for all the genera of the Pomoideæ, in many of the Rosaceæ the basic number is 7. The relative fertility of these strains with 51 chromosomes may be explained by the fact that this basic number 7 is probably built into the genetic constitution of the apple, so that on segregation of the chromosomes, in the formation of the sex cells, whilst it is unlikely that two working sets of 17 would be separated from 51, there is the possibility of working combinations of sevens with some additional chromosomes that can be carried without disorganisation of the machinery of inheritance. In the circumstances, then, it is possible that the history of the Cox's Orange Pippin is correctly recorded; it is stated to be derived from the Ribston Pippin, but it is intelligible that successful new strains from these well-known varieties have usually been sought in vain.

Wheat-Rye Hybrids. Meister succeeded several years ago in obtaining fertile hybrids between wheat ($2n=42$ chromosomes) and rye ($2n=14$). More recently Levitsky and Benetzkaia (*Proc. U.S.S.R. Congress in Genetics, Leningrad*, vol. 2, p. 345) have examined a number of these plants in the F_4, F_5, and F_6 generations and find the somatic number of chromosomes to be 56: that is, the hybrids are amphidiploid, their chromosome number being the sum of the somatic numbers in the parent species. In the megaspore formation of the F_1 plants, it was observed that the 28 chromosomes do not pair but split, from which it is inferred that eggs with 56 chromosomes are formed and develop without fertilisation. The F_1 hybrids have always been observed to produce sterile pollen. In the later (octoploid) hybrids the pollen meiosis is frequently normal, but also shows frequent lagging and scattered chromosomes. Since the later hybrids examined all had 56 chromosomes, it is believed that gametes with extra chromosomes either fail to function or else lose them in the pollen tube formation. This doubling of the chromosomes in a sterile hybrid to produce a fertile form which breeds true is thus similar in essentials to the *Triticum-Ægilops* hybrid, *Primula kewensis*, *Nicotiana glutinosa* × *N. Tabacum* and other recent cases. Such instances offer a suggestion as to how certain genera of plants with increased chromosome number may have arisen in the past.

Ice in the North Atlantic.—The report for 1929 of the International Ice Observation Patrol Service in the North Atlantic Ocean (*U.S. Coastguard Bulletin*, No. 18) contains much interesting matter besides the record of the courses of the patrol boats and the distribution of ice. Perhaps the most significant result of several years' work is the admission that, so far at least, no satisfactory basis for the prediction of ice has been found in surface isotherms. The charts are regularly made, but they cannot be accepted as wholly reliable guides. The cold water from the melting berg appears at times to fall below warmer and lighter surface layers and thus the surface isotherms may be misleading. The problem is, however, being further studied in the hope of reaching more satisfactory results. The construction of dynamic current maps promises to be more useful, but takes more time. It is further noted that no practical way of destroying ice has yet been found. Mechanical means like blasting and mining give little likelihood of success, but it is noted that the use of thermite is rather more hopeful, were it not for the grave difficulties of placing the charge in the heart of the bergs.

Forbidden Transitions in Alkali Spectra.—Lines forbidden by the selection rule for azimuthal quantum numbers ($\Delta k = \pm 1$) have been observed in the absorption spectra of alkali metals under conditions which apparently preclude the usual explanation of this effect as due to the presence of external or ionic fields. Since it is now also recognised that the selection rule represents only approximately the content of the quantum theory of a transition, it is natural to connect these two facts, and to find from a stricter theoretical treatment of the problem the intensity to be expected for a 'forbidden' line. An analysis appropriate to the alkali metals has been developed by A. F. Stevenson in a paper in the August issue of the *Proceedings of the Royal Society*, on quadripole radiation, and by the application of the wave mechanical descriptions of these atoms which have been obtained by Hartree's method, numerical values have been calculated in a number of cases for the theoretical ratios of certain forbidden lines and normal lines. The ratio for all four alkali metals in the case of the $1S-3D$ and $1S-2P$ lines should be about 2×10^{-6}, whereas the experimental numbers, which are available only for potassium and rubidium, range from about one-half to one hundred times this, which is taken to represent a fairly satisfactory agreement in the circumstances. Other experimental evidence for the existence of quadripole radiation has also been found recently by R. Frerichs and J. S. Campbell, from the study of the transverse Zeeman effect for the auroral green line of oxygen (*Physical Review*, vol. 36, p. 152).

Restoration of Ancient Bronzes. The pamphlet with this title, published as *Museum Technique Series* No. 3 (Chicago, 1930) by the Field Museum of Natural History, contains an account by H. W. Nichols of the electrolytic process of restoration and the cure of malignant patina. The electrolytic process was devised by Prof. C. G. Fink at Columbia University. Very detailed directions are given and the pamphlet is illustrated with diagrams of apparatus and with plates showing objects before and after treatment.

The Acetylene Molecule.—The absorption spectrum of acetylene contains a number of bands arising from combined vibration and rotation of the molecule, which are in the neighbourhood of 8000 A. and so accessible to infra-red photography. Two investigations of these, which lead to a fairly complete description of the molecule, are reported in the issue of the *Zeitschrift für Physik* for Aug. 20. The first, by Prof. Mecke and K. Hedfeld, deals with the structure of the bands, and shows that the arrangement of the atoms in the molecule is linear and that if the normal separation of the atoms in the C-H group is 1·08 A., as in methane, that of the two carbon nuclei ($C\equiv C$) is 1·19 A. The distance between the carbon atoms is less than in diamond (1·54 A.) and in the diatomic carbon molecule responsible for the Swan bands (1·31 A.). The second paper, by Prof. Mecke and Dr. Childs, gives the results of a photometric analysis of the band at 7887 A. The course of the intensity changes through an absorption band furnishes considerable additional information about the structure of a molecule, and in this case is consistent with the conclusions that the electronic state concerned is that denoted by the symbol $^1\Sigma$, and that the nuclei of the carbon atoms are without spin, whilst those of the hydrogen atoms have a spin of magnitude $\frac{1}{2}$ in quantum units.

Folk and Open-air Museums.*

THOUGH the expression 'folk museum' is loosely used, it is generally understood, like 'folk-lore', to relate to the ordinary people, the rank and file of the population, the labourers, the artisans, the craftsmen, as opposed to the ruling class. Such collections of indigenous products have great historical value. They deserve to be regarded as almost the only means of preserving visible records of the national characteristics. The humbler the art or the handicraft, the more important it is from this point of view.

In England it is only recently that the regrettable disappearance of the outward and visible signs of the inner history of the people has been fully realised, and consequently it is only recently, and owing to the very rapid growth of local museums, that systematic attempts have been made and are being made to preserve them. The example for this systematic effort was set in Sweden by Dr. Arthur Hazelius, the founder of the Nordiska Museum, which is now one of the glories of Stockholm. This great scheme has been an inspiration for all subsequent attempts to illustrate fully the life of past ages.

It is important, however, to make a clear distinction between two quite different things, although they are adjacent and form part of one scheme in Stockholm. The first is the 'open-air museum' of the Skansen type, in which are re-erected the primitive dwellings, huts, cottages, workshops, windmills, bakehouses, ancient churches, and so on, that would otherwise have been destroyed or converted to other uses; and in these are generally placed the furniture, the appliances, and the decorations that belong to them. The second is the 'folk museum', which contains materials illustrating bygone life and thought at different periods or in different districts of the country; but these materials are not placed in their proper setting, they are brought together and exhibited according to purpose or material, and generally displayed in museum cases in such a sequence as either to compare the customs and handicrafts of one district with those of another, or to illustrate the development of an art or an industry. The open-air museum and the folk museum supplement each other.

There is, in addition, another sort of collection often included under the name 'folk museum', namely, the old house preserved in its original form and in its original place, and containing a display of contemporary furniture and household equipment. There is yet another type of dwelling, namely, the old house or cottage preserved in its primitive simplicity so as to present the appearance of an inhabited dwelling without anything of the museum about it; such is Ann Hathaway's Cottage. It is of such buildings that an 'open-air museum' partly consists.

Let us then confine the term 'open-air museum', for lack of a better, to the Skansen type, 'folk museum' to the Nordiska type, and let us further distinguish between the 'period museum', an old house filled with contemporary exhibits, and the 'period house' or 'period cottage', which has no museum exhibits but reproduces domestic life.

Finally there is the 'period room', either an original transported from a house which has been destroyed, or a facsimile, in which an attempt is made to reproduce the conditions of life, whether in a mansion or in a cottage. Such rooms generally constitute a separate exhibit in a museum.

* Abridged from a paper contributed by Sir Henry Miers, F.R.S., to a discussion on "A Proposed National Folk Museum", in Section H of the British Association at Bristol on Sept. 4.

STATE OF AFFAIRS IN THE BRITISH ISLES.

1. *Open-air Museums.*—In 1912 an attempt was made by a group of influential persons to press the advantages of the Crystal Palace grounds as an ideal site for such an open-air exhibit of a national character. Possibilities for local exhibits of this type have been considered, but nothing has materialised.

Recently the Report of the Royal Commission on National Museums and Galleries has considered the subject from the national aspect and has definitely recommended that a national open-air museum should be established in London; two appropriate sites mentioned are the Botanic Gardens in Regent's Park and the grounds of Chiswick House.

The question has since been taken up by a joint committee initiated by the Royal Anthropological Institute and containing representatives of the Royal Society, the Royal Society of Arts, the Museums Association, and the British Association. This committee has unanimously recommended the Botanic Gardens site as the most suitable, and has approached the Government departments concerned, urging that early action should be taken.

2. *Folk Museums.* Institutions wholly devoted to this subject, like the Nordiska Museum, are also unknown in the British Isles. The fine collection of peasant arts made by the late Master of the Charterhouse is now an annexe to the Educational Museum at Haslemere and is mainly concerned with northern Europe.

3. *Period Museums.*- Of these we have a considerable number, but comparatively few of them relate to the life of humbler folk. I may instance the Priest House at West Hoathly, the Ancient House at Thetford, the Greenland Fishery at King's Lynn, as typical examples.

4. *Period Cottages.* As a good example may be mentioned Ann Hathaway's Cottage, but very few cottage-dwellings have been preserved free from the museum taint: most of them contain showcases.

5. *Period Rooms.*—Most of these again, as at Norwich and elsewhere, are typical of the life of wealthy and cultured folk. In the National Museum at Cardiff, in the Museums at Salisbury, St. Albans, and perhaps elsewhere, attempts have been made to reconstruct a kitchen or some living-room with its appropriate furniture and utensils.

6. *Folk (Museum) Exhibits.*—Of these there are abundant examples, rich in valuable material gathered together either as local 'bygones' or placed among ethnographical collections. Conspicuous are the Pitt-Rivers Museums at Farnham and Oxford, the collections at Huddersfield and at Hull, and many of the national and larger provincial museums, including also such local collections as those at Bedford, Luton, Newark, Bolton (Hall-i'-th'-Wood), Worthing, Lancaster.

Finally, some illustrations of the life of craftsmen may be gleaned from museums which illustrate special pursuits or handicrafts; such are, however, extremely rare in Great Britain, and almost the only one which aims at something like completeness is the Museum of Fisheries and Shipping at Hull.

From this short survey it is clear that there is a vast amount of material from which the life, arts, industries, and customs of the people might be illustrated, but it is buried in other collections. It is equally clear that the real need in Great Britain is for an English or British folk museum associated with an open-air museum.

STATE OF AFFAIRS IN FOREIGN COUNTRIES.

1. *Open-air Museums.*

Sweden.—There are museums of the Skansen type in Sweden not only at Stockholm but also in many other parts of the country. There are no less than 200 open-air collections in Sweden alone. Skansen itself contains 117 separate buildings, records 700,000 visitors in a year, and occupies 60 acres.

Sweden also possesses a number of quite small village enterprises, where a field or small group of cottages have been set aside for this purpose. One of these at Bunge, started in 1907, has since become an open-air museum of considerable importance. A special feature of this museum is the ancient burial-ground, showing various methods of burial and types of burial-stones dating from the time of the Vikings.

Norway.—There is at Oslo the Norsk Museum, which was opened in 1902 and now covers an area of 35 acres, upon which are re-erected old farm-houses of different periods, and an attempt is made to re-create old streets with houses that have disappeared or are fast disappearing. At Lillehammer there is the Sandvig Collection, which contains 75 ancient buildings.

Denmark.—At Aarhus there is Den Gamle By (The Old Town), which was started about sixteen years ago by the re-erection of a Burgomaster's house and has since grown to a considerable size.

Finland.—At Helsingfors, in the Isle of Folesön, there is a large museum, covering an area of 25 acres, which was founded in 1909; this consists of more than thirty buildings of various types and periods.

Holland.—The Nederlandsch Openluchtmuseum at Arnhem consists of 20 buildings, covering an area of 75 acres; this was opened in 1918.

Rumania.—At Cluj an excellent example of an open-air museum is being formed with the object of exhibiting the typical peasant culture of the Rumanians and other nationalities in Rumania, by means of their characteristic peasant buildings and occupations. The collections will consist of typical houses brought from each district, and in each of these houses a family from the same district will live to show the type, costume, typical customs, and occupations. In addition to the typical original buildings, it is intended to erect an open-air theatre for the purpose of peasant festivals, and so on.

2. *Folk Museums.*—Museums of this type similar to the Nordiska Museum at Stockholm, though many of them are on a small scale, exist in many other places. Examples are the Museum at Karlskrona in Blekinge, Sweden, and the Engadine Museum at St. Moritz.

CONCLUSION.

It will be seen from this how late we are in any systematic endeavour to preserve and accumulate such illustrations of peasant and artisan life in Great Britain. The folk museum should undoubtedly, where possible, be associated with and supplementary to the open-air museum. It is deplorable that so many old buildings and other survivals from past times have been irrevocably lost in recent years. But the national conscience is obviously awakening to the value of such things, and determined efforts are now being made in many quarters not only to preserve the amenities of the countryside but also to conserve the old houses and cottages which are in danger of destruction. But in too many instances the advance of town building and the alteration of the countryside threaten the actual existence of many a cottage, wind-mill, forge, or other relic of the past which might be saved and re-erected in an open-air museum. Here again, where these can be retained in their own district, that should be done, and for this purpose it is to be hoped that many localities will follow the Swedish example and preserve and maintain such structures in a local enclosure. The institution of a national enclosure should not in the least interfere with such local efforts, but should serve as an example and inspiration to towns and villages all over the country.

The International Union of Geodesy and Geophysics.

THE fourth meeting of the International Union of Geodesy and Geophysics was held at Stockholm on Aug. 15-23, though the Section of Geodesy found it necessary to begin three days earlier in order to get through a long programme of work. The meeting was very well attended, representatives of thirty countries being present and numbering more than two hundred. A number of other scientific men attended by invitation, among whom were Dr. Linke, of the Geophysical Institute at Frankfurt; Dr. E. Kohlschülter, of the Geodetic Institute at Potsdam; Dr. R. Schreiter, of Freiburg; and Dr. V. Conrad and Dr. Hopfner, of Vienna.

The opening meeting was held on Friday, Aug. 15, in the Concert Hall, where Dr. E. Trygger, the Chancellor of the Universities and chairman of the Swedish National Committee, welcomed the delegates. M. Ch. Lallemand, the president of the Union, replied and expressed the thanks of the delegates for the excellent arrangements which had been made for their comfort. The other meetings of the Union, as well as those of the Sections, were held in the Parliament House, where ample accommodation was available for all.

In the Section of Geodesy, reports were presented by the delegates of the various countries on the progress made in geodetic work since the last meeting of the Union in Prague in 1927, and a number of special points were discussed. These will be published in the *Bulletin* and the *Memoirs* of the Section in due course. Much interest was taken in the account which Dr. Vening Meinesz gave of his recent determinations of gravity at sea, made from a submarine in the neighbourhood of Java, in the Pacific Ocean, and elsewhere. A very interesting discussion took place, and a strong recommendation that work of this character should be undertaken in the Bay of Bengal and other eastern waters was approved, and was later adopted by the General Assembly of the Union.

The death of Prof. H. H. Turner, who was taken ill as he was about to deliver his address as president of the Section of Seismology, cast a gloom over its meetings, but nevertheless a large amount of useful work was done. This Section, as well as that of Geodesy, both of which have to discuss and publish a large collection of data that would not otherwise be readily available to international workers, find their resources far from adequate, and Prof. Turner's address brought the urgent needs of the Section in this respect before the delegates. The work which is being done at Oxford, as well as that under Prof. E. Rothé at Strasbourg, is in need of a fuller measure of support, and resolutions to this effect were adopted by the Section. No successor to Prof. Turner was appointed, but the vice-president, Prof. E. Oddone, was authorised to act as president for the time being.

Owing to illness, Dr. L. A. Bauer, the president of the Section of Terrestrial Magnetism and Electricity, was not present at Stockholm, but his place was taken during the meeting by the vice-president, Prof. Carlheim-Gyllenskold. Dr. J. A. Fleming, of the Department of Terrestrial Magnetism, Washington, was elected president of the Section for the coming period. An interesting series of communications were presented to the Section, in one of which the magnetic work of the international stations during the Polar Year was discussed. It was decided to publish an auroral atlas as soon as the material could be selected and brought together.

The Section of Meteorology had before it a large amount of scientific work in the form of reports and communications. The plans for the work to be undertaken during the Polar Year at the international stations were discussed. This proposal, under which a number of countries have agreed to maintain for twelve months a chain of observing stations in the neighbourhood of the Arctic Circle, and also in south polar regions, was warmly supported as being certain to provide a mass of information of the greatest value and practical importance to meteorology. Dr. Axel Wallen, director of the Meteorological and Hydrographical Service of Sweden, was elected president of the Section in succession to Sir Napier Shaw.

In the Section of Oceanography, Prof. M. Knudsen was elected president in place of Prof. Odon de Buén, who has retired.

In addition to the scientific subjects which were discussed at the meeting of the various sections, the General Assembly of the Union had before it on this occasion the revision of its statutes. These were adoped eleven years ago at Brussels, when the International Research Council and four of the Unions related to it were formed. It was then resolved that the statutes there approved should come up for revision after twelve years, when experience would have shown what modification of them was desirable. At its last meeting, in 1928, the General Assembly of the International Research Council appointed a committee to consider what modifications should be introduced into its statutes, and the draft statutes which the committee prepared were adopted in July last by the Executive Committee of the Council and recommended to the General Assembly for approval at its meeting in July 1931.

The alterations which have been proposed are in the direction of giving as much freedom as possible to the Unions to arrange their own affairs, since these bodies have grown to be active organisations for scientific co-operation. This will necessitate corresponding changes in the statutes of the different Unions, and the consideration of these at Stockholm occupied the greater part of two days. The procedure for the admission of new members was laid down, and greater freedom was given to the Sections dealing with Geodesy, Seismology, Meteorology, Terrestrial Magnetism, Oceanography, Volcanology, and Hydrology to arrange their activities. It was also agreed that they should in future be termed International Associations. An important decision was that the president of the Union should not in future hold office for a longer period than from one meeting of the General Assembly to the next, and that he should not be immediately eligible for re-election. This should assist in maintaining the international character of the organisation. It may be remarked that the same rule is already operative in six out of the seven other International Unions.

Very ample arrangements were made at Stockholm whereby the delegates might visit all the technical institutions in the city which were related to the work of the Conference, and special visits were made to the offices of the Geodetic Institute, the Observatory, the Geological Survey, the Meteorological and Hydrographical Service, and others, as well as an exhibition of instruments, etc., at the house of the Mining Corporation.

Besides the work done in the sessions of the various committees, much valuable information is interchanged by delegates at the social gatherings which take place at other times, and Swedish hospitality provided a number of occasions at which the guests could discuss matters of common interest. The City Council gave a banquet in the magnificent City Hall early in the week, and the Organising Committee invited the delegates to a luncheon so that they might make the acquaintance of each other before the work of the Conference commenced, and also to a dinner, which brought the social part of the proceedings to a close. The delegates were received at the Royal Palace by H.H. the Crown Prince and the Crown Princess in the afternoon of one of the days, and on one evening a gala performance of "Aida" was given at the Opera House. One whole day was devoted to a visit to the City and the University of Uppsala.

Those delegates who were able to remain in Sweden after the meeting at Stockholm was over were able to choose between an excursion through southern Sweden and another in the northern districts of the country. The latter was of special interest for the mining and geological information which it provided. The director of the Geological Survey took charge of it and those who were able to take part enjoyed exceptional opportunities for gaining first hand knowledge of the active development which is taking place in this part of the country.

The next meeting of the International Association of Geodesy and Geophysics will be held at Lisbon in the early autumn of 1933.

The Association of Special Libraries and Information Bureaux.

IN September 1927, at Hoddesden, a conference was held of scientific and business men in many departments of human activity, to discuss the problem connected with the collection, treatment, and dissemination of information. They had no intention of forming a permanent association, but the pressing need for the examination of these problems forced the conference to organise itself. The objects of the Association so formed are: To examine, foster, and co-ordinate the activities of research organisations, special libraries, information bureaux, and similar sources; to act as a directing agency to these sources; to develop the usefulness and efficiency of special libraries; to promote, whether by conferences, meetings, or other means, the wider dissemination and the systematic collection and use of information; and to encourage, by co-operative means, the prevention of waste due to the unnecessary duplication of the work of those engaged in research and allied results. The Association has compiled a very valuable Directory of Sources of Information, and set up an Inquiry Bureau and a Panel of Translators, expert in subject as well as language.

Recently, as the result of long consideration, the Association has decided, in the interest of the more efficient indexing of literature, to become the advocate of a particular classification scheme in order to secure uniformity of method. The special committee appointed to consider the matter came to the unanimous conclusion that the Association should adopt

the Universal Decimal Classification; and, as the result of this decision, a Joint Committee with the British Society for International Bibliography has been set up."

The annual conference of the Association of Special Libraries and Information Bureaux has already become an institution to which members look forward with pleasure as a means of discussing their problems with others having the same or different points of view. It is almost impossible for anyone interested in the collection, supply, or use of information to attend one of these meetings without taking away some new idea, or making some personal contact of value.

The seventh conference, on Sept. 19-21 last, at New College, Oxford, was not less interesting or helpful. In his presidential address, Mr. H. T. Tizard referred to the multiplication of books and the need to develop methods by which people can get access to the information they contain. He quoted Dr. Johnson's dictum that "It is indeed culpable to load libraries with superfluous books", but pointed out that the difficulty is to decide which are superfluous. Readers of the *Journal of the Chemical Society* might agree off-hand that nine tenths of its contents were superfluous, but the digest of the opinions of each fellow, asked separately what tenth he would like to keep, would probably endorse the wisdom of the Publication Committee in retaining the whole. We must make up our minds that the volume of recorded knowledge will continue to swell at an ever-increasing rate, and address ourselves more eagerly than we have in the past to making better use of it. There may be nine-and-twenty right ways of indexing. But the world does not really want more than one general system, and it is high time that there was international agreement on the subject.

Among the many interesting papers communicated must be mentioned two papers by Sir Henry Lyons on "The Display of Scientific and Technical Objects", and by Dr. F. A. Bather on "The Dissemination of Information by Exhibition and Display". Sir Henry Lyons showed how it is possible to convey a great deal of information to the visitor on a short visit by the arrangement of specimens and models to indicate the development of the idea being illustrated, and by paying attention to his physical comfort. This latter aspect was also emphasised by Dr. Bather. Dr. Prinzhorn contributed a paper on the present problem of the movement in Germany for the standardising of the forms of books and periodicals and of library methods, with reference to its wider interest and international importance. In another communication, Dr. A. Schlomann explained the organisation of the German information service on technical literature.

In view of the recent decision to recommend the Universal Decimal Classification and the subject of the presidential address, problems of classification formed one of the main themes of the meeting. In this respect a paper on "The Inadequacy of the Alphabetical Subject Index", by Prof. A. F. C. Pollard and Dr. S. C. Bradford, provoked considerable discussion. The authors showed that no existing index deals with the whole literature of any one subject or generally covers even a large percentage of the total references required by a specialist. Some remarkable examples were given, which were chosen quite at random. In consequence of this incompleteness, searchers must consult as many indexes as possible. But, as they are nearly all different, each separate system must be studied, thus wasting time and patience. Of the multifarious systems in use, those of the alphabetical class are particularly bad. The difficulties inherent in the alphabetical system of subject indexing are due to the fact that the notions to be indexed may be described in each language by a variety of different combinations of different words, any one of which may be selected for an index entry, and the alphabetical order of no series of selected combinations has any direct connexion with the relationship to one another of the notions expressed. The adoption of the principle of alphabetical arrangement amounts to the rejection of that of classification. But as related subjects are scattered throughout an alphabetical index, cross-references must be added in order to direct the searcher to other headings under which related information may be found. Consequently, most alphabetical indexes are based on an unseen classification, comprising a series of selected subject headings combined with a system of cross-references. When, however, the magnitude of a comprehensive classification of knowledge is realised, it is inconceivable that an adequate concealed classification, weighted with the overwhelming mass of necessary cross-references, could be used as the basis of an alphabetical index.

Prof. Pollard and Dr. Bradford pointed out that in the alphabetical subject-index:

1. References to related subjects must be scattered throughout the whole repertory.

1.1. There is no method of co-ordinating related references within the subject except by a complicated labyrinth of cross-references, which is difficult or impossible to elaborate with completeness, and is time-wasting for the searcher.

2. There is the danger of dissociating references to essentially the same subject by the use of synonyms.

2.1. This danger can be reduced by employing a concealed classification together with a second elaborate system of cross-references, that is, from synonyms. But as the unseen classification is inflexible and necessarily incomplete, the indexer is forced to employ terms, usually taken from the authors' titles, which do not belong to the considered classification and are unconnected with either series of cross-references.

3. Essentially unrelated references are likely to be brought together under terms that may have widely different meanings; such a term as 'Survey' may mean almost anything.

4. There is risk of assuming that an expression used metaphorically is intended literally; and

5. The use of an alphabetical system excludes the possibility of collaboration with other bibliographers, especially in different countries.

5.1. This implies the perpetuation of the present chaos of independent bibliographical effort, with a maximum of inefficiency and of labour to the searcher.

On the other hand, none of these objections is inherent in a classified index, since:

1. Related references are brought together by the classification,

1.1. and consequently cross-references within the subject are not required.

2. The classification enforces the contemplation of notions; the same subject must be indexed in the same place.

2.1. No series of cross-references from synonyms is required, since the classification is not concerned with titles,

3. apparent similarity of terms, or

4. metaphorical expressions. Thus the use of a standard classification ensures a maximum of efficiency, and

5. serves to unify the work of all those using the same system, so that their references may be brought together into a single index, which may be consulted with a minimum effort.

S. C. B.

Colloid Science applied to Biology.

THE Faraday Society met at Cambridge on Sept. 29–Oct. 1 for a general discussion on colloid science applied to biology. The occasion was arranged by the Colloid Committee of the Society with the intention of bringing together physical chemists and biologists whose interests meet on this field. The attendance was unexpectedly large, and among those present were some twenty delegates from other countries. Before the discussion began, Prof. Wo. Ostwald delivered greetings to the Society from the Colloid Gesellschaft, and Prof. H. F. Burton presented those of the Ottawa Colloid Symposium. The discussions, which extended over three days, were of sustained and exceptional interest.

The subject first discussed was introduced by Prof. A. V. Hill, whose report dealt with a proof, based upon the work of Dr. I. Straub and confirmed by experiments of his own, that although a 'living' membrane, such as that which separates the yolk from the white of an egg, may be fully permeable to water and electrolytes, thermodynamic equilibrium may never be reached across it. The membrane alters the equilibrium by the continuous performance of work. A 'steady state' is maintained, but there is no equilibrium so long as the membrane is 'alive'. Dr. Straub described experiments involving an endeavour to reproduce this condition in the case of artificial membranes. The subsequent discussions showed the biological importance of the facts involved.

In the absence of Prof. Gortner, of the University of Minnesota, his paper on the state of water in colloidal and living systems was taken as read. A discussion of great interest made clear that a definition of 'bound' as contrasted with 'free' water is not yet possible. Different methods give results so diverse that little meaning can at present be attached to the terms in question. Prof. Svedberg then summarised the results of his determinations of protein molecular weight by means of the ultracentrifuge. Twelve proteins had molecular weights of 1, 2, 3, or 6 × 34,500, while two hæmocyanins had molecular weights exceeding a million. These are constant over a pH range varying from 2 to 8 units, but may dissociate reversibly outside that range. In the discussion which followed, Prof. H. R. Kruyt and Dr. P. Lecomte du Nouy attacked the view that the aggregates the weight of which was thus determined were molecules rather than micelles consisting of numerous molecules. A very wide divergence of opinion on this point was revealed in the debate which followed.

Prof. W. Pauli, of Vienna, described very briefly his recent researches dealing with the behaviour of proteins towards other colloids and towards electrolytes; and Prof. F. F. Nord dealt with the physical influence of gases on colloids. The report of Prof. Fauré-Fremiet dealt with the physiological and physico-chemical factors involved in the active movements of amœbæ, and his remarks were followed by an instructive discussion. A report of Prof. R. A. Peters, of Oxford, giving arguments for the necessity of assuming a permanent architectural structure in protoplasm, led to many interesting expressions of opinion. The familiar difficulty of reconciling such structure with proved fluidity was well to the front. Dr. Cramer directed attention to the significance of structures such as mitochondria and Golgi apparatus; and Prof. J. B. S. Haldane, dealing well with the genes of the geneticist, argued that their history and influence suggest for them a relatively simple chemical constitution with superimposed structure—a combination, as it were, of chemical and morphological patterns.

In the report of Dr. Hans Pfeiffer, of Bremen, the question of the isoelectric point of living cells was raised; and in that of Drs. von Muralt and Edsall —very clearly presented by the former—the technique and results of a study of double refraction in muscle proteins was described. This provoked interesting comments from the physical chemists. Finally, Dr. J. H. Quastel, speaking on mechanisms of bacterial activity, referred to his own theory of molecular activation at the cell surface, and described recent experiments in which it has been found that, after complete lysis, certain dehydrogenases present in the intact cell disappear. Other enzymes, the indophenol oxidase, for example, remain intact.

The complexity of the biological field was brought prominently before the company when, during the first evening, a number of cinematograph films were shown in a theatre at the Engineering Laboratories. These included studies of living cells by Dr. Canti, and one of amœboid motion by Prof. Fauré-Fremiet. A striking film exhibited by Dr. Robert Chambers illustrated the methods of micro-dissection and micro-injection. In relation with these exhibits was a report of Dr. Honor B. Fell, of the Strangeways Research Laboratories, Cambridge, and Dr. Wilmer, on the phenomena observed during the culture of vertebrate cells *in vitro*. Part of this report was presented by Dr. Wilmer during the discussions of the following day.

On the evening of Oct. 1 the members of the conference dined together in the Hall of Pembroke College. The services of Prof. T. M. Lowry, the retiring president, were gratefully acknowledged, and his successor, Dr. Robert Mond, was warmly welcomed.

Imperial Wool Research Conference.

UNDER the auspices of the Empire Marketing Board, delegates from the Dominions, the chief wool-producing Colonies, and research institutions in Great Britain, together with representatives of Government Departments concerned, met in conference upon matters relating to wool research during the week Sept. 22-26. The meetings commenced with an address by the Right Hon. J. H. Thomas, Secretary of State for the Dominions, who welcomed the delegates and expressed the hope that from the deliberations of the conference the progress of research into the production and utilisation of wool throughout the Empire might be stimulated.

Mr. A. L. Hetherington, of the Department of Scientific and Industrial Research, gave a brief outline of the industrial research associations in Great Britain, mentioning especially the position occupied by the British Research Association for the Woollen and Worsted Industries at Torridon, Leeds. Dr. S. G. Barker followed with a paper on scientific correlation between producer and manufacturer, in which he discussed the difficulties of the manufacturer in dealing with wool in the production of which he was not interested or associated, and of the producer who lost interest in his product so soon as he had completed the sale of it and had had it removed from his premises. He stressed the important point that of all animal products wool alone has to pass through

a definite series of manufacturing processes before the finished article made from it is absorbed into commerce, and the further important point that while the producer's unit is to all intents and purposes the fleece, with the broker's 'sorting' and the manufacturer's further 'sorting' the fleece loses its identity long before it reaches a stage where any particularly desirable or undesirable quality can be recognised. This means that it is exceedingly difficult, other than in a very general way, for the manufacturer to express his views in terms that can readily be understood by the producer. Guidance in breeding, feeding, or sheep husbandry for the improvement of the wool produced cannot emanate from the trade organisations representing the manufacturers without some liaison, which could best be provided by a series of scientific research institutions correlated together and cognisant of conditions both of wool production and utilisation. The threat of a revolution in the wool industry based upon the discovery of a method of elaborating a form of artificial wool fibre, which may replace the natural material to a degree equivalent to or greater than that which has occurred in the silk industry, demands that there be a greater correlation between the producer and the manufacturer for the security of each. Such a correlation, in Dr. Barker's opinion, can only come from a thorough understanding of the chemical, physical, biological, and other factors concerning wool itself.

There followed accounts of the results of recent research work and of work in progress in Australia, South Africa, New Zealand, and Canada. The impression gained was that the production of finest quality manufacturing wools is still essentially a monopoly of Australia and South Africa, but that further development is limited, first, by climate and environmental difficulties, and secondly, by the economic menace of the chief competitor of wool, namely, mutton. It would seem that as the large sheep-walks are broken up and more intensively grazed, so does the stock-carrying capacity of the land increase, until there comes a time when in the natural evolution of arable from grazing land the owner is compelled to turn his attention to mutton production, at the expense of his wool quality, the ideal dual-purpose sheep not yet existing.

In the extension of the sheep-walks on to unsettled land, two important limiting factors must be overcome—the deficiency of phosphorus and the inadequacy of a natural supply of protein. It would appear that South Africa's more pressing problem is the provision of a phosphorus compound in a cheap, readily assimilable form, and to this Australia adds that particular sulphur-containing protein which shall eventually prove to be most suitable for the needs of the sheep—but both would welcome a more regular and even rainfall.

Dr. J. E. Nichols reported briefly and in general upon his recent survey of the wool-producing parts of the Empire. He spoke from the production end of the wool industry and indicated the factors arrayed against the production of a uniformity of fibre which would be regarded by the manufacturer as ideal. He stressed the individuality of the sheep farmer and the variety of the environmental conditions under which he works, the variation in breed, in breed type, between individuals, and even in fleeces. He indicated the economic result of producing an article like wool, which is entirely absorbed, including off types, by-products, and waste, away from the farm by the manufacturer.

The most pressing problems in the production of wool are not those of nutrition or disease of the sheep, important though these may be for any one generation, but are problems of genetics and breeding. Only by breeding on sound lines will real successive improvements or the maintenance of excellence in a stock community be achieved.

The delegates then visited Leeds, where, between the regular sessions for discussion, they had an opportunity to see the work in progress, chiefly on the manufacturing side of wool research, both at Torridon and at the Textile Department of the University of Leeds. They also visited, during the week, the Bradford Technical College and the Bradford Conditioning House.

The last session of the conference was held in Edinburgh, at the Animal Genetics Department of the University, where papers relating solely to the biology of the fleece and the physiology of wool production were discussed. The delegates were shown the methods adopted to throw light upon the purely fundamental problems of wool production from physiological and genetical aspects.

At the final meeting, certain resolutions were passed, and these will be reviewed by the Research Sub-Committee of the Imperial Economic Conference now in session.

University and Educational Intelligence.

BIRMINGHAM.—The following appointments to the lecturing staff have been made: Dr. G. E. Harrison (physics), Dr. C. R. Porter (chemistry), Mr. H. M. Bateman (civil engineering), Mr. W. E. Isaac (botany), and Mr. N. M. MacElwee (mining electrical engineering).

Mr. D. J. Cameron has been appointed Registrar in succession to the late Mr. J. H. Costain.

The Wardenship of Chancellor's Hall (vacant by the retirement of Prof. F. Tillyard) has been filled by the appointment of Major Robert C. Panton.

LONDON.—In recent years science courses have not been in very great demand in University Extension work in London, but the current programme issued by the University shows that lectures on scientific subjects are coming again into popular favour. Foremost amongst the courses arranged is a series of twenty-four lectures by Prof. D. M. S. Watson on modern ideas and work in zoology, which are being delivered on Monday evenings at Gresham College, Basinghall Street. The time of the lectures—six o'clock—should prove ideal for those city workers who are interested in this subject and desire to hear of the most recent advances and the outlook for the future. Courses in evolution, heredity, and biology are being given by Mr. G. C. Robson in such widely separated parts of London as New Cross, Stratford, and Woolwich; and Mr. Barratt Brown is conducting an introductory course in psychology at the Mary Ward Settlement on Friday evenings. Details regarding these and other courses may be obtained from the University.

THE Trustees of the Busk Studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1930–31 to Mr. R. H. Francis, of the University College of North Wales, Bangor.

A SPECIAL course of lectures on "Some Newer Therapeutic Agents: their Pharmacological Identification and Tests, with some Account of their Uses in Medicine" will be given by Dr. J. H. Burn, director of the Pharmacological Laboratories, Pharmaceutical Society of Great Britain, in the Society's Lecture Theatre, 17 Bloomsbury Square, on Monday, Oct. 13, and succeeding Mondays, at 5.30 P.M. Admission to the first lecture is without ticket.

Historic Natural Events.

Oct. 13, 1913. Low Temperature in the Upper Air.—It has been known for many years that at high levels over temperate and equatorial regions the temperatures of the air are far lower than any ever recorded on the earth's surface. The lowest known temperature above the British Isles is −98° F. which was recorded by a balloon carrying a small meteorograph, at a height calculated as 7·8 miles (12·5 km.) above Pyrton Hill, on Oct. 13, 1913. Still lower temperatures have been recorded over equatorial regions, the minimum being −133° F. at a height of 10·6 miles (17 km.) above Batavia, Java.

Oct. 13–14, 1881. Great Storm over British Isles.—This was one of the most severe gales of the second half of the nineteenth century in the British Isles. A very deep depression travelled in an east-north-east direction across the extreme north of Ireland and the south of Scotland. The storm caused great loss of life at sea, 108 vessels being posted at Lloyd's in one day, and there was also much damage on the land, especially in the south of Scotland and the north of England. In London the gale caused eight deaths.

Oct. 14, 1755. Red Fog and Red Snow in Locarno.—In Locarno a very hot wind blew with a red fog, followed by blood rain; in the Alps red snow fell accompanied by violent thunder. This was evidently a strong *Föhn* carrying dust from the Sahara.

Oct. 15, 1811. Comet.—During the autumn of 1811 the great comet in the night sky was an arresting object with its bright nucleus and curved tail that was 26° in length (equivalent to 100 million miles) and 5° broad on Oct. 15. This comet, of the exceptional duration of visibility of seventeen months, was one of the most memorable of the nineteenth century. It is described by Sir William Herschel in *Phil. Trans.*, p. 115-143; 1812.

Oct. 15, 1885. Gale at Partenkirchen, Bavaria.—A barometric depression travelled northwards from the Sahara, and a *Föhn* blew in the Partenkirchen Valley, increasing in force until 7 P.M. From 5 to 8 P.M. the storm was the most destructive known since 1821–22. Houses were unroofed, windows were blown in, and a million large trees were uprooted. The rain which accompanied the storm left a yellowish-red deposit, presumably sand from the Sahara. Temperature rose rapidly from 37° to 70° F., and the melting of the snow, combined with the heavy rainfall, caused serious flooding in the Inn.

Oct. 16–19, 1848. New Zealand Earthquakes.—Three great earthquakes were felt, chiefly near the north end of the South Island, on Oct. 16, 17, and 19. Besides the ordinary fissures in the surface soil, a remarkable fracture ran for 60 miles from Cloudy Bay in Cook Strait in a south-south-easterly direction, keeping always parallel to the neighbouring mountain-chain.

Oct. 16, 1913. Heavy Rain in Malta.—Very heavy rain fell over the island of Malta, the amount recorded in 24 hours reaching 16·30 in. at Vittoriosa. At Valletta the fall was 12·56 in., of which 6 in. fell between noon and 3 P.M. The rainstorm was accompanied by violent wind and destructive lightning.

Oct. 17, 1091. Gale in London.—According to the "Anglo-Saxon Chronicle": "Much harm was done in London with an outrageous wind, the violence whereof overturned and rent in pieces above four hundred houses, at which time and tempest the roof of St. Mary Bowchurch, in Cheap, was also overthrown, wherewith two men were slain. Moreover at Salisbury much hurt was done with the like wind and the thunder for the top of the steeple and many buildings besides were sore shaken and cast down."

Oct. 18, 1907. Visibility of Mont Blanc.—An exceptional example of visibility occurred at Dijon on Oct. 18, 1907. As the train left Dijon station, Mont Blanc could be seen very clearly above the chain of the Juras, apparently suspended in the air, only the snow-covered summit emerging. It remained visible until Mâcon was reached. The day was overcast, but the atmosphere was extraordinarily clear, after several weeks of continuous rainfall. The normal limit of visibility of Mont Blanc is 115 miles, and it is extremely rarely seen from the low level of Dijon station 139 miles distant.

Societies and Academies.

LONDON.

Society of Public Analysts, Oct. 1.—G. W. Baker: Scientific evidence relating to firearms, with special reference to a recent murder trial. Scientific methods of investigation were used in examining the bullet and cartridge case found on the scene of a murder in Jerusalem in August 1929. X-ray photography showed that the piece of a bullet found in one of the bodies was British ammunition, and that it had been fired from a rifle of the same calibre and rifling as that of the accused. Photomicrographs showed that the cartridge case found on the scene had at least fourteen marks on the pin impression, all of which were found on the firing pin of the rifle. The extractor mark was also a very characteristic feature.—**J. W. Croxford**: The composition of rye oil. Two samples of rye, a sample of Ryvita crispbread, and a sample of rye flour, extracted by means of petroleum, yielded about 2 per cent of oil. It was semi solid, contained 8-10 per cent of unsaponifiable matter, had chemical characteristics similar to those of maize oil, and behaved like a semi drying oil. It has little, if any, vitamine activity.—**G. E. Lester Smith**: The determination of unsaponified oil in soap or fatty acids. Modifications of the 'emulsion test', in which the presence of oil in fatty acid is indicated by the turbidity of a solution of the ammonium soap in dilute alcohol, are described. So little as 0·05 per cent of oil can be detected. The test may be made quantitative by a determination of the volume of water required to produce incipient turbidity in an alcoholic solution of the ammonium soap under standard conditions.

CAPE TOWN.

Royal Society of South Africa, July 16. Sir Thomas Muir: Note on Brioschi's bordered Hessian.—**S. H Haughton**: Mammoth and elephant teeth from the Vaal River gravels. Nearly every elephant tooth discovered in these gravels has been made the type of a separate species; molars of individuals of the existing African elephant from a single locality show a large amount of variation, and this should be considered in the discussion of the status of fossil forms.—**P. R. v. d. R. Copeman**: Changes in the composition of oranges during ripening. During the period of ripening, the total weight of the orange increases. During the final stages of growth, the effects of transpiration become dominant, causing a loss in weight due to loss of water, which is accompanied by an increase in the concentration of the soluble solids in the juice. There was no significant increase in the nitrogen content or ash content of the juice. The changes in the soluble solids and sugars can be expressed by means of an equation representing an autocatalytic reaction. The changes in the cell-wall material and in the acidity can be expressed by means of a logarithmic curve. Arsenate spray exerts an internal physiological action as a result of which there is a selective oxidation of the respiratory materials in the fruit.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 7, uly 15).—**Linus Pauling**: The structure of some odium and calcium aluminosilicates. The electro-;atic valence rule suggests that aluminium ions in uch salts have the co-ordination number 4, the oxygen oms being common to a silicon tetrahedron, an aluminium tetrahedron, and one or more alkali-ion polyedra. Sodalite, natrolite, the scapolites, and davyite-cancrite have such a structure. It provides, in he zeolite natrolite, channels along (001) planes such hat water can escape without rupturing the frame-vork, and sodium ions pass out as other cations enter o replace them (base-exchange). **Arnold Rice Rich**: 'he demonstration that allergic inflammation is not ecessary for the operation of acquired immunity. After recovery from infection, the body is often highly esistant to the same infectious agent but is extremely ensitive to products of disintegration of the bacteria, which readily produce local damage and severe inflammation (hypersensitive or allergic inflammation). 'ontrary to general opinion, active immunity in yphilis and passive immunity to the pneumococcus re not dependent on allergic inflammation; the spread of pneumococcus is inhibited primarily by a pecific agglutinative process which precedes inflammaion. It is suggested that allergy should be abolished y desensitisation in diseases such as tuberculosis, n which it causes untoward symptoms. **Willem . Luyten**: On the systematic and accidental errors of nodern trigonometric parallaxes. **W. de Sitter**: On he distances and radial velocities of extra-galactic iebulæ, and the explanation of the latter by the relaivity theory of inertia. A theoretical discussion leading to the view that the dynamical solution of the field equations of the general theory of relativity accounts or the expansion of the universe, which is homogeneously filled with matter and has spherical symmetry hroughout its history. **S. S. Cairns**: The cellular livision and approximation of regular spreads. **Harry Levy**: Normal co-ordinates in the geometry of paths. **W. A. Marrison**: The crystal clock. Consists essenially of a constant frequency generator controlled by a quartz crystal resonator. The crystal is in the form of a ring with the plane of the ring parallel to the optic and electric axes, and is so shaped that its temperature coefficient is as near to zero as desired at a given temperature. The clock can be used to give continuous ndication of time, accurate timing signals, or continuous and accurately controlled motion. So far as is known, it is not affected by gravitational and magnetic fields. —**Oliver R. Wulf**: The band spectrum of ozone in the visible and photographic infra-red. Ozone-oxygen mixtures from a silent discharge ozoniser were examined in a tube 2·5 cm. in diameter and 33 metres long. The bands observed are diffuse, suggesting predissociation of the ozone molecule, and there appears to be a weakening of the weak bands with respect to the strong bands with reduction of temperature. This suggests a means of determining the temperature of the atmosphere at the ozone layer.—**Richard C. Tolman**: On the estimation of distances in a curved universe with a non-static line element. Using the line-element determined in earlier papers, a relation is obtained between angular extension and luminosity of nebulæ which should be just within the range of observational verification. —**William Rowan**: Experiments in bird migration. (2) Reversed migration. Juncos were submitted to artificial illumination after dusk, so as to simulate increasing length of days; the gonads increase in size and at a certain period appear to release a hormone, which causes migration. They are small birds and protected by law, so in an attempt to verify these findings and to determine the direction of migration which ensues, crows were used. The numbers available were limited but the results suggest that the enlargement of gonads which occurs under artificial illumination leads to a northward migratory movement, similar to that shown by the birds in the free state with the approach of summer. Controls (with gonads practically at minimum) tended to remain at Edmonton, Alberta, when liberated in winter, although crows normally have gone south at the end of summer.

Official Publications Received.

BRITISH.

Records of the Geological Survey of India. Vol. 63, Part 2, July. Pp. 189-280. (Ca utta nment of India Central Publication Branch.) 2.12 rupees; 5s.

Birkbeck College (University of London). The Calendar for the Year 1930 31 (108th Session). Pp. 245+12. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 44: *Perithomyces hibernicum* New Species. By V. C. E. Kennelly and M. Grimes. Pp. 513-516+plates 20-21. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Norman Lockyer Observatory. Director's Annual Report, April 1, 1929-March 31, 1930. Pp. 8. (Sidmouth.)

University of London. University College. Faculty of Medical Sciences. University Centre for Preliminary and Intermediate Medical Studies. Courses for Dental Students, Session 1930-1931. Pp. vi+253-288. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 405, September. Pp. 1089-1232+xxxiv. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Memoirs of the Cotton Research Station, Trinidad. Series B, Physiology, No. 3. Studies of the Transport of Nitrogen in the Cotton Plant, Parts 4 and 5. By E. J. Maskell and T. G. Mason. Pp. 233-267+657-688. (London: Empire Cotton Growing Corporation.)

Department of Scientific and Industrial Research. Report of the Committee on Welded Containers. Pp. iv+51+11 plates. (London: H.M. Stationery Office.) 1s. 3d. net.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 18, 19: Studies in the Dillavone Group, by Elizabeth Mary Ryan and Dr. Hugh Ryan; On the Constitution of certain Compounds formed by the Action of Alcoholic Hydrochloric Acid on Unsaturated Ketones, by Brian Coffey and Dr. Hugh Ryan. Pp. 425-439. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

FOREIGN.

Sverges Geologiska Undersökning. Ser. C, No. 356: Om jordarternas kapillaritet, en ny metod för bestämning av kapillarkraften (eller kapillära stighöjden). Av Gunnar Beskow. With an English Summary: On the Capillarity of Soils; a New Method for determining the Capillary Pressure (or the Capillary Rise). Pp. 65. 1.00 kr. Ser. C, No. 357: On the Constitution of Hydrated Portland Cement. By G. Assarsson and N. Sundius. Pp. 9+2 plates. 0.50 kr. Ser. C, No. 358: Några till den fennoskandiska geokronologien och issavsmältningen knutna frågor. Av Henr. Munthe. Pp. 19. 0.50 kr. Ser. C, No. 359: Förteckning över lodade spår i Sverige, 2. Av K. E. Sahlström. Pp. 20. 0.50 kr. Ser. C, No. 360: Gillbergaskålens byggnad. Av Nils H. Magnusson. Summary: The Gillberga Syncline. Pp. 84+2 tavlor. 2.00 kr. Ser. C, No. 361: Fosforitbollar från Visingsöserien? Av Herman Hedström. Pp. 8. 0.50 kr. Ser. C, No. 362: Mobergella versus Discinella; Patella versus Scapha and Archæophiala (Some Questions on Nomenclature). By Herman Hedström. Pp. 8. 0.50 kr. Ser. C, No. 363: Die Mollusken und Brachiopoden der Schwedischen Kreide. 1: Eriksdal. Von Richard Hägg. Pp. 93+5 Tafeln. 2.00 kr. (Stockholm: P. A. Norstedt and Söner.)

Transactions of the Astronomical Observatory of Yale University. Vol. 7: Catalogue of the Positions and Proper Motions of 7727 Stars. Re-observation by Photography of the Astronomische Gesellschaft Zone between Declinations +55° and +60°, reduced to 1875·0 without applying Proper Motions. By Frank Schlesinger and Ida Barney. With an Appendix containing the Positions of 396 Stars in Sparse Regions, and an Appendix containing the Positions of 80 additional Gesellschaft Stars near Declination 55°. Pp. iii+20+168. (New Haven, Conn.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 8, No. 1. Pp. 37+4. (Tokyo: National Research Council of Japan.)

CATALOGUES.

Iconographiae Botanicae. Supplementum: Scripta Botanica Miscellanea. (No. 76.) Pp. 12. (Berlin: W. Junk.)

The Use of Nickel in Automobile Engineering. By J. B. Hoblyn. (Nickel, Series H5.) Pp. 15. The Condenser Tube Corrosion Problem and its Solution. (Nickel, Series R3.) Pp. 8. (London: The Mond Nickel Co., Ltd.)

Biological Applications of Absorption Spectrophotometry. Pp. 11. (London: Adam Hilger, Ltd.)

Astronomical Instruments and Observatory Equipment. (Publication No. 700.) Pp. 64. (London: Cooke, Troughton and Simms, Ltd.)

Catalogue of Important Botanical Works: Herbals, Pre-Linnean Botany, Early and Modern Gardening, Floras, Forestry, Orchids, Serials, Biology of Plants, etc. (No. 14.) Pp. 24. (London: John H. Knowles.)

The "Holway" Diathermy Apparatus. (Publication No. B/30.) Pp. 8. (London: Newton and Wright, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 10.

ROYAL SANITARY INSTITUTE (in the Guildhall, Nottingham), at 4.30.—Alderman A. R. Atkey: River Pollution.—Dr. L. P. Lockhart: Industrial Medicine in Relation to Public Health.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

IRON AND STEEL INSTITUTE (Joint Meeting with the Local Branch of the South Wales Institute of Engineers) (at the Royal Metal Exchange, Swansea), at 7.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—N. Heaton: Some Possibilities of Inorganic Paint Vehicles.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—G. E. Windeler: Thermal Progress (Presidential Address).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. Dunlop: The Refining of Cane Sugar.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.—T. H. Turner: Materials Used in Modern Engineering.

INSTITUTE OF METALS (Sheffield Local Section) (in Mappin Hall, Applied Science Department, University, Sheffield), at 7.30.—Prof. F. C. Thompson: Some Observations on the Wire Drawing Process (Sorby Lecture).

RAILWAY CLUB (at 57 Fetter Lane), at 7.30.—C. J. Allen: Notes on Time Tables and Train Running.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—E. W. Brewerton: Presidential Address.—Dr. F. W. Edridge-Green: The Detection of Colour Blindness from a Practical Point of View.

SATURDAY, OCTOBER 11.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at the Technical College, Burnley).—F. Griffiths: Belgian Moulding Sands in the Iron Foundry.

MONDAY, OCTOBER 13.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Hon. Sir Arthur Stanley: Inaugural Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—A. Highley: Presidential Address.

MEDICAL SOCIETY OF LONDON.—Dr. R. A. Young: The Stethoscope, Past and Present (Presidential Address).

SOCIETY OF MOTION PICTURE ENGINEERS (London Section) (at Royal Photographic Society).—P. Smith: Kinephotomicrography.

TUESDAY, OCTOBER 14.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—H. S. Glyde: Experiments to Determine Velocities of Flame Propagation in a Side Valve Petrol Engine.

INSTITUTE OF MARINE ENGINEERS, at 6.—O. Wans: The Design and Manufacture of Marine Auxiliary Oil Engines.

INSTITUTE OF METALS (North-East Coast Local Section) (in Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne), at 7.30.—C. Gresty: Chairman's Address.

ROYAL SOCIETY OF MEDICINE, at 8.30.—Dr. C. Jackson: Suppurative Diseases of the Lungs (Lecture).

WEDNESDAY, OCTOBER 15.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—E. Harle: A Practical Application of British Standard Limits and Fits to Locomotive Construction.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—J. E. Barnard: Demonstration by Micro-Projection of some Histological Preparations from the Society's Collection.—Dr. G. M. Findlay: Some Recent Research on Malarial Parasites.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum, South Kensington), at 5.30.—H. P. Vowles: Enquiry into Origins of the Windmill.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Grand Hotel, Birmingham), at 7.—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

SOCIETY OF RADIOGRAPHERS (in Reid-Knox Hall, Welbeck Street), at 7.—C. L. Winch: Presidential Address.—Dr. E. C. Jorman: Address.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—L. le Conteur: Safety and Welfare in Factories.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—J. W. Cuthbertson: Practical Difficulties in the Electrodeposition of Chromium.

THURSDAY, OCTOBER 16.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Joint Meeting of Pictorial and Kinematograph Groups), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. J. B. Firth: Some Methods of treating Trade Effluents.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—R. L. Smith: The Vickers Projection Microscope.—Demonstrations of The Vickers Pyramid Hardness Testing Machine, C. Baker's Works Projection Microscope, and C. Baker's Brinell Microscope.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—P. L. Roberts: The Replacement of Castings by Weldings.

CHEMICAL SOCIETY, at 8.—Ceremony of the Unveiling of the Perkin Memorial Plaque.—Prof. W. N. Haworth: Oration on the Life and Work of the late Prof. W. H. Perkin.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.1), at 8.15.—Dr. F. Marsh: The Etiology of Heat Stroke and Sun Traumatism.

BRITISH INSTITUTE OF RADIOLOGY (in Reid-Knox Hall, Welbeck Street), at 8.30.—Dr. J. F. Bromley: The Use of Negative Paper.—Capt. A. J. Wood: Ultra-Violet Glasses.—G. Simon: The Use and Technique of Diathermy in the Treatment of Pneumonia.

INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—S. Myer: The Season's Hops.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Middlesbrough).

FRIDAY, OCTOBER 17.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. St. L. Pendred: Presidential Address.

IRON AND STEEL INSTITUTE (Glasgow Section, jointly with West of Scotland Iron and Steel Institute) (at Royal Technical College, Glasgow), at 7.15.—R. Hamilton: Presidential Address.—Discussion on papers by H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice, and J. Šarek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. H. Flowers: The London Automatic Telephone System.

SATURDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Prof. J. B. Leathes: Harveian Oration.

PUBLIC LECTURES.

SATURDAY, OCTOBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Native Life in the Solomon Islands.

MONDAY, OCTOBER 13.

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. P. Gilding: The Reticulo-Endothelial System. (Succeeding Lectures on Oct. 20, 27, and Nov. 3.)—At 6.30.—Miss M. S. West: The Comparative Study of the Religions of the World (Introductory Lecture).

TUESDAY, OCTOBER 14.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Area, Territory, Climate, Vegetation, Mineral Resources.

BEDFORD COLLEGE, at 12 noon.—Miss Tarrant: History of Greek Philosophy.—At 3.—Prof. Spencer: History of Chemistry.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. C. Spearman: Psychologies of To-day (Introductory Lecture).—J. H. Welweg: Danish Castles and Manor Houses. (Succeeding Lectures on Oct. 22 and 29.)

WEDNESDAY, OCTOBER 15.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: The Prevention of Accidents, Disorders and Disease in Members of the Medical and Nursing Professions.

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Regent Street Polytechnic Extension, Little Titchfield Street, W.), at 5.30.—Prof. J. L. Myres: Native Races of the Empire: Facts and Problems.

KING'S COLLEGE, LONDON, at 5.30.—Sir Humphry Rolleston, Bart.: Medicine.

THURSDAY, OCTOBER 16.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. C. K. Millard: Contraception and the Medical Officer of Health.

KING'S COLLEGE, LONDON, at 5.—Dr. J. A. Hewitt: Metabolism of the Carbohydrates and Fats. (Succeeding Lectures on Oct. 23, 30, and Nov. 6.)

KING'S COLLEGE, LONDON, at 5.15.—Miss C. Maxwell: Chateaubriand and the French Romantics.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. E. G. Gardner: The Psychology of Dante.

SATURDAY, OCTOBER 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Uses of a Tail.

CONGRESSES.

OCTOBER 13 TO 16.

CONGRESS OF THE ITALIAN SOCIETY OF SURGERY (at Rome).—Discussions on Treatment of Cranio-cerebral Trauma apart from Gunshot Wounds; Diagnosis and Treatment of Hæmaturia.

OCTOBER 15 TO 23.

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND MEDICAL GEOLOGY (at Lisbon).

OCTOBER 20 TO 23.

FRENCH CONGRESS OF HYGIENE (at Paris).—Discussions on Successive Changes in French Pharmacopœias, Comparative Statistics of Infantile Mortality, Study of the Reports of Health Offices, Hygiene and Reconstruction in the Inundated Districts in the South of France, and Lectures on Psittacosis, by Prof. Sacquépée, and on Lavoisier as Hygienist, by Dr. Dujarric de la Rivière.

SATURDAY, OCTOBER 18, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Industrial Localisation.

DURING recent years close study has been made by the Ministry of Labour, and in other quarters, of labour mobility and transference, and of the various factors entering into the establishment of new industries and the progress or decline of old ones in different localities, matters which may be grouped for convenience under the heading of industrial localisation. This may cover also a comparison of the respective merits of specialist localities, having only one principal industry on which they depend almost wholly for economic life, and diversified localities with several different industries.

A complete discussion of industrial localisation —why a certain trade, or group of trades, settles in one particular locality, why some decline and fall, others are stationary, and others, again, thrive and prosper, of all the varied and complex conditions, indeed, which govern the well-being of industry from the point of view of site selection—this is one of the most important chapters in the economics of industry to-day. No doubt it attracted some attention years ago, at the hands of writers like Marshall, for example; but it has now assumed more than academic importance, and has been well to the fore in most discussions of the dark and intractable problem of unemployment. It is perhaps one of the few avenues where a gleam of hope and light is seen in the far distance.

In approaching unemployment, somewhat wearily at times but yet undaunted, it is of particular interest to note the vital and significant fact that a few districts in Great Britain—one or two of them very extensive—have been much less afflicted with unemployment than the rest of the country. This is doubtless well known to many, but it has been more definitely and clearly demonstrated and set on a more impressive statistical basis by recent investigations than was formerly the case. It is well worth while, however, to consider this matter a little further in its various implications, to inquire a little more closely into the reasons why some parts of the country are so much more fortunate in this respect than others, and, what is of considerable practical importance, to consider whether these favourable conditions can be reproduced elsewhere with similar results on labour demand.

A concrete illustration of fairly successful emergence from the general flood of adversity is afforded by Birmingham and surrounding country.

The incidence or intensity of unemployment may of course be studied by reference to individual trades or individual localities: numerous studies have recently been made of both sorts and a vast amount of statistical material is now available, so that the main issues of the problem are like to be obscured and overwhelmed by a superabundance of such material; but it is difficult to isolate either districts or industries completely, and it is proposed here to consider briefly a large area comprising a great multiplicity of different industries and to examine the suggestions which emerge.

The industrial history of Birmingham and its environs is well known. In 1870 it was mainly engaged in coal-mining, iron manufacture, and numerous hardware trades, but in the great depression which set in about 1874 profound changes took place; many of the older industries declined, some almost to the point of extinction, whilst other new ones took their place, including those connected with the manufacture of bicycles, motor vehicles, and many branches of the rubber, electrical, food, drink, and other trades. The net result is that this part of England has carried out a movement in labour transference on a tremendous scale during the last ten or twelve years—much of it indeed began before the War, so long ago as 1875—and has suffered much less from labour surplus than the rest of the country, with the exception of one or two other areas somewhat similarly circumstanced though on a smaller scale.

The reasons for this are complex and in part obscure, and the usual causes assigned for industrial selectivity are inadequate; or at all events, though we may say that the direct and immediate cause consists in the great diversity of manufactures, it yet remains to ask the reason of this great diversity. It is certainly the case that some areas are specialised and dependent on practically one trade only, and others are diversified and have numerous different trades. Why is this so, and, more particularly, can specialised areas be converted into diversified ones consciously and in accordance with definite planning and co-ordination by Government or other bodies, and thereby reap the same benefits?

The tendency to-day will probably be towards an affirmative reply to the latter query, and it marks a profound change in the modern attitude towards every part of the economic realm. Formerly it was customary, and even regarded as truly scientific and philosophical, to regard economic and industrial phenomena and changes as due to the operation of certain fundamental laws, for the most part inevitable and inexorable: the biological or evolutionary view of society held the field, and governed *inter alia* the localisation of industry. Now we are more disposed to exchange the biological for the architectural and to assert boldly that a nation can consciously build up its economic fabric, going from strength to strength, and perhaps even take some account of beauty in design and form.

The task of construction, however, becomes constantly more difficult and complex, and much, both of the difficulty and complexity, arises from the fact that the political machinery has not even yet been brought sufficiently up-to-date, or inspired with adequate sympathy and knowledge, to realise and deal with the real needs and problems of modern industry. The scientific worker and technologist, it is true, now play a large and prominent part in many departments of government; but this part is still subordinate and the highest ranks of government officials are still dominated by a type of mentality which is certainly not that of the keen alert statesman, trained in business and fully alive to the needs of industry. The political destinies of a great nation have now become so largely dependent on economic and technical factors that it is quite impossible to separate politics from economics: they are now almost one and inseparable, for no industrial problem to-day can be treated apart from its political background and environment.

Reverting, after this brief digression, to the particular aspect of social architecture with which we are dealing, that of industrial localisation, we have found, from the examples of Birmingham and district and one or two other cases, that a diversification of industries—in these cases at least—has reduced the incidence of unemployment. Can we legitimately deduce therefrom a general rule, or is it only applicable in certain narrowly defined areas?

Prof. G. C. Allen, of University College, Hull, in a recent issue of the *Economic Journal*, very ably discusses the particular case of Birmingham and surrounding country, and finds that, where diversified industry is already in existence, it tends to attract additional enterprise and new industries owing to the advantages derived from such variety, among which the chief is that of greater alertness in workers and employers, greater keenness to seize opportunities, and a wider range of technical skill. He does not, of course, suggest that we have here a cure for all industrial ills, that there is no

maldistribution of labour, or that all sections of a diversified area are alike benefited: there are, in fact, wide differences even between places not far apart. But he does insist that in this present age—and still more in the future—of rapidly changing technique and industrial development, it is essential to have a far better co-ordinated policy of localisation of new industries, with the twofold object of satisfying the immediate requirements of employers for labour, sites, and materials, and of building up diversified industrial areas which would be less vulnerable in times of change than our specialist centres have shown themselves to be.

It is thus seen that, in industrial areas, as in individuals, specialism may have decided disadvantages, though in both cases it is impossible to ignore the advantages of specialisation. It is, however, easier to suggest more co-ordination than to work out a practical policy to realise it. Yet the opportunities for co-ordination are greater to-day than they have ever been before. Municipal authorities in existing or potential industrial areas, transport organisations, capitalists and leaders of industry, and government representatives have now, or ought to have, wider and better knowledge of each other's needs and endeavours, and many platforms or other facilities for getting together and pushing co-ordinated effort for all it is worth.

The practical questions now are: Where, in this wide realm of ours, are there suitable areas, either of virgin type and new, or already partially industrialised, where new industries can be established? And should we consider Great Britain alone, or the whole of the British Empire? We are inclined to agree with Lord Melchett and take the Imperial view. It seems desirable, too, that agriculture should be included, for this, our greatest industry still, could be used in many ways to add variety to industrial or manufacturing life. Power, especially electrical power, is a vital factor, and therefore the electrification schemes now slowly proceeding could probably be utilised towards better co-ordination in the establishment of new industries.

A further practical help would be for a national body to determine, without unduly fettering individual freedom of choice, the selection of sites, or at least advise thereupon, rather than leave it to the discretion of municipalities and individual manufacturers. This might form part of a general policy of national development, of urban and rural planning, involving co-ordination among many different authorities.

Genetics, Mathematics, and Natural Selection.

The Genetical Theory of Natural Selection. By Dr. R. A. Fisher. Pp. xiv + 272 + 2 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 17*s.* 6*d.* net.

PROBABLY most geneticists to-day are somewhat sceptical as to the value of the mathematical treatment of their problems. With the deepest respect, and even awe, for that association of complex symbols and human genius that can bring a universe to heel, they are nevertheless content to let it stand at that, believing that in their own particular line it is, after all, plodding that does it. Although it is true that most text-books of genetics open with a chapter on biometry, closer inspection will reveal that this has little connexion with the body of the work, and that more often than not it is merely belated homage to a once fashionable study.

In the preface to his book on "The Genetical Theory of Natural Selection", Dr. Fisher deplores the cleavage between the mathematical and the biological mind, regarding it as due, not to any essential difference in intellectual make-up, but to a difference in the training of the imaginative faculty; and he brings forward an instructive example to illustrate the contrast in the two ways of approaching a problem. "No practical biologist", he writes, "interested in sexual reproduction would be led to work out the detailed consequences experienced by organisms having three or more sexes; yet what else should he do if he wishes to understand why the sexes are, in fact, always two?" To which the biologist, if acquainted with the works of the poet Hoffenstein, might be tempted to reply:

> "Breathes the man with hide so tough
> Who says two sexes aren't enough?"

In spite of Dr. Fisher's view, it is not unlikely that there may be a real genetical difference in the types of mind respectively associated with biological and mathematical thought, so that the matter-of-fact intelligence of the former will seldom be in a position to make much of a response to the imaginative flights of the latter. Nevertheless, it is at times worth the biologist's while to make a special effort, and the present volume offers an occasion; for although Dr. Fisher's mind is essentially a mathematical one, he has marked biological sympathies, and has evidently striven hard to make himself comprehensible to those without the mathematical *flair*. From his book the geneticist will get an idea of the way in which some of his problems are

viewed by a detached intelligence; but it ranges over so wide a stretch that it is impossible in a brief review to touch upon more than a few points which seem of special interest to the geneticist, for whose conversion it would appear in some measure to have been written.

That Dr. Fisher's outlook is based upon the assumption of particulate inheritance is only to be expected. Nevertheless, unlike the average geneticist, he does not reject the possibility of blended inheritance as incompatible with the vast corpus of genetical data, but on the ground that to account for such variance as is known to occur, it would demand a mutation rate some thousand-fold greater than does the particulate theory—a rate far greater than we have any grounds for supposing to exist. Yet, although founding his philosophy upon particulate inheritance, he is inclined to deny to mutations any importance in determining the direction of evolutionary change. Moreover, on the analogy of certain experiments dealing with the sensory appreciation of weights, the selective value of the mutation is regarded as in arithmetic proportion to its size, a view to which we fancy few biologists will be willing to subscribe.

Throughout the book one gets the impression that Dr. Fisher views the evolutionary process as a very gradual, almost impalpable one, in spite of the discontinuous basis upon which it works. Perhaps this is because he regards a given population as an entity with its own peculiar properties as such, whereas for the geneticist it is a collection of individuals.

It is a pity that Dr. Fisher, in formulating his views, should not have considered the group of cases of melanistic moths, one of the few in which we have clear evidence of the supplanting of one form by another within a brief period of time. Surely in such cases the mutation can be said to have determined the *direction* of evolutionary change. The marked and unequivocal dominant, as in the case of the successful melanic mutant, is an evident stumbling-block in the way of Dr. Fisher's attempt to reconcile a particulate basis with a continuous process of evolutionary change, and he has considered the matter at some length in a chapter on the evolution of dominance. His explanation in its abstract form is not easy to follow, but fortunately he has illustrated it by the concrete case of the fowl, the domesticated breeds of which are unusual in presenting a number of characteristics dominant to the corresponding ones in the reputed wild progenitor, *Gallus bankira*. Believing that the slightest differences have some selective value, Dr. Fisher sees in the wild type the form of the species most fitted to the environment, and he regards dominance as " a characteristic proper, not to the predecessor as opposed to the successor in a series of mutational changes, but to the prevalent wild type as opposed to its unsuccessful competitors ". Further, he lays down that " the rule which gives genetical dominance to genes of the prevalent wild type requires that the successful new gene should in some way *become* dominant to its competitors ".

Elsewhere Dr. Fisher states that there is no reason for supposing that the mutational process differs under natural conditions from that occurring in the laboratory or the breeding pen. Hence we must suppose that the mutational changes which give rise to dominant characteristics in domestic poultry show little or no influence in the wild form, that is, are either recessive or nearly so. On the accepted basis of particulate inheritance we must suppose that the dominant manifestation of the mutation in one case, and its relative recessivity in the other, are due to a difference in the substratum on which it acts, that is, to a different collection of modifiers in the two cases. Have we grounds, then, for supposing that this substratum differs markedly in the domesticated and in the wild; and if so, in what way has the change been brought about? Dr. Fisher suggests that it is due to the peculiar manner in which the fowl has undergone domestication.

It is known that domesticated hens may attract the wild cock and produce fertile offspring from them, and Dr. Fisher considers that at one time the fowl was kept only by jungle tribes, and that the domestic flocks were continually liable to be sired by wild birds. Hens showing some slight difference from the normal, for example, incipient crest, would be likely to be preserved through man's love of novelty. Moreover, owing to the fact that the wild bird was always the sire, these differences could not be of the nature of ordinary recessives. The mutant gene for crest must be regarded as having been brought in by the wild cock, in which it behaved as recessive to its uncrested allelomorph. But owing to a difference in the collection of modifiers in the semi-domesticated hens, it was able to gain some expression. By continually selecting for breeding those hens in which it was most markedly expressed, man was really building up a collection of modifiers which allowed of more and more marked expression, until finally the crested gene was placed on a substratum where its effect was one of unequivocal dominance.

The process should, of course, be reversible, and the transference of the crested gene to what is in

other respects a wild *bankira* should result in its becoming a virtual recessive. Dr. Fisher states that experiments on these lines are in progress, and we shall look forward with interest, and some scepticism, to the result. Meanwhile, one need not lose sight of the view that some at any rate of the dominants found in domestic fowls are due to their having had a polyphyletic origin from more wild species of *Gallus* than one. Of the four species known, three have already been shown to give fertile offspring with one another and with domestic races.

Dr. Fisher devotes a chapter to mimicry, rightly perceiving that this is crucial material for the evaluation of any theory of natural selection or of evolution. Denying, as he does, that the mutation or sport can affect the direction of evolutionary change, and being in sympathy with the stock view that natural selection can gradually bring about a condition of adaptation, Dr. Fisher is naturally brought up against Marshall's argument that Müllerian mimicry must be regarded as a special case of Batesian mimicry in that the more numerous species must dictate the nature of the warning pattern. He strives hard, we think unsuccessfully, to get round it; for in doing so he has to postulate an intermediate state enjoying the advantages of both, a very doubtful supposition even allowing that the intermediate state were itself a genetical possibility. But although he seems rather uncomfortable about the way he disposes of Marshall, stating that we "can neither assert that the Müllerian principle will work, nor that it will fail", he nevertheless bases further argument on the assumption that Marshall is wrong. We think that the facts connected with mimicry will repay closer scrutiny on Dr. Fisher's part, for nowhere does there seem to be more cogent evidence for the influence of the discontinuous in evolutionary change.

A considerable proportion of Dr. Fisher's book is devoted to considerations on the evolution of man in his social aspects. He discusses such topics as the decay of civilisations, the mental and moral qualities determining reproduction, the biological aspects of class distinction, the inheritance of fertility, and the decay of ruling classes. He points out that among barbarians the social structure is, as a rule, such that the eminent tend to be the most fertile; whereas in civilised communities social promotion is generally accompanied by infertility. The moral is clear, but the argument is presented in a manner sufficiently detached to avoid that semblance of preaching which is often so boring in works on eugenical reform. Most readers will probably find this the brightest part of the book, for, apart from the absence of mathematical formulæ, it is full of shrewd comments and odd bits of learning. Especially entertaining is the comparison between insect and human communities.

In conclusion, we cannot refrain from a few criticisms of another kind. Dr. Fisher states in his preface that "no efforts of mine could avail to make the book easy reading". That we can well believe. Nevertheless, we feel that he might well have made it much easier reading. The sentences are often unnecessarily long and tortuous, and too often, to make use of a Wellsian phrase, "overlaid with worm-casts of parentheses". Too often the effect of laboriously parsing the sentence in order to grasp its meaning detracts from the necessary effort of comprehension, and the reader feels a just irritation with a writer who might so easily have put it more clearly. As an example, we may give the sentence beginning on line 32 of p. 66, where the word 'to' occurs seven times in various relations. And what are we to make of this other sentence on the same page ?—"To postulate equal functional importance of the two homologous genes is therefore not to deny the possibility of all appearance of dominance, but that a general intermediacy of character, such as that to which attention has already been called in heterozygotes between different mutants of the same gene, should be the prevalent condition." This obscurity of diction is the more to be regretted since Dr. Fisher has given us a provocative and stimulating book, and we are left with the feeling that we might have got more out of it if only the style had been terser and more crisp.

R. C. PUNNETT.

Size and Form.

Size and Form in Plants: with Special Reference to the Primary Conducting Tracts. By Prof. F. O. Bower. Pp. xiv + 232. (London: Macmillan and Co., Ltd., 1930). 12*s*. 6*d*. net.

THE physiological exchange which is inseparable from active life is conducted through limiting surfaces, external or internal. Provided the form remains unchanged, the bulk of a growing cell, tissue, or organ increases as the cube of the linear dimensions, the surface only as the square. Accordingly, as growth proceeds, the proportion of surface to bulk decreases, until a point of physiological inefficiency is approached. The simple cell solves the problem by division, producing new surfaces along the line of cleavage, but an equally effective solution is provided by appropriate change

of form, the fluting or corrugation of the surface, the branching or segregation of the whole structure.

Prof. Bower has emphasised these facts, and has applied them not only to the external surface but also to two other surfaces of physiological transit, the endodermal sheath, where the vascular tracts abut on the surrounding tissue, and the collective surface, where the dead, water-conducting elements of the wood are in contact with living cells. He has the advantage of an unrivalled knowledge of the simplest vascular plants, the ferns and their allies, where the relation of size and form can be studied without the complication of secondary growth. In flowering plants the mass of secondary wood is broken up, interspersed with living cells and traversed by intercellular spaces, so that, in respect of the contact of dead wood elements with living tissue, the needs of increasing size are met without change of outline.

In the sporeling stages of the group of ferns and fern allies, and in the adult stems of its primitive members, the wood elements form a solid column in contact with living cells only on its external surface and lacking intercellular spaces for ventilation. It is here that Prof. Bower has been able to show, by series after series of outline figures, the close association of increasing complexity and increasing size. In the past the relation has often been obscured by the haphazard use of scales of magnification, the enlargement chosen being that which gave a convenient figure, so that the eye was misled. Here, on the contrary, the same magnification is employed throughout a series, and proper emphasis is thereby given to the striking change in size which accompanies development.

In *Psilotum* the young rhizome shows a simple, solid core of wood; as its size increases its outline becomes more elaborate, and it is finally disintegrated into strands surrounding a pith. In a club moss the wood of the sporeling is cruciform as seen in transverse section, in larger axes it is stellate and at last broken into more than twenty radiating strands; in the Cœnopterid group of fossil ferns the surface of the conducting cylinder becomes corrugated and the central cells fail to undergo lignification, forming a columnar pith. In higher ferns the pith is a permanent feature, and great elaboration in the arrangement of the wood is to be found. The endodermal sheath undergoes a similar but less striking series of changes in form, often, as in roots, preserving a circular contour when the outline of the wood is fluted and stellate in section.

Passing to seed plants, Prof. Bower draws an instructive comparison between the wood of the fossil *Sutcliffia* and the larger vascular column of the palms. In *Sutcliffia* the main conducting strand is a continuous mass of wood elements mixed with living cells; it lacks air passages; it is surrounded by similar but smaller strands. Here the contact of wood elements with living tissue is achieved, but the limit of size for an unventilated structure seems to have been reached, and the subdivision of the conducting tissue provides surface through which gaseous exchange can occur. In the well-ventilated vascular column of the palms considerably greater size is attained.

The importance of the relation between size and form is, however, by no means limited to the conducting tissues of vascular plants. Prof. Bower brings under contribution the chloroplasts of the green algæ, showing that these are relatively simple in the smaller species, ridged or flanged in their larger allies; he directs attention to the work of Prof. Hesse on the correlation between the size of the body and the absorptive surface of the gut in the lower Metazoa, and he refers to a number of other zoological examples of the importance of the size-factor in development.

In this book a point of view is elaborated which should both clarify past work and serve to stimulate research. H. C. I. G.-V.

Geophysics Pure and Applied.

(1) *Einführung in die Geophysik.* Teil 3: *Dynamische Ozeanographie.* Von Prof. Dr. A. Defant. Pp. x+222. 18 gold marks. Teil 2: *Erdmagnetismus und Polarlicht, Wärme- und Temperaturverhältnisse der obersten Bodenschichten, Luftelektrizität.* Von Prof. Dr. A. Nippoldt, Dr. J. Keränen, Prof. Dr. E. Schweidler. Pp. ix+338. 33 gold marks. (Naturwissenschaftliche Monographien und Lehrbücher, herausgegeben von der Schriftleitung der *Naturwissenschaften*, Bände 8 und 9.) (Berlin: Julius Springer, 1929.)

(2) *Die gravimetrischen Verfahren der angewandten Geophysik.* Von Dr. Hans Haalck. (Sammlung geophysikalischer Schriften, herausgegeben von Prof. Dr. Carl Mainka, Nr. 10.) Pp. viii+205. (Berlin: Gebrüder Borntraeger, 1929.) 16·80 gold marks.

GEOPHYSICS, like her august sister astronomy, is experiencing a new golden age of activity and rapid advance, and in consequence a spate of geophysical books issues from the Press. As with astronomy also, the mode of publication of geo-

physical work renders the production of works of synthesis and compilation particularly desirable: whereas the researches of physicists and chemists, for example, appear almost exclusively in regular scientific periodicals, which are purchasable through any bookseller, much of the work of astronomers and geophysicists, both on the observational and theoretical sides, appears in the publications of observatories and expeditions, which are often not readily available to private workers, are issued at irregular intervals, and in many cases are not referred to in *Science Abstracts* and similar journals.

The three German books under review are to be welcomed as useful additions to geophysical literature, even where, as in the one dealing with terrestrial magnetism and polar lights, other books on the same subject have recently appeared. While in such cases there is considerable common ground in the different treatments, the divergent interests of different authors, in such wide fields of study, lead to the inclusion by one author of material not mentioned, or only slightly emphasised, by another; the additional facts, views, and references thus made readily available justify the purchase and perusal of the several overlapping works.

(1) Two of the volumes are part of a large collective "Introduction to Geophysics". In the work by Prof. Defant on dynamical oceanography, his aim has been to describe the motion of water in the seas and oceans in the light of the underlying dynamical and physical principles: and in so doing some gaps in the theory have been newly filled in. The part of the subject dealing with waves and tides is treated only briefly, as there is already a considerable literature specially devoted to it. The main theme is the great oceanic circulations and currents, the forces which give rise to them, and the modifications due to the rotation of the earth and the friction and conformation of the oceanic beds and boundaries. The author has given an excellent brief general account of the subject, incorporating much recent work and, by diagrams and otherwise, bringing into close relation with one another the observed facts and the results of research on associated idealised problems. The index of writers quoted in the book illustrates well the author's prefatory remark that, as yet, German workers in oceanography have been few; English, American, and Scandinavian names largely predominate.

In Prof. Nippoldt's admirable brief summary of terrestrial magnetism and polar lights, the space given to the main sections of the subject is as follows: instruments and measurements, 46 pages; the main magnetic field and its secular variation, 63 pages; the transient variations (daily and irregular), 39 pages; and auroræ, 21 pages. In view of the fact that the author is a leading authority on the magnetic distribution and anomalies over Europe, it is natural, and welcome, that this subject is particularly well illustrated and described. The treatment also of other aspects of the subject is clear, concise, and attractive; the diagrams are numerous and well chosen, and the critical accounts of theoretical work, though very brief, are (with few exceptions) excellent.

Prof. Schweidler's interesting summary of atmospheric electricity occupies 91 pages; it will give the non-specialist reader a good general knowledge of the leading problems and results in this field, apart from questions of instruments or measurements, which are not discussed. It is concerned almost entirely with the lower atmosphere, and the Heaviside layer, with its relations to radio transmission and terrestrial magnetism, is not considered.

Dr. Keranen's contribution comprises 122 pages; it relates to a subject which, so far as we know, has not hitherto been summarised in this way. It deals with the intake and emission of heat at and just below the earth's surface, assuming the sun to be the sole source of the heat-changes. The mathematical theory of the subject, so far as it has yet been developed (including that of the downward penetration of periodic temperature variations by thermal conduction), is briefly reproduced. Methods of observation, and the influence of different surface coverings (such as vegetation or snow) on the temperature variations, are carefully considered, and a chapter is devoted to ground frost and its penetration below the surface. Dr. Keränen's account should prove of interest and value to engineers as well as to those concerned mainly with pure science.

(2) The third volume is specially addressed to those wishing to use geophysical science for immediately practical ends. After a brief account of the theory of the gravitational potential (24 pages), and of pendulum observations for the measurement of the direction and intensity of gravity (31 pages), the author proceeds to his main themes; these are the measurement of intensity gradients and of the curvatures of the equipotential surfaces, by means of the Eotvös balance in its various forms (52 pages), the reduction of these measurements (56 pages), and their physico-geological interpretation (38 pages). The volume is a valuable companion to the same author's book on magnetic methods in applied geophysics.

Our Bookshelf.

The Art of Retouching Photographic Negatives: and Practical Directions how to finish and colour Photographic Enlargements, etc. By Robert Johnson. Twelfth edition, revised and rewritten by T. S. Bruce and Alfred Braithwaite. Revised and enlarged by Arthur Hammond. Pp. x+154+16 plates. (London: Chapman and Hall, Ltd., 1930.) 12*s*. 6*d*. net.

That a twelfth edition of Robert Johnson's handbook on the art of retouching has been published is testimony to its excellence and to the fact that progress is constantly being made in the methods and appliances for working up and finishing photographs. The leading professional photographers of the world have so developed their art and their lighting systems that their finished results owe but little to the skill of the retoucher, and their clients are learning to accept the straightforward untouched portrait as a better thing than the old over-retouched ones that former generations demanded. There is, however, still a great majority that demands that their likenesses shall be smoothed out of all semblance of their natural selves, whilst the technical equipment of many photographers is unequal to providing what is required without extensive use of the retoucher's skill. There is also a legitimate demand for skilled retouching in commercial and industrial photography. For these purposes this handbook gives full but concise instructions in the difficult art, but, as the writers confess, success depends rather upon intelligent practice than upon following any printed directions. It is mainly a matter of manual skill wisely directed.

The latest revision of the book is by Arthur Hammond, an associate of the Royal Photographic Society. A comprehensive and painstaking account is given of the materials and methods to be used, of the modelling of each feature of the face, of the working up of backgrounds, etc., of the retouching of landscape, architecture, and animals with pencil, brush, and airbrush. Finally, a series of chapters is devoted to the colouring of photographs by all suitable methods. The whole forms a complete text-book of the retoucher's art based on modern practice. J. Dudley Johnston.

Sexual Life in Ancient India: a Study in the Comparative History of Indian Culture. By Johann Jakob Meyer. (The Broadway Oriental Library.) Vol. 1. Pp. xi+275. Vol. 2. Pp. ix+277-591. (London: George Routledge and Sons, Ltd., 1930.) 36*s*. net.

The "Broadway Oriental Library", of which this work is one of the initial issue, will meet a very real need if it follows the line suggested in the general introduction. It is primarily intended for those who are interested generally in the results of Oriental studies rather than in their technical and highly specialised details. Oriental studies are at present not well served in this respect, especially as regards India. Much material of the highest value to the student of culture is rendered difficult of access because of the form in which it is cast.

"Sexual Life in India" is an attempt to give an account of the life of women in ancient India based upon the two great epics, the Mahabharata and the Ramayana. It covers the religious and social, as well as the sexual, sides of that life. From this material the author has extracted the most intimate details as to the relation of the sexes. The importance of such matters in the life of the East, and particularly of India, is difficult to overestimate. It gives an orientation to the mind of the East which the West finds difficult to grasp. Prof. Meyer's study is comprehensive within limitations: it deals with the position of the daughter in the family; preparation for marriage; the duties and position of the wife; motherhood; the widow; sexual relations, both regular and irregular, and so forth. But it does not tell the whole story. The material is necessarily, in view of its source, somewhat idealised, and certain sides of sexual life do not come within its purview. This, however, does not detract from the value of the book as a social document. It depicts the theory, if not in all respects the practice, of a certain section of Indian society. For the purposes of this translation, the author has revised the text and added to the notes, to which one of the translators has made further additions.

The Zeta-Function of Riemann. By Prof. E. C. Titchmarsh. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 26.) Pp. vi+104. (Cambridge: At the University Press, 1930.) 6*s*. 6*d*. net.

The function now known as Riemann's zeta-function may be defined as the sum of the s^{th} powers of the reciprocals of all the positive integers from unity to infinity. This definition only holds for a certain range of values of s, but it may be generalised, in the usual way, by contour integration. So far back as 1737, Euler had noticed the relation between this function and an infinite product involving primes. No further progress seems to have been made until 1859, when Riemann, in a short paper of only ten pages, indicated a number of ideas which have proved extraordinarily fruitful, and from which many modern researches have developed.

It will surprise those who look upon mathematics as a cut-and-dried science, leaving no scope for imagination and intuition, that an important part of Riemann's work consisted in six theorems which he believed to be true but could not prove. Hadamard at last succeeded with three of these in 1893, while von Mangoldt dealt with two others in 1895 and 1905. The sixth, the famous hypothesis that all the complex zeros have a real part $\frac{1}{2}$, is still unproved.

Prof. Titchmarsh's tract is chiefly devoted to researches produced since Landau's extensive work (1909), but he gives also a brief sketch of earlier work. Some use has been made of an unpublished manuscript by Profs. Littlewood and H. Bohr. The application to the theory of numbers is being dealt with in a companion volume by Mr. A. E. Ingham. H. T. H. P.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Stomatic Control of Transpiration.

THE magnitude of the influence exercised by the stomata in the regulation of the water losses of plants appears to be very different under different conditions.

It has been found that when the mesophyll is rich in water the water loss is largely independent of the stomatic area ('aperture', measured by the porometer) if other conditions are constant.

When a widely open stoma changes in size, the margin of its opening scarcely alters in length. The change in area is due almost entirely to alteration of the length of the short axis.

The following experiment demonstrates that the rate of diffusion of vapour from slit-like apertures is independent of the breadth of the slit (in the case of moderately narrow slits) and is dependent in the main on the length of the slit or of its margin only.

Glass cover slips were cemented over the open ends of a number of cylindrical specimen-tubes leaving approximately rectangular openings, of which the lengths equalled the diameters of the tubes. These tubes were filled with petrol and weighed. The petrol was allowed to evaporate into the air, which may be regarded as a perfect sink for petrol vapour. After ten hours' evaporation the tubes were weighed again; the losses in weight of the various tubes and the dimensions of the slits through which the evaporation took place are recorded in the table below. The first eight experiments made are shown.

Expt.	Length in mm.	Width in mm.	Rel. wt. evptd.	Rel. margin.	Rel. area.
1	11·5	0·16	100	100	100
2	10·5	0·90	97	98	514
3	11·0	1·44	103	107	862
4	11·0	1·40	116	106	838
5	10·9	3·20	100	121	1897
6	7·1	1·18	60	71	452
7	18·3	1·20	252	167	1193
8	23·0	1·15	352	207	1437

From these results it is clear that the breadth of a narrow rectangular opening does not sensibly affect the amount of diffusion through it: in other words, the rate of diffusion through narrow openings is proportional, not to the areas, but to the lengths of the margins of the openings.

It has been pointed out elsewhere ("Transpiration and the Ascent of Sap", p. 5) that the results of Brown and Escombe may be stated in this manner. However, their observation that the amount of vapour transmitted by diffusion through a circular aperture is proportional to its radius does not account for the fact that, while the closing of widely open stomata is not accompanied by a reduction in transpiration, the final stages of the closing bring about a marked falling off in water loss.

This result is, however, inevitable when we consider that owing to the form of the stomata, during the earlier stages of the closing the margin remains the same length, while, during the final stages, the length of the slit, and consequently that of the margin, is rapidly decreased.

HENRY H. DIXON.
T. A. BENNET-CLARK.

School of Botany,
Trinity College, Dublin, Oct. 4.

Oviposition of *Hæmatopota pluvialis* Linné.

THE association of tabanid species with their eggs has been determined in only a comparatively few cases. Despite the local abundance of Tabanidæ in tropical, sub-tropical, and temperate countries, the egg-masses and egg-laying habits of many of our common species have consistently escaped the observation of investigators. Not only has the discovery of the eggs in Nature proved elusive, but also frequently the attempts to induce oviposition under controlled conditions in the laboratory have been attended with little or no success. Consequently the biology of many species that have been studied is incomplete. The reasons for this hiatus in our knowledge I have already discussed in a previous paper ("Tabanidæ of the Canadian Prairie", *Bull. Entom. Res.*, **17**; 1926). Failure to find eggs has led investigators at various times to suggest that some species may deposit their eggs indiscriminately in the soil instead of ovipositing on the leaves and stems of semi-aquatic plants or on the surfaces of stones in or near water. This hypothesis would appear to be supported by the occasional finding of tabanid larvæ in comparatively dry soil at some distance from water. In western Canada *Tabanus Reinwardtii* Wied. and *Chrysops fulvaster* O.S. are common species, the eggs of which were not found although diligently sought in localities where these species were abundant. It was surmised that the eggs might be laid separately in the soil and thus render their discovery difficult. Both of these species were, however, induced to oviposit in glass jars in the laboratory, when they produced masses similar in all respects to those that are normally laid on leaves by other members of the family.

A survey of the literature of European Tabanidæ shows that the eggs of only two species are known. In 1854 Kollar found the eggs of *Tabanus quattuornotatus* Meig. ("Beitrag zum Haushalten der sehr lästigen Viehbremsen (Tabanidæ)", *Sitzungsber. d. Akad. d. Wiss.*, Wien, 13), and they were again observed and described by Lécaillon in 1905 ("Sur la ponte des œufs et la vie larvaire des Tabanides, particulièrement du Taon à quatre tâches (*Tabanus quattuornotatus* Meig.)", *Ann. Soc. entom. France*). Two further contributions on the eggs of this species were made by the same author in 1906 (*Compt. rend. Soc. Biol.*, 60) and 1911 (*Ann. Soc. entom. France*, 80). In 1909 Surcouf and Ricardo ("Étude monographique des Tabanides d'Afrique", Paris) recorded the discovery of the eggs of *T. autumnalis* L. at Lamballe (Côtes-du-Nord) in 1907. Unfortunately, the eggs were not collected when first seen, and on the following day, when a return visit was made, the grass on which the eggs had been deposited was found to have been mown.

Up to the present there is no record of the finding of the eggs of any species of *Hæmatopota*. This is remarkable considering the relative abundance and wide distribution of the genus, of which *H. pluvialis* is our commonest species. In Scotland it is locally very abundant from June to September, and can be readily collected in rural districts where there are ponds and bogs. During July of this year specimens were collected at Threipmuir reservoir, Balerno, near Edinburgh, and were permitted to feed either on the hand and forearm of a human host or on the ear of a rabbit. Some fed immediately the host was presented, and became engorged in ten minutes or less. Others refused to feed after repeated trials from day to day. A female that has partaken of a full blood-meal in the laboratory does not feed a second time, and it is surmised that those specimens which refuse to feed in the laboratory at the first and subsequent trials may have already fed in Nature before they were captured.

Of those that were induced to feed, one deposited a mass of 75 eggs on the walls of a glass jar, in which it was confined, 10 days after engorgement. A layer of moist sand was placed in the bottom of the jar, and into the sand there were stuck the stems and leaves of grasses in an upright position. The escape of the fly was prevented by plugging the mouth with a wad of cotton-wool. In this way the atmosphere in the jar was maintained fresh and slightly humid, and the flies continued to live for two to three weeks. A second fly kept under these same conditions deposited a mass of 125 eggs on the flowering head of perennial rye-grass inside the jar. The accompanying photograph (Fig. 1) shows this second egg-mass. Both

FIG. 1.—Eggs of *Hæmatopota pluvialis* L. on flower of *Lolium perenne*. ×8.

batches of eggs were fertile. Mating probably occurs soon after the adults emerge from the pupæ. In this regard it is interesting to note that a swarm composed entirely of males was observed on the bank of Thriepmuir reservoir on July 19 at 11 A.M. It maintained a position just out of arm's-reach above a chironomid swarm.

The process of egg-laying was carefully observed. The ovipositing behaviour of the fly conforms exactly to that of other tabanid species in which it has been observed (Cameron, loc. cit., 1926). The head of the female is directed downwards, and the abdomen recurved ventrally and anteriorly in the actual laying of the individual eggs. In the interval between the laying of one egg and another, the ovipositor is withdrawn and the abdomen straightened. Each egg, as it is laid, receives a thin coating of cement, which is brushed on by the tip of the ovipositor. This cement is a secretory product of the enlarged, accessory, vaginal glands. The eggs are laid almost vertically to the surface chosen for oviposition, and they remain firmly attached to this and to each other. Having completed one layer the fly proceeds to deposit a second on top of the first. The eggs of this superimposed layer adhere to those of the first end to end. The time occupied in the deposition of the individual eggs averages 15 seconds. They are at first white, but gradually darken to a greyish brown. The egg is cylindrical, tapering slightly to the rounded ends. The average length is 1·612 mm., and the average breadth is 0·29 mm. Hatching occurred in about 10 days under mean daily laboratory temperatures of 60° F. The first instar possesses a prominent, black, sharp-edged, labral, hatching spine, and emerges through a slit, which extends posteriorly for one-third the length of the egg on the antero-dorsal side of the chorion. The cephalic capsule is rudimentary with weak mouth-parts, and is in direct contrast to that of the second-stage larva, which is well developed and resembles in all respects the cephalic capsule of the full-grown larva. The first instar does not feed, but subsists on the occluded yellowish yolk-mass in the mid-gut. Soon after hatching, the first-instar larva moults, and the second instar commences to feed. In the absence of suitable food the second instar will continue to subsist on the remainder of the occluded yolk-mass, and will live unimpaired for four or five days, if kept in a moist atmosphere, without partaking of extraneous food.

A female *H. pluvialis* captured on Aug. 7 fed on a rabbit the same day. This specimen lived in the laboratory for 17 days without ovipositing, when it died. Dissection showed that the ovaries were mature, each containing about 50 eggs.

The investigation of the biology of *H. pluvialis* is to be continued and extended.

A. E. CAMERON.

Department of Zoology,
University of Edinburgh,
Sept. 1.

Velocity of Sound in Tubes: Ultra-Sonic Method.

THERE are points still uncertain concerning the velocity of sound in fluids contained in tubes. Relatively little experimental work has been carried out in liquids as the contained fluid, but outstanding is the research of Dorsing (*Ann. der Physik*, **25**, pp. 227-251; 1908), who reported certain cases of *increase* of the velocity as compared with the velocity in the same liquid when unconfined. Generally there is expected a decrease in velocity depending on the diameter of the tube. Unlike most experimenters, Dorsing employed a relatively high frequency in his experiments, about 4000 vibrations per second; so also did Busse (*Ann. der Physik* (4), **75**, pp. 657-664; 1924), who adopted Dorsing's method to determine some useful thermodynamical constants.

Considering the elasticity of the tube wall, corrections to the velocity should be applied for the waste of energy laterally by the vibrations of the wall. No wall is *rigid* to any elastic vibrations, and, in consequence, the wall vibrations (of any type) will cause a damping of the longitudinal vibrations in the contained fluid column. This damping causes a diminution of longitudinal velocity in the column, but generally the diminution is small. The phenomenon has been observed experimentally, and also investigated mathematically, most recently by Gronwall (*Phys. Rev.*, **30**, pp. 71-83; 1927). Pooler (*Phys. Rev.*, **31**, pp. 157-158; 1928) has found an experimental verification of Gronwall's relation by determining experimentally the velocities in a column of liquid contained in a vertical cylindrical steel tube. The vibrations used were of audio frequency, generated by an electromagnetically excited diaphragm at the bottom of the column.

When present-day ultra-sonic methods are applied to the further elucidation of this problem, new and interesting results are disclosed. By using ultra-

sonic frequencies, wave-lengths can be employed comparable to the diameter of the column; it turns out that it is then possible to cause at will largely augmented, as well as largely diminished, phase velocities in the liquid of the column—in fact, the velocity-frequency curve is like the selective absorption curve of optics. An actual curve obtained by employing quartz-metal ultra-sonic generators in a glass tube 3·5 cm. in diameter, 57·3 cm. long, wall thickness 2 mm., with naphtha as the contained fluid, is shown in Fig. 1. The frequencies here employed ranged from 25,000 to 74,000 cycles per second, the 'absorption band' appearing between frequencies 34,000 and 40,000 cycles per second. Phase velocities ranged from 0·9 to 2·1 × 10^5 cm. per sec., the undisturbed velocity being 1·35 × 10^5 cm. per second.

The experimental method employed was that of stationary waves, the best adaptation so far being an arrangement whereby the positions of the stationary waves could be *seen* by the eye and their breaking up in the frequency range of the absorption band observed visually. Consequently, tubes of transparent materials like celluloid and glass were used, with clear liquids like water, naphtha, chloroform, and oil. Moreover, by taking advantage of the phenomenon of ultra-sonic cavitation, bubbles of gas produced in the liquid by the ultra-sonic vibrations could be made to locate in curtains marking the positions of the nodes of the stationary waves. From the positions of these curtains the measurements of wave-length were taken, from which velocities were computed. It is extremely difficult to get good stationary waves to form, and so permit good determinations of velocity, in the region of frequencies covered by the absorption band.

The best method of generating the stationary waves consisted in the use of two quartz oscillators instead of one, an oscillator being placed at each end of the experimental tube (Fig. 2). These oscillators were made as nearly as possible identical, and were connected in parallel to the oscillating electrical circuit, so that the same frequency and voltage were imposed on each. The positions of the oscillator in the tube were capable of slight adjustment so that the best stationary wave formation could be obtained. But no matter what the method of experiment or what tubes or experimental liquids used, the velocity-frequency curve always had a form like Fig. 1. The same type of experiment carried out at the same frequencies in columns of air only gave the usually anticipated velocity, but no special search for absorption bands was made in this case.

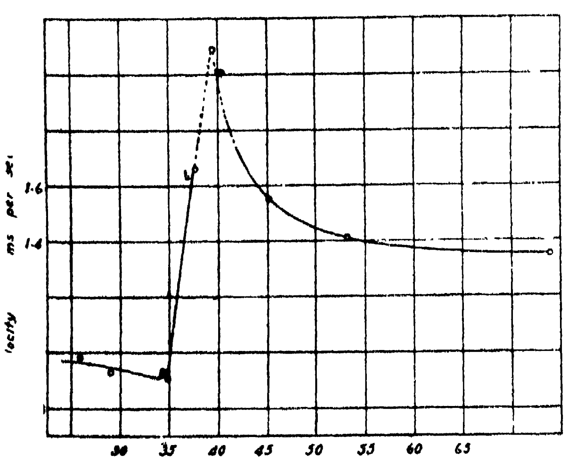


FIG. 1.

All the results obtained on liquids have not yet been analysed, so that it is not yet known with certainty what is the particular form of energy transference which causes this phenomenon; the experiments were of necessity interrupted more than a year ago and are now being resumed.

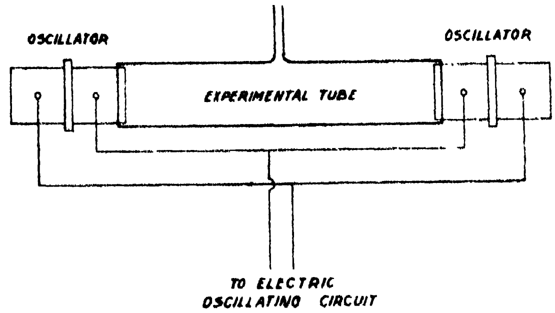


FIG. 2.

R. W. BOYLE.
D. FROMAN.

National Research Laboratories,
Ottawa, Sept. 10.

Splitting of the Frequency of Light scattered by Liquids and Optical Anisotropy of Molecules.

As has already been reported (see NATURE, Aug. 9, 1930), the frequency of light scattered by liquids or crystals is split into several components, and their position in the case of strongly scattering liquids like benzene and toluene may be represented by the expression

$$\left(1 \pm 2n \frac{v}{c} \sin\frac{\theta}{2}\right), \text{ where } n = 0, 1, 2, 3.$$

The study of the polarisation of different components of light scattered by benzene has shown that the central unmodified line and two neighbouring ones, the 'inner' components ($n = 0$ and $n = 1$), are strongly polarised, the electric vector being perpendicular to the direction of incident light. On the contrary, the other, 'outer' components ($n = 2, 3$) are not polarised. Thus the depolarisation of the light scattered by liquids is connected with the presence of the 'outer' unpolarised components. It may, therefore, be supposed that in liquids with large coefficients of depolarisation (strongly scattering liquids) the intensity of 'outer' components is relatively greater than in liquids with small depolarisation (weakly scattering liquids).

In fact, further experiments with carbon disulphide, which possesses optical anisotropy to a high degree, have shown that for this substance 'outer' components are very intensive, being almost of the same intensity as the 'inner' ones. The same may be said of chlorbenzene. On the other hand, for water, ethyl ether, and alcohol, which have very small optical anisotropy, I could not establish with certainty the existence of 'outer' components. Probably they are very weak, and the satellites of the hyperfine structure of the mercury-line (λ4358 A.) prevent their detection.

It may be concluded from these experiments that the existence of 'outer' components is associated with the depolarisation, and the liquids which do not produce depolarisation have not such components.

It may be supposed that the appearance of 'outer' components is due to the diffraction of light, by 'heat-wave lattices' of harmonics, that is, they are produced

by lattices with a constant smaller than the half of the wave-length of incident light. In the domain of X-rays such reflections are, as is well known, impossible. It may be that in the case of scattering of light, owing to the depolarisation, they become possible.

These experiments (with echelon grating) corroborate the view expressed in my previous communication [see NATURE, **126**, p. 400; Sept. 13, 1930] that the broadening (nebulosity) of original lines of the mercury arc after scattering in some liquids (of the order 40-50 A.), which can be observed with spectrographs of small resolving power, is probably connected with the existence of 'outer' components (with $n > 3$). The stronger the depolarisation of the light scattered by the liquid, the stronger must be the 'outer' components, and more pronounced broadening of original lines will result. This is in accordance with the observations of Raman and Krishnan (NATURE, **122**, p. 882; 1928), and my own unpublished experiments with a spectrograph of moderate dispersion that this broadening of scattered lines is connected with the optical anisotropy of the molecules of the liquid.

If the above explanation is correct, the broadened lines must have a definite boundary the position of which corresponds to the greatest possible frequency $\nu_{max.}$ of the Debye 'acoustic spectrum', and therefore must depend for various liquids upon the velocity of sound and the distance between molecules. Experiments now in progress seem to support this view.

E. GROSS.

Optical Institute,
Leningrad, Sept. 8.

Energies of the C – I and C – Br Bonds.

THE absorption spectra of methyl, ethyl, and isoamyl iodides consist, in the near ultra-violet, of broad continuous bands, with maxima at about 2550 A., and at high vapour pressures, a fairly well defined long wave-length limit at 3340 A. Undoubtedly this corresponds to dissociation into an excited iodine atom and an alkyl residue, and the process might be considered analogous to the disruption of hydriodic acid, HI. If we accept Mecke's figure (NATURE, April 5, 1930) for the energy of the C – H bond (115 kcal.) in hydrocarbons, there is very nice agreement between the thermochemical and spectroscopic data for the energy of the C – I bond. Using Berthelot's figures for the heats of combustion of the alkyl iodides, this energy is calculated to be 65 kcal. Allowing for the excitation energy of the I atom (21 kcal.), the spectroscopic figure is 64 kcal.

With ethyl bromide, assuming that the dissociation is of a similar nature, there is not such excellent agreement. The long wave-length absorption limit of C_2H_5Br appears to be 2800 A. Allowing for the excitation energy of the bromine atom (10 kcal.), the energy of the C – Br bond comes out to be 91 kcal., whereas the thermochemical value is 80 kcal. A discrepancy of the same order of magnitude has already been observed in the case of hydrobromic acid, HBr.

In the liquid state the absorption limits are found to alter, though they are no less well defined than in the gas state. If we allow for the molar heat of vaporisation and compare the minimum dissociation energies of the molecules as imagined free from each other's influences in the two states, these energies are 20 kcal. less in the liquid state for the iodides, and 10 kcal. less for ethyl bromide. It is possible that the molecule dissociates when its total energy increase (electronic, vibrational, etc.) is equal to the heat of dissociation. The absence of a rotational quantisation which is apparent with certain liquids is probably a contributing factor to the instability of the molecule on excitation. The mode of dissociation must be different in the liquid and gas states.

In a paper shortly to be published we hope to describe the experimental work from which the above data were obtained.

T. IREDALE.
A. G. MILLS.

University of Sydney,
N.S.W., Australia.

Zacyntha verrucosa Gärtner: Another Plant with Six Somatic Chromosomes.

AMONG many thousands of flowering plants which have been subjected to cytological investigation, there are known only two examples of a chromosome number so low as six in the diploid condition. One of them is the well-known case of *Crepis capillaris* (L.) Wall. (*C. virens* Vill.), first discovered in 1909.[1] The second reported case is *Callitriche autumnalis* L.[2]

After having studied a great many related genera and species I chanced to find an additional six-chromosome species—a distant relative of *Crepis capillaris*. This species is *Zacyntha verrucosa*. Together with *Crepis* it belongs to the chicory tribe of Compositæ—a group of plants which may now be said to be distinguished by the low chromosome numbers of its representatives.

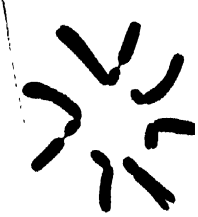


FIG. 1.—Somatic chromosome group of *Zacyntha verrucosa* Gartner. From a root tip taken from an adult plant. ×2250.

The somatic complement of *Zacyntha* is shown in Fig. 1. From this figure one can see the peculiarity of the largest pair of chromosomes, each of them bearing a large satellite on the proximal short arm. The remaining two pairs exhibit slight although distinct differences of size (especially of their smaller arms).

It is premature as yet to say whether *Zacyntha* will prove to be of genetic interest comparable to that of *Crepis*, for, being a monotypic genus, it may fail to cross with any other species. Investigation is in progress now, and additional data on this new object as well as a full account of its cytology will be published elsewhere in the near future.

M. NAVASHIN.

Timiriazev Biological Institute,
Moscow.

[1] Rosenberg, O.: *Svensk Bot. Tidskrift*, **3**, 64-77; 1909.
[2] Jorgensen, C. A.: *Dansk Bot. Tidskrift*, **38**, 81-126; 1923.

English Equivalents of *Eigenfunktion* and *Eigenwert*.

IN publications dealing with wave mechanics there is a growing practice of rendering the words *Eigenfunktion* and *Eigenwert* into English by *eigen-function* and *eigen-value* respectively. The English expressions *proper function* and *proper value* are equally concise, correspond exactly in etymology to the originals, and have the sanction of Prof. Schrödinger himself in the English lectures which he gave at the Royal Institution. Is it not desirable, therefore, that we should discontinue the use of the mixed forms, which is a barbarism without sense or convenience, and equally repellent to German and to English ears?

C. N. HINSHELWOOD.

Trinity College,
Oxford, Sept. 28.

The Proton.*

By Dr. P. A. M. DIRAC, F.R.S.

MATTER is made up of atoms, each consisting of a number of electrons moving round a central nucleus. It is likely that the nuclei are not simple particles, but are themselves made up of electrons, together with hydrogen nuclei, or protons as they are called, bound very strongly together. There would thus be only two kinds of simple particles out of which all matter is built, the electrons, each carrying a charge $-e$, and the protons, each carrying a charge $+e$.

It should be mentioned here that there is a difficulty in this point of view provided by the nitrogen atom. One can infer from the charge and mass of the nitrogen nucleus that it should consist of 14 protons and 7 electrons, but it appears to have properties inconsistent with its being composed of an odd number of simple particles. However, very little is really known about nuclei, and the opinion is generally held by physicists that some way of evading this difficulty will be found and that all nuclei will ultimately be shown to be made up of electrons and protons.

It has always been the dream of philosophers to have all matter built up from one fundamental kind of particle, so that it is not altogether satisfactory to have two in our theory, the electron and the proton. There are, however, reasons for believing that the electron and proton are really not independent, but are just two manifestations of one elementary kind of particle. This connexion between the electron and proton is, in fact, rather forced upon us by general considerations about the symmetry between positive and negative electric charge, which symmetry prevents us from building up a theory of the negatively charged electrons without bringing in also the positively charged protons. Let us examine how this comes about.

The energy W of a particle in free space is determined in terms of its momentum p according to relativity theory by the equation

$$W^2/c^2 - p^2 - m^2c^2 = 0,$$

where m is the rest-mass of the particle and c is the velocity of light. This equation can easily be generalised to apply to a charged particle moving in an electromagnetic field and can be used as a Hamiltonian to give the equations of motion of the particle, and thus its possible tracks in space-time.

Now the above equation is quadratic in W, allowing of both positive and negative values for W. Thus for some of the tracks in space-time the energy W will have positive values and for the others negative values. Of course a particle with negative energy (kinetic energy is referred to throughout) has no physical meaning. Such a particle would have less energy the faster it is moving and one would have to put energy into it to bring it to rest, quite contrary to anything that has ever been observed.

The usual way of getting over this difficulty is to say that the tracks for which W is negative do not correspond to anything real in Nature and are to be simply ignored. This is permissible only provided that for every track W is either always positive or always negative, so that one can tell definitely which tracks are to be ignored. This condition is fulfilled in the classical theory, where W must vary continuously, since W can never be numerically less than mc^2 and is thus precluded from changing from a positive to a negative value. In the quantum theory, however, discontinuous variations in a dynamical variable such as W are permissible, and detailed calculation shows that W certainly will make transitions from positive to negative values. We can now no longer ignore the states corresponding to a negative energy and it becomes imperative to find some physical meaning for them.

We can deal with these states mathematically, in spite of their being physically nonsense. We find that an electron with negative energy moves in an electromagnetic field in the same way as an ordinary electron with positive energy would move if its charge were reversed in sign, so as to be $+e$ instead of $-e$. This immediately suggests a connexion between negative-energy electrons and protons. One might be tempted at first sight to say that a negative-energy electron *is* a proton, but this, of course, will not do, since protons certainly do not have negative kinetic energy. We must therefore establish the connexion on a different basis.

For this purpose we must take into consideration another property of electrons, namely, the fact that they satisfy the exclusion principle of Pauli. According to this principle, it is impossible for two electrons ever to be in the same quantum state. Now the quantum theory allows only a finite number of states for an electron in a given volume (if we put a restriction on the energy), so that if only one electron can go in each state, there is room for only a finite number of electrons in the given volume. We thus get the idea of a *saturated* distribution of electrons.

Let us now make the assumption that almost all the states of negative energy for an electron are occupied, and thus the whole negative-energy domain is almost saturated with electrons. There will be a few unoccupied negative-energy states, which will be like holes in the otherwise saturated distribution. How would one of these holes appear to our observations? In the first place, to make the hole disappear, which we can do by filling it up with a negative-energy electron, we must put into it a negative amount of energy. Thus to the hole itself must be ascribed a positive energy. Again, the motion of the hole in an electromagnetic field will be the same as the motion of the electron that would fill up the hole, and this, as we have seen, is just the motion of an ordinary particle with a charge $+e$. These two facts make it reasonable to assert that *the hole is a proton.*

* Based on a paper read before Section A (Mathematical and Physical Science) of the British Association at Bristol on Sept. 8.

In this way we see the proper rôle to be played by the negative-energy states. There is an almost saturated distribution of negative-energy electrons extending over the whole of space, but owing to its uniformity and regularity it is not directly perceptible to us. Only the small departures from perfect uniformity, brought about through some of the negative-energy states being unoccupied, are perceptible, and these appear to us like particles of positive energy and positive charge and are what we call protons.

This theory of the proton involves certain difficulties, which will now be discussed. The theory postulates the existence everywhere of an infinite number of negative-energy electrons per unit volume, and thus an infinite density of electric charge. According to Maxwell's equations, this would give rise to an infinite electric field. We can easily avoid this difficulty by a re-interpretation of Maxwell's equations. A perfect vacuum is now to be considered as a region in which all the states of negative energy and none of those of positive energy are occupied. The electron distribution in such a region must be assumed to produce no field, and only the departures from this vacuum distribution can produce a field according to Maxwell's equations. Thus, in the equation for the electric field E

$$\operatorname{div} E = -4\pi\rho,$$

the electric density ρ must consist of a charge $-e$ for each state of positive energy that is occupied, together with a charge $+e$ for each state of negative energy that is unoccupied. This gives complete agreement with the usual ideas of the production of electric fields by electrons and protons.

A second difficulty is concerned with the possible transitions of an electron from a state of positive energy to one of negative energy, which transitions were the original cause of our having to give a physical meaning to the negative-energy states. These transitions are very much restricted when nearly all the negative-energy states are occupied, since an electron in a positive-energy state can then drop only into one of the unoccupied negative-energy states. Such a transition process would result in the simultaneous disappearance of an ordinary positive-energy electron and a hole, and would thus be interpreted as an electron and proton annihilating one another, their energy being emitted in the form of electromagnetic radiation.

There appears to be no reason why such processes should not actually occur somewhere in the world. They would be consistent with all the general laws of Nature, in particular with the law of conservation of electric charge. But they would have to occur only very seldom under ordinary conditions, as they have never been observed in the laboratory. The frequency of occurrence of these processes according to theory has been calculated independently by several investigators, with neglect of the interaction between the electron and proton (that is, the Coulomb force between them). The calculations give a result much too large to be true. In fact, the order of magnitude is altogether wrong. The explanation of this discrepancy is not yet known. Possibly the neglect of the interaction is not justifiable, but it is difficult to see how it could cause such a very big error.

Another unsolved difficulty, perhaps connected with the previous one, is that of the masses. The theory, when one neglects interaction, requires the electron and proton to have the same mass, while experiment shows the mass ratio to be about 1840. Perhaps when one takes interaction into account the theoretical masses will differ, but it is again difficult to see how one could get the large difference required by experiment.

An idea has recently been put forward by Oppenheimer (*Phys. Rev.*, vol. 35, p. 562) which does get over these difficulties, but only at the expense of the unitary theory of the nature of electrons and protons. Oppenheimer supposes that all, and not merely nearly all, of the states of negative energy are occupied, so that a positive-energy electron can never make a transition to a negative-energy state. There being now no holes which we can call protons, we must assume that protons are really independent particles. The proton will now itself have negative-energy states, which we must again assume to be all occupied. The independence of the electron and proton according to this view allows us to give them any masses we please, and further, there will be no mutual annihilation of electrons and protons.

At present it is too early to decide what the ultimate theory of the proton will be. One would like, if possible, to preserve the connexion between the proton and electron, in spite of the difficulties it leads to, as it accounts in a very satisfactory way for the fact that the electron and proton have charges equal in magnitude and opposite in sign. Further advances in the theory of quantum electrodynamics will have to be made before one can deal accurately with the interaction and see whether it will settle the difficulties, or whether, perhaps, a new idea can be introduced which will answer this purpose.

Physiological Effects of Work in Compressed Air.

THE average man always finds it surprising that our bodies can support such atmospheric pressures as 100 lb. per sq. in. without the slightest derangement of the delicate structures and processes on which life depends, but that, owing to a secondary effect, the return to normal pressure is accompanied by grave risk. A sojourner in compressed air inevitably soaks up a considerable volume of the nitrogen of the air into simple solution in the tissues and fluids of his body. So long as the pressure is maintained this gas remains hidden and harmless, but any reduction of pressure will drive it out of solution. The critical time in the management of compressed air workers is the period of decompression when they are passing from high air pressures down to the normal. Given time, the blood will carry off the excess gas and discharge it to the atmosphere in the lungs as the

pressure falls, but a rapid decompression overloads the blood with excess gas, which bursts out in the form of bubbles and chokes the circulation with froth.

Compressed air is used by engineers to keep back water in sinking the foundations of bridges and in tunnelling under rivers; besides the men engaged in such work, divers using the ordinary rubber dress have to breathe air at high pressures. The joint discussion between the Sections of Engineering and Physiology of the British Association at Bristol attracted leading exponents of practice and theory in both these lines of work. Although divers are fewer in number than tunnel workers and their occupation is of less public importance, most of the recent research and experimental work has been directed to their special circumstances, and those responsible for diving work have been quick to take advantage of any new knowledge. An outstanding example is the action of the British Admiralty in being the first to adopt the entirely novel system for conducting the decompression which was devised by Prof. J. S. Haldane and has since been taken up by most of the navies of the world. Its value for divers has now been established by twenty-five years' experience, and particularly in some recent salvage operations where more than five thousand dives were made at pressures between 50 lb. and 60 lb. per sq. in. without accident.

The circumstances of tunnel workers differ from those of divers in that they have to work much longer shifts under pressure, though the pressures themselves are never so high as those experienced by divers. In times past the mortality among the tunnel and caisson workers from compressed air illness was so heavy that many countries adopted State regulations designed to protect the men by limiting the length of shift and enforcing some sort of gradual decompression. Undoubtedly these regulations have done good, but in the light of modern knowledge and experience they could be improved so as to give greater security to the men while avoiding the costly waste of working time resulting from some of their clauses.

If the civil engineering of the future is going to call for higher pressures than the 40 lb. or 45 lb. per sq. in. that has been the limit hitherto, it is certain that these rules will be found badly wanting, and Sir Ernest Moir in opening the discussion indicated that the time has come for concentrating the available knowledge and experience in producing a rational and practicable code or system for the use of engineers charged with the control and safety of workers in such air pressures. One of the difficulties of the matter is that there is a very great difference in the susceptibility to compressed air illness of different individuals, which at present can only be discovered by trial, so that cases of illness are still to be expected under a system which is quite safe for the average man. Fortunately, a cure is available in 'recompression', which if applied sensibly and at once is certain. Sir Ernest Moir, by his introduction and employment of the 'medical air lock' for applying this treatment, has been the means of saving many hundreds of lives.

Dr. M'Master, who described the latest British experience at the Silent Valley dam of the Belfast waterworks, mentioned many points which seemed to show that secondary factors, such as the temperature and humidity of the workings or a slight vitiation of the air supply, which would be unimportant in diving work, made a marked difference in the number of cases. In the sea we have a continuously graded range of hydrostatic pressures through which the diver can be decompressed as he gradually ascends, but in caisson work the pressures can only be roughly adjusted to the theoretical requirements, so that, though all serious illness was prevented, a good many minor but painful cases of 'bends' had to be treated by recompression, and to cure them it was found necessary to recompress many of the patients to 5 lb. above the pressure at which they had been working (about 35 lb.). This contrasts strangely with experience of divers working at 50 lb. pressure, who when they develop similar symptoms are nearly always cured by recompression to a mere 15 lb. or so, which greatly simplifies and shortens the treatment. But divers, being on board ship, are generally treated immediately the symptoms appear, while men on engineering work may have time to get home before they become ill and then may not present themselves for treatment for some hours. This probably underlies the difference, and the point illustrates one of the difficulties of the engineer: he cannot very well insist on a shift of a hundred men hanging about round the works for an hour or two after they have finished work for the day on the off chance that one of them may develop compressed air illness, but the salvage officer with his handful of divers can easily arrange for there to be no means of getting ashore until the danger period is past.

Mr. Davis, jun., in the course of an interesting review of the history of the subject, described apparatus lately introduced by Messrs. Siebe, Gorman and Co. for very deep diving, including a large steel pressure chamber which is lowered under water so that the diver can enter it on the completion of his job and be hoisted inboard without releasing the air pressure from his body. A long decompression can then be conducted in warmth and dryness instead of under water with much discomfort and fatigue as hitherto, while the ship is free to slip her moorings and get clear or fire blasting charges, which could not otherwise be done until the diver's decompression was finished.

Sir Leonard Hill and Commander Selby spoke of the experimental diving which has been carried out for the Admiralty to more than 300 ft. or 130 lb. pressure, using the Davis decompression chamber and other special devices. One unexpected and rather awkward finding was that, though all the divers were picked men who had been put through a specially searching medical examination, some of them became abnormal mentally (or emotionally as Sir Leonard Hill put it) whilst under this high pressure, and on their return to the surface could remember nothing of what they had been doing before they began to ascend. This effect

might be attributed to the high partial pressure of oxygen in pure air when breathed at 130 lb., or to impurities in the air which was actually supplied to the divers, but Sir Leonard Hill has made tests on the same men which satisfy him that neither oxygen nor carbon dioxide is responsible. It seems to be an extreme case of the subtle change in character and behaviour which comes over some men at less high air pressures and is well known to experienced diving officers. Divers affected in this way generally keep fairly quiet on the subject, as they do not wish to be thought excitable or foolish about their work. The steel decompression chamber was employed to great advantage in these experimental dives, but, as Prof. Haldane pointed out in concluding the discussion, the stages of decompression given to the men were not calculated on the principles which have proved so satisfactory hitherto and do not appear to have given sufficient margin of safety. This is a matter which can easily be rectified if necessary without invalidating the ingenious methods and appliances which have been elaborated for this extremely difficult sort of diving.

The Italian divers now working on the wreck of the *Egypt* at a depth of 400 feet have cut out all danger of compressed air illness and the need for a host of hampering precautions by using the Neufeldt and Kuhnke armoured apparatus, which, though flexibly jointed, sustains the enormous hydrostatic pressure of 170 lb. per sq. in. corresponding to that depth and enables the man inside to breathe air at atmospheric pressure. The gain in safety and economy of working time which results is partly offset by a loss of mobility and manual efficiency as compared with a rubber-dressed diver, but this again is compensated by the elaborate grabs and machinery of the salvage ship. The diver on the bottom has become less the working agent and more the eye and brain directing engines which are lowered to him and worked from above. Conceivably some such semi-automatic system of working may develop in caisson and tunnel work, though it does not seem called for with the pressures likely to be used in the near future. None of the speakers expressed any doubt that all serious illness could be prevented by suitable decompression: the real problem is to key these lengthy decompression periods in with the design of the tunnel, the scheme of work, and the system of shifts, so that they may become something less wasteful and unsatisfactory than hours of enforced idleness passed in dismal steel cylinders.

G. C. C. DAMANT.

Centenary of the Royal Geographical Society.

THE Royal Geographical Society will celebrate on Oct. 21 and the two succeeding days its centenary of inauguration. The Duke of York will open the proceedings on the afternoon of Oct. 21, and delegates from the Société de Géographie, of Paris, and the Gesellschaft für Erdkunde, of Berlin, both of which have already celebrated their centenaries, will present addresses. In the evening, Sir Charles Close, president, Mr. Douglas Freshfield, Sir Francis Younghusband, the Marquess of Zetland, and Dr. H. R. Mill will speak on the history of the Society. On the mornings of Oct. 22 and 23, a series of short papers on "The Habitable Globe" will be read by British and foreign geographers, and in the afternoon of Oct. 23, another series on "Incidents in the History of Exploration" will be read by Lord Lugard, Sir Martin Conway, Sir Francis Younghusband, Sir Halford Mackinder, Col. H. Bury, Mr. J. M. Wordie, and others. The centenary dinner of the Society, at which the Prince of Wales will preside, is to be held on Oct. 23.

Enjoying, on Dec. 31, 1929, the enviable roll of 6369 members, inclusive of 679 women, the Royal Geographical Society emerges from one hundred years of vicissitudes a successful and vigorous English institution. Among our readers there must be some of an earlier generation privileged to retain contemporary recollections of intercourse with intrepid pioneer discoverers who, in their day, lifted the veil in fields of the Society's operations—of, for example, John Rae, Erasmus Ommanney, McClintock, Inglefield, Nares, Leigh Smith; of John Kirk, Grant, Burton, Joseph Thomson. To these elders the centenary proceedings should, for this reason, bring especial interest and point.

Space would not permit notice here of the position of geographical knowledge among the nations at the time of establishment of our home-born organisation. Most of us know, however, that in the early years of the nineteenth century, science was moving definitely towards co-operative effort and in departments—its horoscope was cast that way, though no seer maybe could have forecast our present-day delimitations and specialisation. There sprang into existence new bodies—offshoots of the parent Royal Society—and with each that institution observed terms of amity, though Banks was, perhaps, an unduly obstinate element. Among such were the Geological Society (1807), Institution of Civil Engineers (1818), British Association (1831). As regards individual effort and consequent influence on thought, it is useful to recall that Lyell published the first volume of his "Principles of Geology" in 1830; that year witnessed also the issue of Charles Babbage's argumentative "Reflections on the Decline of Science in England".

Already, however, in the geographical domain, Paris had instituted the Société de Géographie (1821); Berlin, the Gesellschaft für Erdkunde (1828). There was at this period half a world of unknown tracts of land to conquer. All Europe, too, was discussing the achievements of Baron Alexander von Humboldt, traveller and naturalist. This illustrious geographer, welcomed constantly in English philosophical circles, had been elected

a foreign member of the Royal Society in 1815, had dined with the men of science at their club in 1817, accompanied by Arago and Biot, visiting them again, with Kater as host, in 1827. Much was to ensue from these movements and international greetings and friendships.

In the last-named year, another London dining club, the Raleigh, composed mostly of men of travelling proclivities, came into being, and it early realised that a British institution for the advancement of geographical science was a necessity. The idea found current expression in the influential *Literary Gazette*. In the issue for May 24, 1828, over the initials " A. C. C.", the following appeared: " This society [*i.e.* the Asiatic] has certainly filled up one great hiatus . . . but there is another almost equally important to supply . . . I allude to the want of a Geographical Society, a want which is the more singular, as our nation has always been, and still is, the very foremost in promoting geographical discoveries. I am convinced that if such an Association were now to be formed it would in a few years become even more eminently useful than the famous society of Paris."

The outcome of various individual efforts and alliances of views was the foundation of our London society, brought about at a public meeting held on July 16, 1830, and under the advantageous and able chairmanship of John Barrow, secretary to the Admiralty. Viscount Goderich was elected the first president. King William IV. became patron, directing that the Society's title should be the " Royal Geographical Society ". Further, His Majesty granted an annual donation of fifty guineas to constitute a premium for the encouragement and promotion of geographical science and discovery. Four hundred and sixty names were enrolled, forty-three of whom were naval officers, fifty officers of the army, all the leading statesmen of both political parties, including the Duke of Wellington (then Prime Minister), and men of science eminent in all its branches.

The first president, Viscount Goderich, was not, in strict sense, a geographer, neither had his qualifications, so far as one can be aware, any particular scientific bearing or significance. His interests lay in active politics. Notwithstanding these drawbacks, if indeed they were, he seems to have been considered a good figurehead for a Society that had to make beginnings, and a safe one to start with. Educated at Harrow and St. John's College, Cambridge, he entered the House of Commons as the Hon. Frederick John Robinson, filled various subordinate posts, eventually becoming Chancellor of the Exchequer from 1823 until 1827. Upon Canning's death in 1827, he was raised to the peerage as Viscount Goderich, and was Prime Minister for a short while. At the time of election to the presidency of the Royal Geographical Society he was Secretary for War and the Colonies, and a fellow of the Royal Society. He was created Earl of Ripon in 1833.

The *Gentleman's Magazine*, under date Nov. 14, 1831, provides a lively notice of the Society's inaugural session, held in the rooms of the Horticultural Society in Regent Street. We read :

" The first meeting for the season of the Royal Geographical Society took place, the president, Viscount Goderich, in the chair. The room was very much crowded to witness the presentation of his Majesty's first premium of fifty guineas, placed at the disposal of the Society, to Richard Lander, for his discovery of the termination of the Niger, or Quorra, in the sea. After the secretary had read a long paper by Col. Leach on the very interesting question, ' Is the Quorra the Niger of Antiquity ? ' the noble chairman stated that the meeting had been made special for two specific objects, both of great importance to the general purposes of civilisation, but more particularly to this Nation. The first was to present, on this, the first occasion on which the Society had to dispose of the bounty of his gracious Majesty, the prize to an individual certainly the most enterprising of those men who had their names recorded in the annals of geographical discovery. He felt convinced all who heard him would agree that the first award placed at the disposal of this Society by their gracious Sovereign could not be more appropriately disposed of, than by conferring it on an individual whose talents, courage, and enterprise had achieved so much for the advancement of science. His lordship then presented Lander, who rose for the purpose from his seat at the noble chairman's right hand, with the first premium. The latter, in a few words returned his acknowledgments and expressed his deep gratitude. The second proposition was to incorporate the African Association with the Society, which was carried."

Here it should be mentioned that the African Association, referred to as merged in the new Society, was formed in 1788, mainly through the efforts of Sir Joseph Banks and Major Rennell. It had a small but select membership, and, as its name would imply, concerned itself with the geography of Africa and with schemes for forwarding exploration in that continent.

In connexion with the first allotment, in 1830, of the Royal premium to Richard Lander, it may be recalled that his pioneer explorations (and those of Mungo Park) are commemorated by an obelisk, erected last year on Jebba Island in the Middle Niger. A tablet bears the following inscription :

" To Mungo Park, 1795, and Richard Lander, 1830, who traced the Niger from near its source to the sea. Both died in Africa for Africa."

The fifth annual premium at the disposal of the Society took the form of a gold medal, and the practice continued. On the accession of Queen Victoria it was resolved to award two gold medals annually : (1) the Founder's medal ; (2) the Patron's medal.

For a whole decade after inception, the Society met in the apartments of the Horticultural Society. Thereafter, circumstances necessitated sojourns elsewhere, so that the Society became itself a traveller, seeking, yet not securing, a fixed location where all its functions could be performed under one roof. These peripatetic phases are happily ended. Its house at Kensington Gore, occupied in 1913, offered settled habitation, and a long-cherished scheme for additional buildings has come to fruition. It is gratifying to learn that the

structures include a meeting hall with seating for 850 persons; ample library space, worthy of the Society's fine collection of books; with other easements necessary to complete the working scope and social aims of a scientific corporation of this kind.

No reference to the Society would be adequate without testimony to the wonderful and enlightened activity it has consistently displayed in regard to exploration in Africa and in Arctic and Antarctic regions, and help in such undertakings as the successive Mount Everest Expeditions, as well as in others. Scientific men and a vast public are well aware of these services; and, should the lands fail in a measure, there remains the air. Already the Society has encouraged the British Arctic Air Route Expedition by supplying it with "the best instruments it could furnish, and a little of its money".

It remains to add that Admiral Sir William Goodenough has been chosen as the new president in succession to Sir Charles Close, whose term of office ends as the one hundred and first year of the Society begins. Scientific workers generally wish the Society continued prosperity and increased activity in this second century of its existence.

Obituary.

Mr. M. A. Giblett.

When in 1924 it was decided to take up again with renewed energy the development of airships, it at once became clear that a prime necessity was a specialised meteorological service devoted entirely to airship problems. What exactly were those problems was not known: weather forecasting was obviously one, but there were others, not yet formulated, connected with the forces present in the atmosphere which would affect largely the success of airship transport. It was therefore necessary to place the new Airship Services Division of the Meteorological Office under an able Superintendent. The man chosen for this responsible post was at the time a relatively junior Assistant Superintendent in the Forecast Division, but a man who had already made his mark by his scientific ability and outstanding personality.

Mr. M. A. Giblett was then only a little more than thirty years old, having been born on July 15, 1894. He had been educated first at Upton School, Slough, and Modern School, Maidenhead, and then at the Universities of Reading and London. Three years as nautical master on the Cadet Ship *Worcester* under Capt. Sir David Wilson Barker were no doubt responsible for his becoming interested in meteorology, and in March 1919 he joined the staff of the Meteorological Office for training preparatory to going out to the British Expeditionary Force in North Russia on meteorological duties. He sailed for Russia at the end of July 1919 and received his commission as 2nd Lieutenant in the Meteorological Section, Royal Engineers, while actually on the voyage. He was stationed at Archangel, but had been there only a few weeks when the British Expedition was withdrawn. He returned to the Meteorological Office and resumed his duties as professional assistant in the Forecast Division in October 1919.

As soon as Giblett received his appointment as Superintendent of the Airship Division, he set to work with great energy to plan and build up the meteorological organisation which was to be an integral part of the Imperial scheme for the development of airships. At first this scheme only visualised an airship route to India. He found an almost unexplored field before him. It is true that at each end of the route there were highly developed meteorological services, but between the shores of India and the east of the Mediterranean there was no meteorological service and no synoptic charts had ever been drawn for these regions. Further, although practically every country in Europe prepares its own synoptic charts, there was no single chart of Europe on a scale sufficiently large to make it possible to study in detail the changes of weather even in Europe as a whole. Giblett therefore set to work to collect from every possible source observations for the whole area embracing the route from England to India, and from these prepared a series of daily weather charts for a whole year. It was a stupendous piece of work, which is not yet entirely finished, but with the aid of these charts it was possible to study the routes open to airships and to calculate in detail the times it would occupy to travel each route in different types of weather.

Although at that time the route to India was the only one on which it was planned to employ the airships, it was necessary to make a preliminary survey of possible airship routes to all parts of the Empire. In 1926 this became an urgent problem, for the Air Ministry wished to place before the Imperial Conference which was held in that year a scheme for the development of Imperial air transport. This scheme was presented to the Imperial Conference in a book, afterwards published, entitled "The Approach towards a System of Imperial Air Communications", in which sections on the meteorological investigation of the England-India route and on the meteorological organisation in connexion with the development and operation of airship services were written entirely by Giblett. This description of possible routes, the necessary ground organisation for meteorology, and the co-operation required between the meteorological services was a remarkable piece of work and received much commendation at the Imperial Conference: it showed a power of planning and organising seldom met with in so young a man and a 'scientist' to boot.

It had by that time become clear that meteorology would play an important if not the chief

(*Continued on p. 619.*)

Supplement to NATURE

No. 3181 OCTOBER 18, 1930

The Electron Theory of Metals.*

By R. H. Fowler, F.R.S.

FROM the point of view of the electron theory, a metal is any solid which is a good conductor of electricity. In attempting to survey roughly the present position of the electron theory of metals, I cannot guarantee that what I say will be everywhere up-to-date, but I shall be satisfied if I can indicate the standing of the theory, as re-established by quantum mechanics.

The Nature of a Metal and Classical Theory.

One may assume that the electron theory of metals effectively began with Drude. At any rate, the triumphant explanation by his theory of the relationship between electrical and thermal conductivities gave it its first real start. The theory, of course, was based, and is still based, on the simplifying approximation, now fairly well justified, that a metal consists of a number of positive ions atoms that have lost one or more electrons more or less permanently resident at the positions required by the lattice structure of the metal crystal, together with the lost electrons free to move about among the positive ions.

The simplest assumption of all, which should be correct for monovalent metals like the noble metals and the alkalis, is that each atom sets loose exactly one electron. The electrons and ions act on one another with the usual Coulomb forces, but to the first approximation the effect of these from the point of view of an electron is to make the interior of the metal an electrically neutral region of roughly constant *positive* potential, such that work must be done to extract an electron and leave it at rest outside in free space at zero potential. Inside the metal, then, to this approximation the free electrons will behave like a perfect gas of uncharged particles of mass m, the mass of the electron. In the next approximation we must recognise that there are regularly arranged spots (the ions) where there is a more or less violent deviation from uniformity; classically, a moving electron will suffer collisions at these spots. The electrical resistance of a metal is determined by the rate at which these collisions dissipate the directed momentum in a beam of moving electrons. The mean space rate of dissipation of this momentum, p, involves a length which one calls the mean free path λ,

$$\frac{dp}{dx} = -\frac{p}{\lambda}.$$

The classical theory included in its initial successes even the prediction of conductivities of the right order for not unreasonable values of λ. But it was ruled out of court by at least one outstanding difficulty, that a perfect gas of one free electron per atom would necessarily contribute $\frac{3}{2}R$ to the specific heat of the metal, that is, 3 calories per gram-atom per degree Kelvin, whereas no comparable contribution is allowable. The vibrations of the massive ions satisfactorily account for the whole (see Fig. 1). There are also other difficulties. The main difficulties could have been turned by supposing that there were only a few free electrons doing all the work; they would then require to have correspondingly long free paths. The surprising effect of small traces of impurity upon conductivity requires these long free paths to be real. But classically it was quite impossible that the free path should be much longer than the atomic spacing in the lattice.

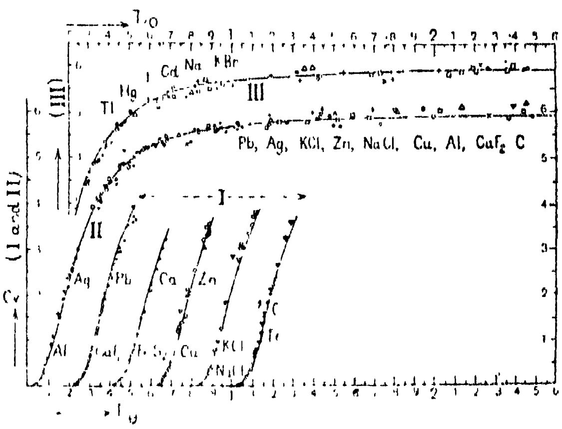


FIG. 1 The specific heats of various solids as functions of T/θ

The Quantum Mechanical Revision.

All these and similar difficulties have been entirely removed by the quantum mechanics using

* An abridged version of the twenty-first Kelvin Lecture delivered at the Institution of Electrical Engineers on May 1.

Drude's model unaltered. In fact, it was the dynamics of electrons, not the physical model of a metal, which was wrong and impeding progress. A recognition of some of the more subtle features of quantum mechanics is required to put us on the right track. Let us therefore make a fresh start by discussing the quantum mechanical behaviour of a single electron in the approximate potential field provided by our model of a metal.

Quantum mechanics assigns to any such system a certain number of possible stationary states the energies of which are fixed by the condition that solutions of a certain linear differential equation (Schrödinger's) shall exist, satisfying certain physically obvious requirements. If V is the potential energy of an electron, h Planck's constant, and ∇^2 the familiar operator of Laplace, then this equation is

$$\frac{h^2}{8\pi^2 m}\nabla^2\psi + (V - W)\psi = 0$$

and the possible values of W are the possible *total* energies of the electron. Now our picture requires V to vary rapidly near the metal boundary, and

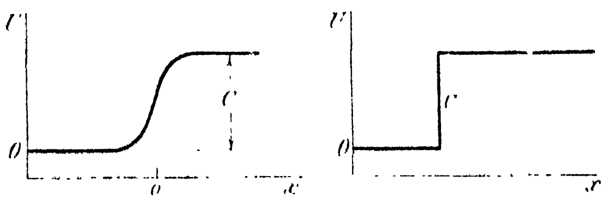


FIG. 2.—The boundary hill.

otherwise to be either 0 or $-C$, according to whether we are outside or inside. The transitional region is probably fairly thin, but we need not at this stage worry about it, for it can be shown that it makes no difference if we take it instead as a sudden step. Again, as this step is fairly high (10 volts or so would be high for present purposes), it makes little difference if we take it infinite. We have then to solve the wave equation

$$-\frac{h^2}{8\pi^2 m}\nabla^2\psi - E\psi = 0,$$

where E is *kinetic* energy, subject to the condition that $\psi = 0$ on the boundary and outside, where V becomes infinitely greater than it is within.*

It is easy to solve this equation if the region within which the electrons are confined is a rectangular box of edges a, b, c. The shape of the box can be shown not to matter for practical applications. For this simple shape the possible kinetic energies are given by

$$E = \frac{h^2}{8m}\left(\frac{r^2}{a^2} + \frac{s^2}{b^2} + \frac{t^2}{c^2}\right),$$

* This is the form to which our physical requirements reduce in such a limiting case.

where r, s, t are positive integers, and the corresponding function ψ is

$$\psi_{r,s,t} = \sin\frac{\pi r x}{a}\sin\frac{\pi s y}{b}\sin\frac{\pi t z}{c}.$$

We now find, on account of the smallness of h and in spite of the smallness of m, that if we take a box of any ordinarily small size, let us say 1 mm.[3], or even a cube of edge $\frac{1}{2}\times 10^{-4}$ cm., a wave-length of visible light, the energies of the possible stationary states lie so close together that we cannot distinguish them for practical purposes from the continuous distribution allowed by classical mechanics. If we then pack into such a box a number of electrons comparable with the number of atoms in the same volume of metal, *and if they do not interfere with one another in any way*, we get a distribution of free electrons indistinguishable from the classical (Maxwellian) distribution of Drude's theory—with the same properties and the same failure as a representation of an actual metal.

Here quantum mechanics makes its first really fundamental contribution in this field, as was first pointed out *for metal theory* by Sommerfeld. It is that one can never, even in zero-order approximation—even in the limit of vanishingly small interactions of the particles' mutual potential energy—treat a composite assembly of two or more electrons by simple combinations of the states possible to one electron. This is not at all (at least to the present depth of our analysis) because of the Coulomb repulsion between them. It applies equally in the limit when this may be supposed to be neutralised. It is not because of other forces which might be regarded as giving the electron a *size*. It is something far more fundamental, entering into the quantum dynamics because its equations are all *linear* in the fundamental wave-function ψ, and entirely foreign to classical particle dynamics because its equations are essentially non-linear, for example in the momenta. It is mathematically like a species of interference due to the superposition of wave systems, with which we are familiar in ordinary oscillating systems, though this analogy must be used with extreme caution. One is apt to think of the de Broglie wave systems associated with particles by the quantum mechanics as wave systems like electromagnetic waves in the ordinary space-time of physics. But the wave system of a pair of electrons, for example, so far as it is anything describable, is strictly a wave system in a six-dimensional space, and so on for more electrons. Electromagnetic or optical analogies are invaluable, but when we wish to use our results by interpreting them in physical space-time, the greatest caution may be necessary.

Whatever may be the correct physical description, the theory is certainly of such a form that possible states of two or more electrons present in a single box together are confined to a selection only of all the states that can be built up by repetition from the states of a single electron. The proper selection can be simply described by saying that *no two electrons can ever be simultaneously in the same stationary state*. This rule holds for all assemblies of electrons, for example, for a single free atom, for which it was first detected semi-empirically by Pauli. It is generally

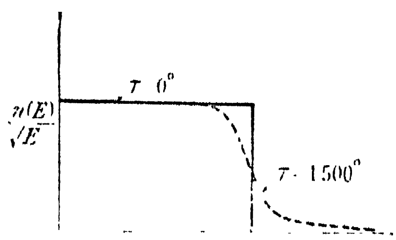


FIG. 3.—The distribution law at 0° and 1500° Kelvin.

now known as *Pauli's principle*. The principle must be strictly interpreted. We shall have to admit later on that electrons have a spin of their own and an associated magnetic moment which is capable of exactly two orientations, along and against any magnetic field. These two orientations may be regarded as the two possible values of another quantum number which, with r, s, and t, makes up four for each electron. The strict enunciation of Pauli's principle is, then, that in any assembly of electrons no two electrons may ever have the same *four* quantum numbers.

I have deliberately stressed the independence of Pauli's principle of any crude mutual potential energy between the electrons. This is the correct and only not misleading attitude to adopt at the present stage of development of the theory. But perhaps if the recent researches of Eddington prove ultimately fruitful, one may hope to fuse together Pauli's principle and Coulomb interactions as two manifestations of a single, more comprehensive scheme.

Quantum mechanics cannot yet predict that electrons will in fact obey Pauli's principle; it can as yet only show that if initially all electrons obey this principle, they will continue to do so for ever. In fact, it seems they always do obey it. As has been said, it was its introduction into metal theory by Sommerfeld that gave metal theory its new start. Allowing for Pauli's principle, we find that the number of free electrons with kinetic energies between E and $E+dE$ in a unit volume of an idealised metal, instead of being given by the familiar distribution law of Maxwell,

$$n(E)dE = A'e^{-E/kT}E^{\frac{1}{2}}dE, \qquad (1)$$

is given by the slightly different law of Fermi and Dirac,

$$n(E)dE = \frac{4\pi(2m)^{\frac{3}{2}}}{h^3}\frac{E^{\frac{1}{2}}dE}{1+e^{E/kT}/A'}. \qquad (2)$$

A, A' are constants so adjusted that the total number of electrons of all energies is correct—perhaps the equivalent of one per atom for a monovalent metal. It will be noticed that equation (2) reduces to equation (1) when A is very small, but there is no resemblance when A is large. When A is large its value is given approximately by

$$A = e^{E'/kT}, \quad E' = \frac{h^2}{8m}\left(\frac{3n}{\pi}\right)^{\frac{2}{3}},$$

where n is the total density of the electrons.

Just here is where the very small mass of the electron takes effect. Obviously, A depends on the mass, and turns out to be large for electron densities of the order of metallic ones, so large, in fact, that the distribution would be quite unclassical even, for example, for copper at 1500° K. This is shown clearly by the actual distribution law sketched by Nordheim in Fig. 3. At ordinary room temperatures, and even well above, the distribution is such that, nearly enough,

$$n(E) \propto E^{\frac{1}{2}} \quad (E < E'),$$

$$n(E) \propto e^{-E/kT}E^{\frac{1}{2}} \quad (E > E').$$

What happens is that at all such temperatures practically every possible electronic state for which

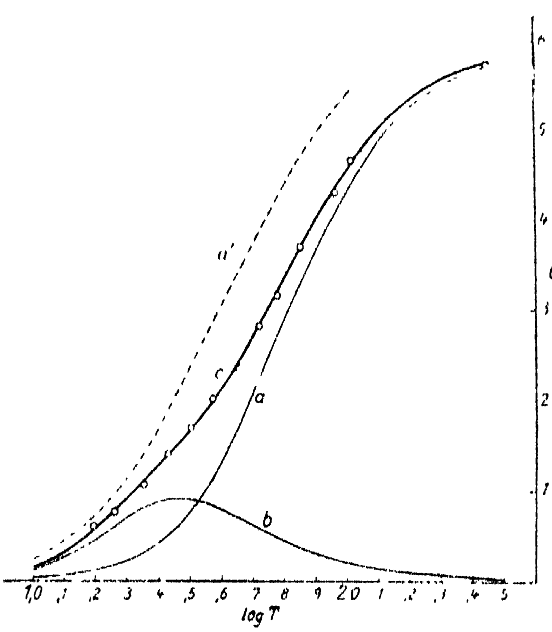


FIG. 4. Specific heat of grey tin. Circles indicate observed values. Curves a and a' are Debye curves which cannot be made to fit; curve c is $a+b$, and b is here interpreted as the contribution of the electrons.

$E < E'$ is occupied by its one electron, while for $E > E'$ practically all are empty. The very few electrons that are there are too few to worry each other, so that they can obey Maxwell's law.

We find at once that the specific heat difficulty melts away. One can see at a glance from Nordheim's figure that the change of energy content with change of temperature must be very small. Detailed calculation confirms this and gives the total kinetic energy, $E_{kin.}$,

$$E_{kin} = \frac{\pi}{40} \cdot \frac{h^2}{m}\left(\frac{3n}{\pi}\right)^{\frac{5}{3}} + \frac{2\pi^3 mk^2T^2}{3h^2}\left(\frac{3n}{\pi}\right)^{\frac{1}{3}},$$

from which the specific heat contribution is utterly negligible. It is, in fact, *too* small, and later more refined calculations by Bloch make it rather larger generally and possibly much larger in a limited region, so that it is able to account in a most satisfactory way for certain interesting specific heat anomalies such as have been found by Simon at fairly low temperatures for grey tin (see Fig. 4) and other metals. The constant term, on the other hand, is large; the electrons have a large 'zero point energy'. But this is without importance for metallic phenomena.

The New Conduction Theory.

We have so far considered equilibrium states only, and have still to apply the new theory to conduction problems, states of steady flow.

In a preliminary survey, Sommerfeld revised Lorentz's calculations by using the new equilibrium $n(E)$ instead of Maxwell's, and showed that to give observed conductivities the mean free paths must be very long. As we have seen, this is all to the good for empirical reasons, but classically a free path in a metal of from 10 to 100 interatomic distances seems to be nonsense. Quantum mechanically, however, it is just what we must expect, as the work of Houston, Bloch, and Peierls has shown. For if one examines the behaviour of an electron now no longer in a region of uniform potential but in a potential with variations which are perfectly space-periodic, one finds that though these periodic variations alter the energies of the stationary states of an electron in the box, yet they do not affect at all its power to move freely through the box in a given direction.

Such perfectly periodic variations of potential can correspond only to a metal which is a perfectly pure, perfect, single crystal at zero temperature, assuming that then all the ions are at rest relative to each other. But in such a substance the mean free path of an electron with a kinetic energy of a few volts should be infinitely long, and the substance should possess an infinite conductivity. One can give an analogy to these long or infinite free paths from physical optics. Light in passing through an optically homogeneous medium such as air or many crystals is to a first approximation not scattered or absorbed at all, though every molecule is a potential scattering centre. As was first shown by the late Lord Rayleigh, it is only local deviations from perfect uniformity that scatter the light; deviations which in a dust-free gas are probably fluctuations of concentration, and in a crystal flaws and foreign bodies. Just so the de Broglie waves of the electron are not scattered by perfectly regular lattices but only by random deviations from perfect regularity, due to thermal agitation, to strains, or to impurities.

This description, however, is still not entirely adequate. It is quite certain, both theoretically and from X-ray evidence, that at the absolute zero of

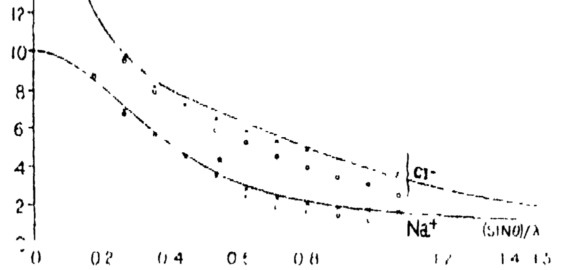


Fig. 5.—Comparison of F values deduced from observation with those calculated from theory. F is plotted as function of $\sin\theta/\lambda$ for Na^+ and Cl^- ions, θ glancing angle, λ wave-length in A. Curves show values of F for distribution of electrons calculated by wave mechanics. Crosses show values of F deduced from observation assuming zero point energy; circles show values of F deduced from observation, assuming no zero point energy.

temperature the ions of a metal crystal are not at rest in their positions of equilibrium but oscillating about them, the whole crystal containing a considerable irreducible zero point energy of oscillation. This fact (see Fig. 5), which at first sight appears destructive of the theory, urges a closer investigation, for conductivities certainly tend to infinity in favourable cases as the temperature tends to zero, even if supra-conductivity does not appear. It is then found that one cannot properly discuss the mean free path without investigating in detail the exchange both of energy and momentum between an electron and the lattice, which must occur when a free path is terminated.

One can analyse the motion of the ions in the lattice into elastic waves in the manner of Debye in his theory of specific heats. In order that a free path may be terminated it is necessary—

(1) That an electron of energy E and momentum p shall be transferred to E', p', which latter, by Pauli's principle, must be a *vacant stationary state*.

(2) That the oscillatory state of the lattice shall

change to a new state, absorbing the energy and momentum differences $E - E'$, $p - p'$.

At high temperatures there is comparatively little difficulty in fulfilling these requirements, but at low temperatures Pauli's principle makes it difficult for an electron to do anything but gain energy, while the oscillations of the lattice, being almost entirely in their lowest state, find it almost impossible to lose energy. Thus the chance of exchanges (in spite of zero point energy), and therewith the resistance, rapidly diminishes.

Quantitative investigation on these lines has been carried through exactly for high temperatures and yields an electrical resistance varying as T, in admirable agreement with experiment. At low temperatures the investigation is much more difficult, and theoretical resistances varying like T^3, T^4, or T^5 have been obtained. While any of these is sometimes in fair agreement with experiment (see Fig. 6), it seems to me that the final investigation has yet to be made. We may, however, rest well content with what has been done until the next step can be taken in relating the theory to supra-conductivity. This step has not yet been taken. It may be connected with the theory of magnetic effects, about which there is much to be learnt from Kapitza's experiments. There is as yet no theory which accounts for his results, and, interesting as they are, we must perforce pass them by here.

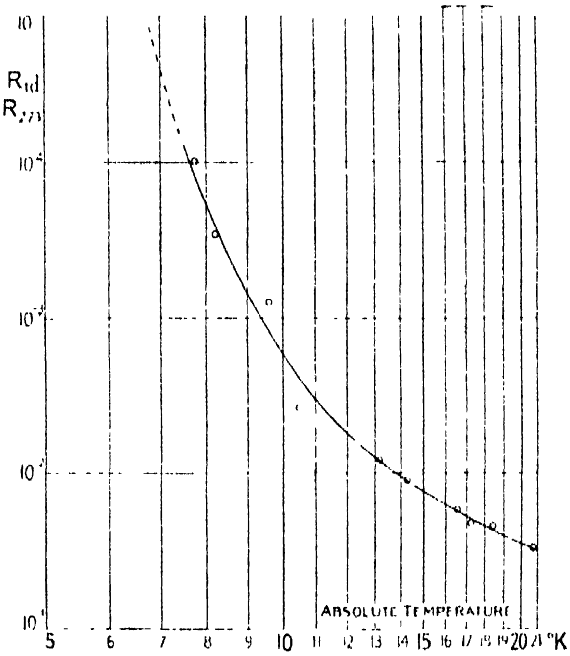


FIG. 6.—Change of the ide[illegible] of lead near the absolute zero plotted on a logarithm[illegible] ie resistance varies like T^4 in the region of 15°–20°, but is already varying faster than T^5 below 10°.

Thermo-Electric Effects.

Before leaving the subject of conductivity, I should record that the theory as so far developed gives an explanation of reversible thermo-electric phenomena which in a general way is entirely satisfactory. The various thermodynamic relationships are of course preserved, and the Thomson and Peltier coefficients are given values of the right general order of magnitude and type of variation with absolute temperature, even by Sommerfeld's version. The refinements introduced by Bloch and Peierls could no doubt be made to give a very satisfactory account for many metals.

Emission of Electrons.

We have so far tacitly assumed that all the electrons stay for ever in the metal, as of course they would have to do if the potential step at the surface were infinitely high. But if the step is finite, no part of what precedes is effectively altered, except that formula (2) indicates that there are present in the metal at any time a certain number of electrons (depending on the temperature) with sufficient energy to escape. Since free paths are rather long, it is sufficient to ignore the periodic lattice structure in the potential and consider what happens when an electron of kinetic energy E falls on a potential step or hill, in which to a first approximation the potential is a function of the distance from the boundary alone. It is easy to show that in such a problem the motion of the electron parallel to the surface is unaffected, and the problem resolves itself into a one-dimensional one. We can now confine attention to a stream of electrons, of energy W in their motion normal to the surface, incident from inside the metal on potential hills of various shapes. Typical natural and idealised boundary hills are shown in Fig. 7.

Now the classical solution of this problem is rather rigid and gives no scope for the observed variety. The electron would then always come out if $W > B$, the summit height of the hill, and never if $W < B$. In the quantum mechanics, however, things are very different. The electron never comes out if $W < C$, the *final* height of the step, but always has a non-zero chance of coming out if $W > C$, even though $W < B$. If we call this chance of emergence $D(W)$, and $N(W)dW$ the number of electrons incident on unit area in unit time with normal energies between W and $W + dW$, the total saturated current I per unit area which the metal can emit (supposing it is all collected as in the usual thermionic measurements) is given by

$$I = \epsilon \int^{\infty} N(W)D(W)dW.$$

Now on Sommerfeld's theory we know $N(W)$ (Fig. 8), and this theory is amply accurate for the present

application. We can calculate $D(W)$ and hence the thermionic current I. I think one may say that these calculations are successful, for they show that

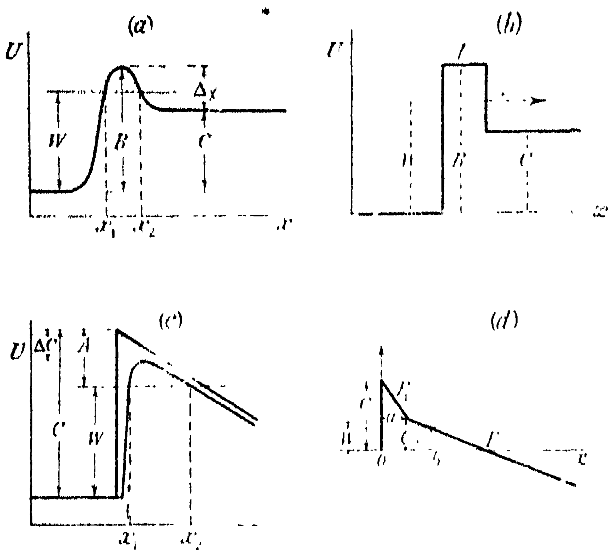


FIG. 7. Typical natural and idealised boundary potential hills. (*a*) A natural type of hill when an electro-positive monomolecular layer is present and the force is ignored; (*b*) the same idealised for simplicity of calculation, but without loss of any essential feature; (*c*) an idealised hill (a precipice) with a strong external field of force helping to pull out the electrons, and the same hill modified by the image effect (this modification explains the Schottky effect, and the unmodified hill the ordinary auto-electronic discharge); (*d*) a hill with two slopes, one intrinsic and the other that of the applied external field, explaining the combined effect of strong fields and monomolecular surface layers.

$D(W)$ is sensitive to the nature of the hill, that is, *to the nature of the surface layer, which may often be a layer of impurity present by accident or design*. The theoretical current is given by the formula

$$I = AT^2 e^{-\chi/kT},$$

where A and χ are constants characteristic of the emitter. This is of the well-known proper empirical

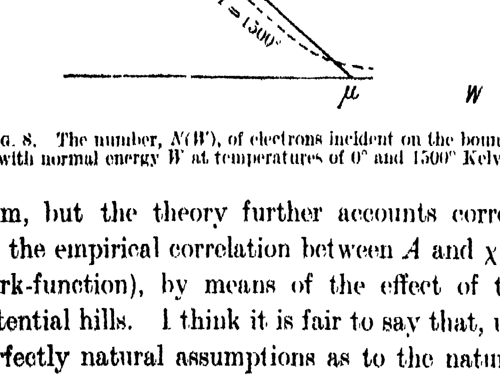


FIG. 8. The number, $N(W)$, of electrons incident on the boundary with normal energy W at temperatures of 0° and 1500° Kelvin.

form, but the theory further accounts correctly for the empirical correlation between A and χ (the work-function), by means of the effect of these potential hills. I think it is fair to say that, using perfectly natural assumptions as to the nature of the boundary hill, the usual phenomena of emission of electrons, from hot metals, under very strong electric fields, and under the influence of light, can to a first approximation be accounted for to our complete satisfaction.

It is interesting to observe that an electron can go through a region in which its kinetic energy is apparently negative. Its chance of going through is large if the region is very thin, and dies away exponentially as the region widens. When we consider the wave nature of the electron, regarding it as a train of de Broglie waves, we see that this is closely analogous to a well-known phenomenon of physical optics. If light is incident on a plane interface at an angle greater than the critical angle, there is total internal reflection. But if the second medium is very thin and followed by a third medium the same as the first, there *is* a weak transmitted beam formed in the third medium after all.

MAGNETISM AND FERROMAGNETISM.

So far we have been able to proceed ignoring the specific interaction of the Coulomb forces between each pair of electrons or ions. But Heisenberg has shown that when these are taken into account, and also the magnetic moments of the electrons themselves, the theory, though still in a larval stage, gives a beautiful account of ferromagnetic phenomena.

The first step in this part of the theory was due to Pauli and concerns the approximation in which we still neglect the Coulomb interactions. We infer from atomic spectra that every electron has a spin or moment of momentum $h/4\pi$, that is, a one-half quantum, and at the same time a magnetic moment of one Bohr magneton. The Bohr magneton is the magnetic moment of any electronic orbit in any atom in which the electron has just one unit, $h/2\pi$, of orbital angular momentum. Thus the ratio of magnetic moment to angular momentum for the intrinsic spin of the electron must be just double the ratio of these quantities for any electronic central orbit. (Incidentally this fits beautifully into the later versions of relativistic quantum mechanics which we owe to Dirac.) Since, then, free metallic electrons carry each a Bohr magneton the axis of which can be turned along and against any imposed magnetic field, the alkalis and noble metals would be strongly paramagnetic with a temperature-dependence similar to that of the classical gas theory of Langevin, if it were not that once again Pauli's principle intervenes to prevent the accumulation of the electrons at any reasonable temperature into states in which an appreciable excess are orientated along the field.

The susceptibility of such an electron gas is not

difficult to work out exactly. It turns out that there is theoretically a slight residual temperature-independent paramagnetic susceptibility of the same order as the usual diamagnetic one. In combination with a normal diamagnetic effect from the ions, this accounts very satisfactorily for such paramagnetic effects as are actually observed in the lighter alkalis. These effects are really extremely small, and from here on we shall ignore them and speak as if our idealised metals, neglecting specific interaction effects, were magnetically neutral. We have, of course, assumed here that the ions are inert, as they would be for the monovalent ions of the alkalis and the noble metals, which contain only completed groups of electrons.

In introducing his theory of ferromagnetism, Heisenberg points out that as a *formal* explanation of the whole body of ferromagnetic phenomena, Weiss's familiar theory is completely satisfactory. The essence of the theory is that there must be in the total internal energy of a ferromagnetic substance a rather large term which depends in a certain way on the magnetisation. Granted the existence of this term, known as Weiss's molecular field, everything fits together as it should, but the difficulty has been to account rationally for its existence, since the actual magnetic energies involved are some ten thousand times too small. This defect quantum mechanics and Heisenberg have now removed.

Heisenberg starts by directing attention to the *gyromagnetic anomaly*. When a bar of metal is magnetised it requires simultaneously a proportional angular moment of momentum which can be actually measured if the suspension is sufficiently delicate. Since all atomic orbits of electrons have one constant ratio, $e/(2mc)$, for magnetic moment to mechanical moment of momentum,* one expects to observe a constant ratio between the magnetisation and the angular momentum generated, from which e/m may be calculated. The constant ratio is found, but for all ferromagnetics, for which alone until quite recently experiments have been made, the value of e/m so observed has exactly twice its expected value. This is the so-called anomaly, but the observed value is exactly what one would expect if the magnetisation were contributed entirely by the orientation of the intrinsic spins of electrons and not of their orbits at all. We assume, therefore, that the magnetism of a ferromagnetic is derived entirely from the orientation of the spins of its loosely bound or free electrons. Heisenberg then finds that the terms needed to account for Weiss's field are to be found in the effect of the Coulomb forces—the electrostatic repulsions and attractions—which have hitherto been disregarded in our theory. In this step, however, we meet one of the most elegant subtleties of quantum mechanics which I will try to explain by using the simplest possible example.

In order to get a feasible method of approach to the interaction problem, Heisenberg idealises the metal in a different way from that which we have used hitherto. He imagines the crystal lattice to be composed of *atoms*, not ions, and expanded by continuous growth of the lattice constant until all the atoms are rather far apart. This looks so different a model as almost (if accepted) to deny the validity of our old one—but this inconsistency is only superficial, and it has, in fact, been shown by Bloch (at least, I think his argument is valid) that one can get similar effects to Heisenberg's by putting the interactions into our original model; the necessary technique is, however, more complicated and we may follow Heisenberg, recognising that there is nothing inconsistent with our previous model in his method of approximation, even if the magnetic and conduction electrons are the same, as recent experiments seem to suggest. We must therefore discusss the possible stationary states and energies of a large number of regularly arranged similar atomic systems each containing one, two, or a few electrons in similar orbits sufficiently loose for the interactions to matter. The large number, though essential to represent a metal, introduces merely complications of detail but none of kind; we can confine attention to *two*, and for purposes of illustration to two hydrogen atoms in their normal states.

Now here again the linearity of the wave equations comes in. It is impossible, when account is taken of the electrostatic interactions, for there to be a stationary state in which one electron is in one atom and the other in the other. If we could start with a particular assignment we should still find, after a time depending on the distance apart, that the electrons had changed places. When the atoms are fairly close together these exchanges become quite rapid and the corresponding energy term—the electrostatic interchange energy, as it is sometimes called—quite large and nearly comparable with the unperturbed energies. The system, of course, has actual stationary states (in fact, two) of definite energies, which may be regarded as built up by superposition in definite ways out of the unperturbed solutions with the electrons in their separate atoms.

* Here c is the velocity of light and e/m the ratio of charge to mass for the electron.

The two states have quite different energies which vary differently with the distance apart of the atoms (see Fig. 9). In one of them the electron spins and magnets balance each other out and the system has no magnetic moment. In the other the spins have to be parallel and the system has a magnetic moment of two Bohr magnetons. The energy difference of the two states, due to the electrostatic interchange term, is of altogether greater order, at least when the atoms are fairly close together, than the magnetic energy terms themselves. Now suppose we consider a number of such pairs set parallel and far apart from each other in a magnetic field. The magnetic field will alter the distribution of all the electron magnets (to what exact amount, of course, it is part of Heisenberg's problem to calculate), and therefore

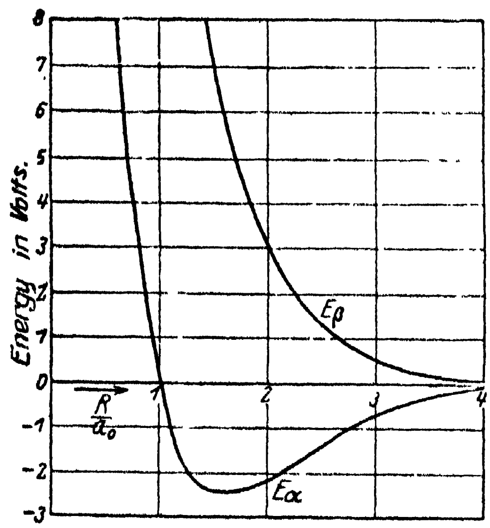


FIG. 9. The potential energy of two colliding hydrogen atoms, showing the two quite distinct values which it can take.

the relative number of pairs which are neutralised or possess a magnetic moment, and of course the orientation of the latter It will therefore have to alter the distribution of the pairs among their two stationary states, and therewith the energy content of the whole system, and that, too, by an amount depending on the magnetisation, which is very large compared with the magnetic energies themselves.

Here is the true origin of Weiss's molecular field! The atoms in a real metal lattice, each with an electron in a similar orbit, present a problem exactly similar in type, though it requires the help of abstract group theory conveniently to carry through the calculations. We can now safely proceed to the result of these calculations. Heisenberg finds, for a metal in which there is one 'active' electron per atom, that in the equilibrium state the magnetisation σ is given by a root of equations which are essentially the same as Weiss's. Heisenberg neglects all interactions except those between nearest neighbours, and his final equations contain a quantity J_0 which is practically the interaction energy giving the energy separation between the stationary states of a pair of neighbours. In order that the metal may be capable of ferromagnetism, J_0 must be *positive*: in order that the Curie point may be at a reasonably high temperature, J_0 must be rather large. Heisenberg can show in a general way that these conditions are rather difficult of fulfilment and that ferromagnetics might be expected to be rare and to be found only (as they are) among the metals of least atomic volume—a genuine triumph! *

CONCLUSION.

It must not be thought that I am too blindly optimistic about the present position of the theory of metals. There is much still to be done. I am optimistic to this extent—that I think that quantum mechanics, at our disposal to-day, is entirely adequate for a final electron theory of metals, or for any other physical theory which can treat the velocity of light as infinite. But metal theory is still far from adequate; I mean, of course, that part of the complete theory of metals is to deduce from the properties of atoms and the principles of quantum mechanics that a collection of, say, copper atoms with a reasonable energy content will form a metal and not, for example, a gas. The theory must next specify what simplifications may or may not be made in the further treatment of conduction.

In the work I have described these more fundamental problems have not been touched, but I think that a very promising beginning has been made on them by Slater. It appears likely that this work and the complete theory when it comes will very greatly modify the simple model which we have used hitherto. But part of my faith in quantum mechanics is derived from the fact that for any physically reasonable model it provides results which are always in good sensible accord with the requirements of experience. Theory and experiment may both be pushed ahead in the confident expectation that we are on the right lines and that progress will be sure and not particularly slow.

* Bloch (*Zeitschrift fur Physik*, vol. 61, p. 206, 1930) has still further advanced the theory by improving it for low temperatures with the help of very important new methods developed by Slater (*Physical Review*, March, 1930).

Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

part in the development of airship transport, and that airship-meteorology must be developed along with airship-architecture and airship-mechanics. It was therefore only natural that when the Air Ministry despatched a mission to South Africa, Australia, New Zealand, and Ceylon to confer with the governments on airship routes and to survey possible sites, Giblett should be a member. On this journey, which lasted from May 5, 1927, to December 17, 1927, Giblett met the official meteorologists in the Dominions mentioned and also those in India and Egypt. Everywhere he made friends and impressed everyone with his scientific judgment and enthusiasm for his scientific work. He explained the problems and was highly successful in enlisting the co-operation of the various meteorological services in initiating the meteorological observations, both surface and upper air, on which alone a reliable survey of the atmosphere can be made.

During Giblett's absence the collection of data of upper winds and thunderstorm frequency in all parts of the world, which he had planned before leaving, had proceeded apace, and progress had been made in an investigation into the structure of the wind which will be a piece of classical work when the results are published.

The time had now arrived for making detailed plans for the journeys of the new airships *R100* and *R101*. At first it was proposed that both these airships should be employed on the India route, but early last year the plans were altered and it was decided that *R100* should go to Canada instead of to India. This necessitated a new and rapid meteorological survey of the Atlantic crossing which could only be made with the aid of synoptic charts. Much work was done, mainly by Giblett personally, to calculate the time taken to reach Canada on different routes under different weather conditions. In co-operation with the navigators he carried out on paper a number of crossings of the Atlantic. A date of departure would be chosen and then from the synoptic chart of the day a course would be laid down. The next day's chart showed where the airship would have been and then the course for the next day set. In this way the whole crossing was worked out in detail. A large number of occasions were studied and the statistics of the time taken on the different routes were discussed. An interesting result came out, namely, that the track across the north Atlantic, in spite of its greater winds and bad weather, was more frequently a better crossing than one farther south where the weather as a whole is much better. This was against the opinion generally held.

Simultaneously, in conjunction with the wireless staff, detailed plans for the collection of data by the airships when in flight were worked out, and areas delineated in which the ship would receive its forecasts from specified meteorological services, these being the meteorological services of London and Canada on the Canada route and those of London, Malta, Egypt, and India on the India route. A scheme for handing over responsibility from one service to the other was worked out in great detail.

Those of us who worked with Giblett were much impressed with the thoroughness with which he planned his organisation. It is impossible here to go into any further details of this work, but sufficient has probably been said to indicate the remarkable organising powers of Giblett. He was given almost complete freedom in working out his plans, and he never failed in the trust reposed in him.

There is not space to say much about his purely scientific work: but Giblett was one of our very best meteorologists. He worked on turbulence, and applied the new work of Taylor and Richardson to the problem of evaporation from a large expanse of water. He was an enthusiastic follower of the Bergen school of forecasting and made use of the new knowledge of 'fronts' in all his forecasting for airships. The importance of atmospheric disturbances for the safety of airships led him to a detailed study of line squalls and water spouts, and his paper on line squalls, which he read before the Royal Aeronautical Society in 1927, contains the best review of our knowledge on this subject which exists.

Added to his ability as a man of science and as an organiser, Giblett possessed a charming personality. This was a great asset, for it endeared him to the technical officers with whom he worked, and he became a close personal friend to Colmore, Scott, and Richmond. It is heartbreaking to those of us who worked during the last five or six years with Giblett to see all his plans destroyed before they were put to the test, and the loss of so much knowledge and experience is a disaster compared with which the material loss is absolutely insignificant.

Giblett leaves a widow and daughter three years old, to whom, as well as to his mother, the sympathy of all will go out.

G. C. SIMPSON.

LIEUT.-COL. V. C. RICHMOND, O.B.E.

VINCENT CRANE RICHMOND, who was killed in the disaster to the *R101* on Sunday, Oct. 5, was the Assistant Director of Airship Development (Technical) at Cardington, and as such was responsible not only for the design work there but also for the control of airship research. He was born on Jan. 21, 1893. His education at the Royal College of Science, London, was that of a physicist rather than a mathematician, and it was indicative of his capacity that he was undertaking work that needed not only an understanding of those subjects but also considerable engineering knowledge as well.

Richmond's connexion with airships dates from 1915, when he was dealing with the manufacture of envelopes for non-rigids for the R.N.A.S. The design of the gas-bags and the methods of taking the stresses in the *R101* showed many signs of his experiences of those days. His experience of rigid airships was chiefly commenced in 1919, when he was attached to the Inter-Allied Commission in

Germany, in the department that dealt with the surrender of airships. It is probably no secret now, that as a result of his experience there he was convinced of the folly of the school of thought, then in the ascendency, that all the Zeppelin work then on hand should be destroyed and the organisation disbanded. Just how far his opposition to this policy influenced the official decision to reverse it, one outside those august circles is not permitted to know, but the many tributes that members of the Zeppelin Companies' staff have paid to him show that they have a full appreciation of his courage and far-sightedness upon this occasion.

One of Richmond's earliest problems at Cardington was that of carrying out full-scale experiments for the elucidation of many unsolved problems upon the co-ordination of wind-tunnel and full-scale test results. At this stage there were alarming discrepancies, and the existing information upon heavier-than-air craft was not of great use, as the conditions were so essentially different. The *R34*, upon which he carried out his experiments, then provided a fresh problem by breaking away from the mast and proceeding upon her now historic flight over the North Sea and back. The present-day British mooring system shows many signs of Richmond's ingenuity in dealing with the weaknesses made apparent by that mischance. It is no mere expression of opinion to say that it is completely successful. During last spring the *R101*, at the new mooring-mast, weathered one of the worst gales experienced in Great Britain for many years past.

Richmond's position as designer of the *R101* presented him with many problems that would have defeated men of less breadth of vision. He had to hold the balance between a set of conflicting requirements that must have been almost unparalleled in the history of scientific research. He had to hammer out an almost entirely new principle of construction that should overcome the weaknesses in previously accepted methods, as made apparent by the failure of the *R38* some years before. His materials were new and none too thoroughly investigated then. It was decided that every theory about which there was any possible doubt should be supported by a test upon a full-scale section of the structure. He had to satisfy a panel of independent experts who would have the eventual responsibility of certifying his ship as airworthy. Finally, he had to collaborate, as the necessity arose, with the designers of the sister ship, the *R100*.

During the last few years Richmond had been lecturing upon airship design at the Royal College of Science, South Kensington, and whatever the future of airships may be, the information disseminated through that source, and his students' personal remembrance of their teacher, will remain as, at least, one monument to his memory. "Operæ pretium est."

WE regret to announce the following deaths:

Dr. D. Adamson, past president of the Institution of Mechanical Engineers, on Oct. 11, aged sixty-one years.

Dr. H. R. H. Hall, Keeper of the Egyptian and Assyrian Antiquities, British Museum, on Oct. 13, aged fifty-seven years.

Prof. Paul Wagner, director of the Agricultural Research Station at Darmstadt from 1872 until 1923, on Aug. 26, aged eighty-seven years.

Dr. C. Powell White, for some years director of the Helen Swindells Cancer Research Laboratory at the University of Manchester, and pathologist at the Christie Hospital, Manchester, and a member of the executive of the British Empire Cancer Campaign, on Sept. 26, aged sixty-three years.

News and Views.

A FEATURE of the developments of electron theory dealt with by Mr. R. H. Fowler in the Supplement which we publish in this issue of NATURE is the extent to which older ideas have proved amenable to the requirements of quantum mechanics. The 'electron cloud', for example, has persisted, to provide, with certain modifications, the physical picture upon which most aspects of the theory are still developed, and the conception of a work-function for the passage of an electron through a surface has again emerged in the expressions for thermionic emission in a form little different, for practical purposes at least, from its original one. The amount of co-ordination and clarification of ideas effected by the quantum mechanics is nevertheless enormous, and it appears the more remarkable when the wide range of the electrical properties of metals to be explained is taken into account. Whilst there are still outstanding problems, notably in connexion with supra-conductivity and magnetic phenomena, as well, of course, as the fundamental ones referred to by Mr. Fowler at the end of his lecture, it will probably be generally admitted that his expectations are not unduly optimistic. Mr. Fowler has very modestly done less than justice to the importance of his personal contributions to the subject, which have been published in "Statistical Mechanics" and in numerous papers in the *Proceedings of the Royal Society* and the *Proceedings of the Cambridge Philosophical Society*.

As will be seen from Mr. Fowler's May lecture, the lines of experimental research which theory indicates as being probably most profitable at the present time would seem to be the electron emitting properties of surfaces, the properties of single crystals, galvano-magnetic phenomena generally, and supra-conductivity. Probably no stimulus would be required for the first two in any event. Both have practical applications of much importance, one in connexion with thermionic devices and photoelectric cells, and the other as the rational line of approach to a proper understanding of the elastic and electrical properties of the ordinary metals of engineering practice. The investigations of the magnetic properties of materials that are called for do not, however, appear likely to be capable of such applications, and the same is true

to an even greater extent of the results to be obtained from low-temperature work. Magnetic and cryogenic laboratories are expensive to equip and maintain, and progress in these two directions may prove to be slower.

"THIS very year of grace", said Sir William Hardy, in his presidential address to the British Association of Refrigeration, "is not far from the three hundredth anniversary of the birth of modern science." Science is still in its raw youth; yet when we think of what it has already achieved, both as a philosophy and as a utility, the belief in an indefinite future of progress upwards for humanity scarcely surprises us. Sir William Hardy told his audience that he would leave the hillock which offered a view of the relation of science to industry in order to climb a hill whence the outlook on modern science was wider. Those who journeyed with him must have returned refreshed in spirit and eager to explore what lies beyond. Modern science is both a mode of thought and an austere discipline; it regards nothing as impossible, takes nothing for granted, and accepts nothing on authority. Modern science, which like other philosophies gives one of the many answers to the questions where man is and whither he is going, is not merely a docile slave which ministers to our comfort and our convenience; yet it cannot help contributing directly to the material well-being of mankind, for knowledge leads to mastery over the forces of Nature. Indeed, so great and so obvious is the material utility of science that its deeper significance has become obscured. The great utilities of science have been won not by aiming at them; they are the result of the organic growth of a vast body of interrelated knowledge. Natural science is a philosophic system which a man who would serve industry has to master as well as he can, and the more mastery he has the better services can he render.

EXCEPTIONS to the paradox of the utility of science, that the short cut to utility is to forget it, are apparent only, said Sir William Hardy; they exist when the needs of industry are ahead of scientific knowledge. Thus the search for new industrial metals is largely a matter of hit or miss, of trial and error. Astonishingly successful as the method has been, it would be dropped immediately if we knew enough about the solid state, for the development of fundamental laws results in an immense saving of time and labour. Assistance can be rendered to the fishing industry by improving the treatment of fish oils, but here again the shortest road to utility lies in the direction of an increase by experiment of the general body of fundamental knowledge. While it is true that material progress follows advance of thought and the development of fundamental considerations, we must not overlook the effect which such material progress itself has on our whole outlook. The first reaction to Copernicus's deposition of man from the important position which ancient belief and ancient science had given him was anger, and the second pessimism. He owes the re-establishment of confidence in himself and belief in his destiny to the tremendous triumphs of modern science both on the theoretical and on the practical sides. Yet the theory of progress needed a century to gain sufficient ascendancy to open the way for the tremendous optimism which seems so natural to us. Sir William Hardy also referred to the part which the State should take in fostering science on behalf of industry. Industry still regards science as a visitor to be warmly welcomed only in times of emergency. Mistrust of science will prevail so long as a polite education, in which a training in scientific method and outlook has no place, is accepted as complete. The collaboration of the State in scientific advancement is legitimate and necessary, but in the future a greater share of the burden must be shouldered by industry itself, for applied science cannot grow except in association with fundamental science.

THE incoming president of the Royal Aeronautical Society, Mr. C. R. Fairey, delivered his presidential address on Oct. 9, taking as his subject "The Growth of Aviation". Comparing the feats of the pioneers with present-day achievements, Mr. Fairey remarked that whereas in 1903 the distance performance and its duration were 852 ft. and 59 sec. respectively, the corresponding figures for the present time are about 5000 miles and 67 hours. In 1903 flight was just above the ground and speed about 30 miles per hour; recently a height of 42,000 ft. was reached and the record for speed is 357 miles an hour. Progress has been continuous during the past twenty years, but it seems that, at any rate as regards speed and height, the limit for present methods will soon be reached. Military aviation has, in the past, provided the greatest support to the growth of the technical side. Commercial aviation has made remarkable strides and with present progress should soon be self-supporting. Australia had half the mileage of Great Britain in 1922, but in 1929 had equalled it; Canada had less than 200,000 miles in 1923, passed the total for Great Britain in 1928, and in 1929 nearly doubled it. The rate of expansion in both countries has been exceeded only by the United States. The total mileage of commercial aircraft in the United States in 1929 was 104,000,000 miles, an increase of 375 per cent of that for 1928 and equal to 80 per cent of the total flying mileage of the world. Subsidies for aviation last year throughout the world reached the total of £5,000,000, and the output of machines was not less than ten thousand. In the United States civil aviation is of more importance than the military side; in Great Britain 70 per cent of the manufacturing firms depend on Government contracts, but last year 15 per cent of the total products was exported. The future of aviation rests with the development of commercial flying.

GOVERNMENTS are slow to recognise the needs of scientific work, on the western side of the Atlantic as well as on the eastern, and the growth of the U.S. National Museum is a case in point. Started with appropriations from the funds left by an English man of science, James Smithson, the museum owed little to Congress until in 1877 it granted 250,000

dollars for a building. This, now the Arts and Industries Building, was supplemented in 1907 by the New National Museum Building, for which Congress voted 3,500,000 dollars. For long this building has ceased to be adequate housing for the enormous collections, and after much pleading Congress has passed, without a dissenting vote, the Smoot-Elliott Bill authorising an appropriation of 6,500,000 dollars for the enlargement of the U.S. National Museum. The new extension of the Natural History Building will roughly double the present floor space of nine and a half acres, and in addition to increased room for exhibits, this will permit enormous expansions of collections now hopelessly overcrowded. It is interesting to know, as showing an aspect of museum work which does not catch the public eye, and of which even scientific men are sometimes unnecessarily ignorant, that as against 1400 mammals on exhibition in the museum, 210,000 are included in the study collection - a proportion that suggests something of the hidden reserve of research and classification that lies behind the office doors.

WITH the co-operation of the authorities of various national museums, the Museums Association organised a short training course for curators during the week Oct. 6-11. The course was attended by 33 students from provincial museums, for the most part junior assistants, though a few seniors were glad to avail themselves of this opportunity. The gathering was welcomed in the new Conference Hall at the Science Museum by Sir Henry Lyons, when an opening address on first principles of museum work was given by Dr. F. A. Bather, and Dr. E. E. Lowe discussed some fundamental points in museum practice. Succeeding days were devoted to the Victoria and Albert Museum, with demonstrations on textiles, wood furniture, ceramics, prints, and the Circulation Department; the Natural History Museum, with demonstrations on habitat groups, casting of whales, preparing spirit specimens, and preparation of fossils for exhibition; the National Galleries in Trafalgar Square and at Millbank, with talks on storage, cataloguing, and the explanation of pictures; the laboratory of the British Museum, with a lecture on restoration of Egyptian relics.

THOSE who attended this course for museum curators expressed their high appreciation of the arrangements made and of the information imparted. There can be no doubt as to the success of the experiment, and the Museums Association will be encouraged to repeat it. The chief obstacle is the difficulty that members of the staff of provincial museums have in getting leave of absence and in paying the necessary expenses of travel and maintenance; hence the compression into five days of demonstrations that would, with more profit and less weariness, have occupied a fortnight or more. It is to be hoped that the authorities governing museums will see the benefit to themselves of helping the Association over this obstacle, and will not rely entirely on the generosity of individuals or on pecuniary assistance from outside.

THE Council of the British Association has forwarded for the consideration of the Government a resolution urging that effect be given to the recommendations of the Royal Commission on National Museums and Galleries, for the establishment of a National Open-air Folk Museum. The view is expressed that such a museum would best fulfil its objects if established in or quite close to London, and it is further suggested that the possibility might be considered of utilising the gardens of the Royal Botanic Society in Regent's Park for this purpose, in view of their admirable situation and the proximity of a building (St. John's Lodge) suitable for exhibition purposes and offices; provided this can be done without interfering with the use of such part of the gardens as may be available for the scientific work of the Botanical Departments of the University of London.

THE suggestion has recently been made that the swarming of bees is a social expedient due to the need for relief from overcrowding. In the September number of *Discovery* there is a remarkable account of the inducement of artificial swarms amongst termites, which indicates that amongst them climatic conditions may be the stimulus which sets the swarming instinct in motion. Under natural conditions, the swarming of termites takes place at the end of the equatorial summer, that is to say, at the beginning of the rainy season. The Bazinza people, natives of the south-western coast of the Victoria Nyanza, however, can induce swarming at almost any time, in June, July, August, or September, the last being even two months before the normal breaking of the rains. The process, described by R. A. J. Maguire and illustrated by photographs, is an elaborate one. A shelter of leaves is built over a termite mound so that the termitary is in subdued light, suggesting an overcast sky; sticks are beaten to suggest the patter of rain, and water is sprinkled over the 'nest'. Two hours of such activity bring the first winged termites from their galleries, and an hour later the artificial swarm, containing several thousands of 'fertiles', is over. The natives pound these, after the wings have been removed, into a paste which may be eaten raw, but is usually fried and eaten as a flavouring to grain or meat. The artificial swarm raises several biological problems: Is the colony for six months in a condition of overcrowding and awaiting the stimulus of season to break away, or is the stimulus of suitable conditions so strong that it compels swarming whether the termitary is overcrowded or not? Are winged forms specially associated with swarming, or do they exist in the termitary many months before normal swarming takes place? Finally, does the fact that normal swarming at the beginning of the rains may follow artificial swarming in the dry season, mean that between times fresh legions of winged fertiles have been produced to make up the lost numbers?

MARCONI'S Wireless Telegraph Co., Ltd., has built or received orders for many broadcasting stations in Europe; these include three stations in Switzerland, two in Poland, one in Finland, one in Rome and one in the Vatican City, and others at Trieste, Warsaw, and Brno. The Irish Free State has now placed an

order with Marconi's for a sixty kilowatt broadcasting station. When completed it will be one of the most powerful stations in Europe. It will not begin to operate until the autumn of 1931. The waves will be controlled by an oscillating quartz crystal compensated for temperature. This will insure that the frequency of the transmitted waves will be kept constant within very narrow limits. The wave-length used will probably be 413 metres. It is interesting to note that power to operate the station will be supplied from the Shannon high-pressure network. Water-cooled and air-cooled valves will be used in the different amplifier stages. The aerial will be suspended from two lattice steel masts, each 330 ft. in height, and it is at a considerable distance from the transmitting building, in accordance with modern practice. Arrangements have been made to enable the aerial power to be doubled at a later date if required. The alternating current from the Shannon grid will be rectified at the station by a Brown Boveri arc rectifier.

DURING the last eighteen months, progress has been made in building the Battersea generating station. In about two years' time the two huge 80,000 kilowatt generators which have been ordered will begin working. Deptford West, another generating station of the London Power Company, will have a capacity of 195,000 kilowatts. A third large station will be the new Fulham station, the designs for which have been approved by the Central Electricity Board. As these stations will burn thousands of tons of coal daily, the gaseous products of combustion from which will be blown over central London, it is satisfactory to learn from a patent specification, No. 334,660, that Dr. S. L. Pearce, the chief engineer of the London Power Co., and his assistants, are confident that the fumes problem has been overcome. Apparently there is little to fear from grit, dust, and noxious gases when the new stations begin to help the supply of electricity to London. It will not be long before the present stations are working at their maximum capacity, and there will soon be an urgent demand for more electric power. The method Dr. Pearce employs is to cause the products of combustion to pass through a conduit containing a series of spray washing departments. The direction of flow of the gases is altered several times, and they pass through curtains of liquid. The gases are subjected to the action of free iron or other suitable agents so as to convert the sulphur dioxide into sulphur trioxide. A method is also suggested of mixing the gases with ozonised air. Several other claims are made. By the use of hot water and catalysts, the sulphur dioxide, sulphurous acid, and sulphites can be readily converted into substances which can easily be removed.

IN a recent address entitled "Surgery in the Immediate Future", delivered at Guy's Hospital Medical School, and published in the *British Medical Journal* of Oct. 11, Lord Moynihan repeated the assertion for which he had previously been criticised, to the effect that the craft of surgery has now almost reached its limit in respect both of range and of safety. While, however, surgery as a mere mechanical craft can scarcely advance any further, he maintained that it must still continue as a weapon of therapeutics and a weapon of research. He suggested that in the immediate future surgery will concern itself with the sympathetic and parasympathetic nerves in the chest, abdomen and pelvis, intrathoracic diseases, ductless glands, and questions of immunity. He deplored the absence of close affinity between laboratory workers, particularly physiologists, and clinicians, and attributed this defect to a lack of clear vision on the part of both. The new outlook in surgery demands a change in the training of the medical student, which should include a study of logic and philosophy, so as to render his mind more efficient and adaptable. In conclusion, Lord Moynihan criticised the Medical Research Council, which, he says, is too aloof from the day-to-day practitioner of medicine, and out of touch with the desires and needs of clinicians. He holds that the Council should either have a larger representation of clinical medicine and surgery or summon practitioners in an advising capacity.

SCIENCE Service, the well-known American science news agency, has supplied the American press for a considerable time with a regular series of simply written articles on meteorology entitled "Why the Weather?" by Prof. C. F. Talman, the librarian of the United States Weather Bureau. A large number of these have appeared, and continue to appear at frequent intervals, normally as single sheets, each dealing with one particular item of meteorology. The date on which it is intended that the article shall appear is always indicated. This arrangement secures their appearance at a time when the matter under discussion is likely to be of particular interest to the general public. Prof. Talman is to be congratulated on the attractive way in which he writes, and on his unfailing supply of fresh material. With a meteorological library of the size of that of the U.S. Weather Bureau to draw upon, there is no reason why the supply should ever fail, and it is to be hoped that the standard of accuracy set in the early articles can be maintained in the future. In this respect one regrets to see, in a recent contribution entitled 'Buchan Spells', symptoms of a falling off. The impression given in this example is that Alexander Buchan—a sound meteorologist of extraordinary energy, to whom we owe a great debt—was guilty of publishing results of "no scientific value whatever". The fact is that certain writers have attributed ideas to Buchan that the latter almost certainly never entertained, and have made an unjustified practical application of Buchan's results on 'recurrences' of weather to long-period weather forecasting.

THE continued improvement in the maps of the Ordnance Survey of Great Britain in recent years is a matter of general comment. In the Report of the Progress of the Ordnance Survey for 1929-30, the Director indicates some further changes that are proposed. The 1-inch map was originally an engraved map, and the engraved plate formed its basis until within the last few years, when for the 'popular'

edition of the 1-inch map of Scotland drawings reproduced by the helio-zincographic process were used. Drawings are to be used also in the fourth revision of the 1-inch map of England and Wales which has recently been begun. The break with the engraved map will then be complete. Other changes include a more pleasing style of lettering, improved symbols for main roads and railways, the restoration of parish boundaries, and the indication of National Trust areas. The lettered and numbered two-inch reference squares will be abandoned in favour of a grid of 5000 yards side, so that positions can be easily defined by east and north co-ordinates. It is proposed also to incorporate the title, scale, and references as part of the border of the map, instead of leaving them in the blank margins.

The building of large steel frame buildings in cities is often accompanied with so much noise that it becomes very objectionable to dwellers in neighbouring houses. It seems to us that from this point of view alone the new electric welding methods that are coming into use should be welcomed. In the *Westinghouse International Magazine* for August a description is given of the new eleven-story building at East Pittsburgh, U.S.A., which will house the laboratories of the company. The whole of the structural steel framework has been joined up by arc welding without using a single rivet. As 1500 office workers are only a few feet away from the building, considerable annoyance has been avoided. The weight of the framework would have been increased three per cent if rivets had been used. The weather was very inclement when the foundation stone was laid. As this, however, was done in miniature in a reception room several hundred feet away from the actual corner stone which, through a mechanism controlled by photoelectric cells, followed exactly the motion of the model, the heavy rain did not matter. In one of the laboratories in the new building any kind of weather can be imitated so that devices can be tested under the most trying conditions. In another there will be a working model of an electric transmission system supplying a group of towns. There is also a laboratory where artificial lightning can be produced by simply turning a switch. This will be used for practical tests of lightning arresters. The flashes are photographed and analysed by the Norinder oscillograph.

Further developments in the equipment of eastern Canada with water-power are described in *Quebec* for July, in an article on the Beauharnois Canal project on the St. Lawrence river some twenty-five miles above Montreal. From Lake St. Francis on the river above Valleyfield, the new Beauharnois Canal is being cut to Lake St. Louis, a wide portion of the river lower down. The canal will be about fifteen miles long and will carry a quarter of the flow of the river. The fall of 83 feet is to be concentrated at the lower end and is planned to produce 500,000 horse-power, although less than half that amount will be available in two years' time. A 27-foot navigation channel in the canal will be part of the scheme for deep water access to the great lakes. The power will be readily utilised in southern Ontario and Quebec.

A public lecture entitled "Some Biological Aspects of Population" will be given at the London School of Economics and Political Science by Prof. Lancelot Hogben, research professor of social biology in the University of London, on Thursday, Oct. 23, at 5 P.M. The chair will be taken by Mr. H. G. Wells. Admission is free, without ticket. The recent foundation at London of a research chair in social biology is an event of importance to sociology generally, and Prof. Hogben's inaugural address should mark a stage in the study of human society.

Under the Order in Council dated Feb. 6, 1928, the Lord President of the Council has appointed Dr. E. J. Butler, Dr. Kenneth Lee, and Dr. N. V. Sidgwick to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. The following members of the Advisory Council have retired on completion of their terms of office: Prof. V. H. Blackman, Prof. F. G. Donnan, Prof. F. A. Lindemann. The appointment of Sir Ernest Rutherford to be chairman of the Advisory Council, as from Oct. 1, was announced in May last.

The second Henry Herbert Wills Memorial Lecture in physics, founded to commemorate the gift of the laboratory to the University of Bristol, will be given by Prof. J. Franck, of the University of Gottingen, on Saturday morning, Oct. 25, at 11.45, in the Henry Herbert Wills Physical Laboratory of the University of Bristol. The title of Prof. Franck's lecture will be "Relations between Spectroscopy and Chemistry". Visitors from other universities are cordially invited.

The twenty-first Annual Exhibition of Electrical, Optical, and other Physical Apparatus is to be held by the Physical Society and the Optical Society on Jan. 6–8, 1931, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a Trade Section and a Research and Experimental Section, and the section for the work of apprentices and learners, introduced at the last Exhibition, is to be continued. The Research and Experimental Section will be arranged in three groups: (*a*) exhibits illustrating the results of recent physical research; (*b*) lecture experiments in physics; (*c*) historical exhibits in physics. No charge will be made for space or catalogue entries in the Research and Experimental Section. Offers of exhibits, giving particulars of space and other facilities required, should be communicated, not later than Oct. 30, to the Secretary, Exhibition Committee, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

We much regret that throughout the review entitled "More Antarctic Meteorology" in Nature of Oct. 11, p. 561, the name of the author of the work noticed, Dr. Edward Kidson, was incorrectly spelled Kitson.

A catalogue (No. 14, October) of many secondhand books on botany has been received from Mr. J. H. Knowles, 92 Solon Road, S.W.2. It is one of the fullest recently sent to us.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A handicraft master at the new Metal Work Room of the Bermondsey Central School, with qualifications in metal work—The Education Officer (E.2), County Hall, Westminster Bridge, S.E.1 (Oct. 20). A laboratory assistant at the County and City Mental Hospitals, Gloucester — The Medical Superintendent, County and City Mental Hospitals, Gloucester (Oct. 20). An assistant engineer inspector (mechanical) for service in England under the High Commissioner for India—The Director-General, India Store Department, Belvedere Road, S.E.1 (Oct. 24). Certifying officers under the Ministry of Transport for the various Area Traffic Commissioners' Offices in Great Britain—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Oct. 24). A whole-time member of the Medical Board for Silicosis—The Industrial Division, Home Office, Whitehall, S.W.1 (Oct. 25). An assistant director of public health (woman), for maternity and child welfare work in the Madras Presidency—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Oct. 25). A junior engineer under the Safety in Mines Research Board, for research on colliery wire ropes—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Oct. 27). A research assistant for physico-chemical work on cellulose at the Manchester College of Technology—The Principal, College of Technology, Manchester (Oct. 31). A research assistant in the University of Leeds for work in connexion with chemotherapy—The Registrar, University, Leeds (Oct. 31). A professor of pathology at the Medical College, Madras—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Nov. 3). A technical officer (Grade 1) at the Royal Aircraft Establishment for mathematical work in the application of results of current research to the design of aircraft—The Chief Superintendent, R.A.E., South Farnborough, Hants (quoting A.389) (Nov. 5). An assistant lecturer in physics in the University of Sheffield—The Registrar, University, Sheffield (Nov. 8). A graduate master for biology at the Lord Wandsworth Agricultural College, Long Sutton, Basingstoke—The Principal, Lord Wandsworth Agricultural College, Long Sutton, Basingstoke. A junior botanist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, 2-4 Idol Lane, Eastcheap, E.C.3.

Our Astronomical Column.

Recent Sunspots.—A large group of spots has recently passed across the sun's disc, with the centre of which it was almost coincident on Oct. 11·0. This group, visible for some days to the naked eye, is the largest that has appeared since last December. Its formation was that of a stream or 'bipolar' group, and there were appreciable changes from day to day in the appearance of the component spots. The activity of the group was also clearly evident by spectroscopic observations made at the Royal Observatory, Greenwich, especially between 9^h and 10^h G.M.T. on Oct. 6, when the observed radial movements of hydrogen gas, in the form of dark filaments near the leader spot, were of the order of 150 km./sec. A considerable tract of faculæ (visible in an ordinary telescope when the spots were near the sun's limb) and of bright hydrogen flocculi (seen at all times on the disc with the spectroheliloscope or on spectroheliograms) accompanied the group, mainly in its rearward portion. Brilliant points or small patches of flocculi of a transient nature were also occasionally seen, in particular one that appeared with the formation of the dark filaments described above. The details of the position of the group are as follows:

Date on Disc.	Central Meridian Passage.	Long.	Max. Area.
Oct. 4-17	Oct. 11·0	$7\frac{1}{2}°$ N.	1300 millionths of sun's hemisphere.

Eros.—The errors of the ephemeris of Eros that was published by Prof. G. Witt in vol. 85, No. 9, of *Mon. Not. Roy. Ast. Soc.* in 1925 for the present apparition are proving unexpectedly large. In *Astr. Nach.* No. 5729 he published an improved ephemeris for October 1930; but he now finds that his corrections in this were too small, and *Astr. Nach.* No. 5736 contains an ephemeris by him for November 1930 which has been further corrected with the aid of recent observations. The average correction of the original ephemeris (*Mon. Not. Roy. Ast. Soc.*, vol. 85) for November is $-40^{sec.}$ in R.A., and $+5'$ in declination. It is estimated that it will exceed a minute of time at the time of nearest approach next January. Since the list of comparison stars was drawn up on the basis of the old ephemeris, the error will cause some inconvenience for those who are taking photographs of large scale. Prof. Kobold suggests centring the plate on the old predicted position of the planet, so as to include the selected stars, but some of the observers express a preference for keeping the planet central on the plate, and sacrificing some of the comparison stars. The cause of the error in the ephemeris is not yet located, but as the predicted positions in 1928 were already some 3^{sec} of R.A. in error, there is probably some undetected error in the computations, for an epoch not very long before 1928.

Tempel's Second Periodic Comet. This comet was discovered in 1873 and was found to have the short period of 5 years and 2 months. It has now completed eleven revolutions since its discovery; it was observed in 1873, 1878, 1894, 1899, 1904, 1915, 1920, 1925, 1930. An ephemeris was published in the Handbook of the British Astronomical Association for 1930; with its aid Mr. H. E. Wood detected the comet photographically at the Union Observatory, Johannesburg, on Aug. 26; it was a faint, ill-defined object of the twelfth magnitude.

The following observations are to hand:

Date.	R.A. 1930·0.	S. Decl. 1930·0.	Observer.
Aug. 26·73172 U.T.	$15^h\ 21^m\ 7·20^s$	$11°\ 58'\ 35·6''$	H. E. Wood
,, 28·72106 ,,	15 25 56·28	12 41 16·2	,,
Sept. 22·05471 ,,	16 35 53·6	20 57 15	G. van Biesbroeck

The last observation was made at Yerkes Observatory (*U.A.I. Circ.*, 298).

The following approximate orbit is given in the Handbook:

$$\begin{array}{rl} T & 1930 \text{ Oct. } 5·5 \text{ U.T.} \\ \omega & 186°\ 34'\ 32'' \\ \Omega & 120°\ 52'\ 0'' \\ i & 12°\ 46'\ 33'' \\ \log q & 0·1184 \\ e & 0·5603 \\ \text{Period} & 5·162 \text{ years} \end{array} \left.\begin{array}{l} \\ \\ \\ \\ \end{array}\right\} 1930·0$$

The comet is too far south for convenient observation in England.

Research Items.

Medieval Indian Culture.—In the *Indian Antiquary* for September, Mr. K. de B. Codrington continues his study of the Ajanta frescoes, dealing with ships and boats, horse furniture, arms, metal-working, and pottery. The simplest form of boat is canoe-like and has two masts. It is clearly not a dug-out. Boats used for horse and elephant transport are broad in the beam and have grotesque *makara* figureheads. The large boat of Cave I has a high-pitched and finely cast bow and stern, on both of which *oculi* are painted. The passengers sit under an awning. A merchant ship has a full set of sails with two paddlers amidship. The arms show spears with short triangular blades and ferrules. Daggers are of one type with triangular blades and shaped grip. Three types of shields occur: a small parrying shield of metal; a round shield, usually of hide; and a curved oblong shield with tasselled edges which seems to have been made of black and white bamboo basket-work. Both composite and long bows are found. The swords are of three types: a type comparable with the modern *kukri* with the cutting edge on the incurved side; the long Indian sword with straight pointed blade; the leaf-bladed *pattisā*. All the Ajanta types have survived to-day and the straight and leaf-blade swords are found in Tinnevelly and Nilgiri iron age urn-burials. All have one type of hilt only—an angular V-shaped guard and disc-like pommel. The blade is usually strengthened by processes which run up it either in the middle or along the reverse, necessitated by the peculiar properties of Indian steel, which lacks flexibility. Little can be said of the metal work. Beside lamps and gadrooned pots in Cave I, the only articles recognisable are the mirrors. These are circular with a knob behind, pierced to take a ring or cord. This form is specially associated with China. Mirrors are rare in archæological finds in India, only three being recorded.

Stone Ages in South-east India.—The contents of *Antiquity* for September include a communication by M. C. Burkitt and L. A. Cammiade on palæolithic implements from sites in south-east India situated in the wild country in the Eastern Ghats, which run parallel to the coast for some three hundred miles. The climatic succession which has been worked out for this area may be correlated with the climatic changes now being worked out in East Africa. Four cultures are distinguished, each with its characteristic series of industries. Series 1 is distinguished by the presence of hand-axes made of quartzite which can be closely paralleled by finds from Africa. Thus hand-axes from the Bhaavanasi gravels and from Chodavaram are compared with the gigantic specimen from Nigeria now at Cambridge and examples from Victoria West in South Africa. Series 2 are flake industries with some much more neatly made hand-axes, the material used being chiefly quartzite. Series 3 is characterised by the occurrence of slender blades with blunted backs, a few burins, planing tools, and end-scrapers. This series is best found at sites at the east and west ends of the Nandi-Kanama Pass. Small crescents perhaps link Series 3 with Series 4, a rather monotonous series of microliths with some larger tools. A large number of this series are found on the surface near the Godaveri. They link up with the Wilton of South Africa. The comparative poverty of industries of Series 3 would suggest that we are here on the periphery of the distribution of the Upper Palæolithic found in South, North, and East Africa and extending as far as Transjordania; while Series 4 forms part of the great spread of mesolithic culture.

Education of Cats.—A Chinese psychologist, Zing Yang Kuo, of the University of Chekiang (according to Science Service, of Washington, D.C.), has been testing the reactions of cats to rats and mice. Kittens were isolated at an early age and never knew rats, others were given rats and mice for companions almost from birth, still others were allowed to see their mothers catch and kill rats. Some kittens were brought up as vegetarians, others on a diet of meat and fish. Of the 21 normally educated kittens which watched their parents rat-hunting, 85 per cent killed a rat before reaching the age of four months. Of the 20 kittens kept in a ratless environment, only 45 per cent killed rats without being taught; and of the kittens raised with rats, not one ever killed any of its playmates or any rat of its kind, but 3 of these 18 kittens killed other kinds of rats. The vegetarian kittens were as keen as the others to kill rats, but most of them would not eat the rats they had killed. Indeed, after three to four months of a meatless diet, the vegetarians refused any meat. The experiments indicate that the explanation that a cat hunts by 'instinct' is inadequate, and that the reaction of cat to rat is much more complex and variable than has been supposed. "Our study shows that kittens can be made to kill a rat, to love it, to hate it, to fear it, or to play with it."

Distribution of Birds in the open Atlantic Ocean. During Prof. Johs. Schmidt's *Dana* Expeditions of 1920–22 in the north Atlantic and Gulf of Panama, primarily in pursuit of the breeding area of the fresh-water eel, ornithological observations were made by an experienced worker, P. Jespersen (*Oceanographical Results of the Danish Dana Expeditions, 1920–22*, No. 7, 1930. Copenhagen: Gyldendalske Boghandel; London: Wheldon and Wesley, Ltd., 1930, 6s.). The frequency of the birds observed was greater nearer land, and here fulmars, kittiwakes, skuas, and shearwaters predominated, but birds were seen on the entire stretch across the ocean, the open sea being mainly populated by kittiwakes, skuas, shearwaters, and, particularly in the summer half-year, storm-petrels. Contrary to expectation, the number of birds over the Sargasso Sea was less than elsewhere in the open water, and this scarcity (the German plankton expedition of 1889 saw only one bird in seventeen days) was found to be correlated with a relative scarcity of plankton. The distribution of plankton throughout the whole Atlantic, most abundant near the coasts, least abundant in the Sargasso Sea, appears to determine the presence or otherwise of the sea birds. Thus the Sargasso Sea had fewest birds, but the Gulf Stream area, with its considerably larger quantity of plankton, had a greatly increased number of birds—at least ten times as many per day as in the central part of the Sargasso Sea. In the north-eastern corner of the Atlantic, between Great Britain and Iceland and around the Faroes, the largest quantities of plankton were found, and there was a correspondingly rich bird population.

Manganese in Insects.—Qualitative determinations of manganese in the ash of insects made in the Bio-geochemical Laboratory of the Russian Academy of Sciences by A. P. Vinogradov and M. V. Neustrueva (*Comptes rendus, Acad. Sci.*, No. 6, 1930) proved that it is present in all species (30) examined. The quantity varies from 2×10^{-4} to $1{\cdot}2 \times 10^{-2}$ per cent, the Lepidoptera containing less manganese than any other insects. In the species feeding on green parts of plants, the quantity of manganese is usually higher,

but on the other hand it is very high in some insects with different food—for example, in the mole-cricket (*Gryllotalpa gryllotalpa*, L.) and red ants (*Formica rufa*, L.). In the ants, manganese was found to be concentrated mainly in the abdomen, and it may be suggested that this fact has some relation to the physiology of their poison glands, in connexion with the fermentative oxidation processes taking place there and leading to the production of formic acid. In other insects, there is more manganese in the more active species; this may again depend on more active gaseous metabolism. The influence of manganese on fermentative process in other organisms is well known and its rôle in insects may possibly be the same.

A Lethal Gene in Cattle.—The usual method of breeding cattle, in which bulls are mated to their daughters, tends to bring out recessive genes. No less than eight, and possibly ten, recessive lethal genes have now been found in cattle, compared with eleven in all other mammals. One of these, called short spine, has been described by Mohr and Wriedt (*Jour. Genetics*, vol. 22, No. 2), who discuss the best method for testing the genetical condition of bulls to be used for breeding. The new lethal appeared in the Oplandske mountain cattle of Norway. The anatomical condition of the homozygous lethal is described. The vertebral column and sternum are greatly shortened, as are the neck and thorax; the vertebræ are reduced in number through fusion, and the ribs number six or seven instead of thirteen. The head and legs are normal. These calves die at birth. This condition is exactly complementary to the sub-lethal type called amputated, in which the skeleton of the head and legs is chiefly affected. Both show the same type of inheritance. They must have arisen in the germplasm as mutations. Eleven of the short-spine type have occurred among the descendants of a particular bull. It is not known from elsewhere and may have originated in this bull or his immediate ancestors. As it has not spread far, there should be a good chance of preventing its further spread in the germplasm of other herds, and it may be possible to eliminate it altogether by careful breeding.

Origin of Maize.—The origin of maize, which was widely cultivated by the Indians in North and South America at the time of the discovery of these lands, has long been a subject of hypothesis and investigation. The botanical evidence points to Mexico or Central America as the original home of the plant, but it has never been found wild and must have been greatly altered during the long period of Indian cultivation. It has been generally assumed that the wild plant, whatever its form, was extinct, perhaps even in Aztec times. Mrs. Zelia Nuttall (*Jour. of Heredity*, vol. 21, No. 5) now cites documentary evidence which may lead to a different view. The Chevalier Boturini, an Italian traveller and naturalist, published a work in 1746, after spending eight years in Mexico collecting evidence of its former civilisation. He describes the native tradition concerning the origin of agriculture, that while setting fire to the forests to clear them of wild beasts they noticed grains of maize which had been roasted, and finding them delicious, collected fresh seeds to plant in the soil. Boturini asserts that he himself found in New Spain a maize growing wild in the forests, with a small ear and few seeds, but more delicate in flavour than the cultivated kind. This may have been the wild progenitor of maize, since become extinct through deforestation and other causes. That the plant may still survive in Guatemala is suggested by the experience of Mr. Oliver La Farge, an American, who recently found there, at an attitude of 5000-6000 feet, a wild plant used by the natives in May, when the maize fields had only just been sown. This plant had ears about two inches long, "looking rather like oat-sheaves without the 'whiskers', and having the unmistakable flavour of corn".

Root System of the Tree.—Some results of a very intensive study of the root system of the apple and allied fruit trees are presented by V. A. Kolesnikov in the *Journal of Pomology and Horticultural Science*, vol. 8, No. 3, 1930. The root systems of seedlings and young trees were washed free from soil, studied, and measured. As the result of such laborious work, the author is able to present an interesting picture of the gradual growth of the root system. During the season, branch roots emerge, and then again upon these, branches of a lower order, until, in apples and pears, in a growing season of five or six months, roots of eight orders had appeared. Perhaps as a result, the average length reached by a root is not long and appears to tend to a standard length in a variety. Also, the roots tend to die back from the tip, the branches first formed, which lie nearer the base of any root, dying back first; and therefore the root system, around the base of the trunk, tends to become free of young branches with an absorbing surface still active, whilst further from the trunk a dense array of branching roots, those of younger orders still actively absorbent, are advancing farther into the soil, with a habit of growth which will cause them to 'quarter the ground' thoroughly as they advance.

Dutch Elm Disease in America.—Science Service, of Washington, D.C., reports that the Dutch elm disease, caused by a fungus known as *Graphium ulmi*, which has caused serious damage to elm trees in Holland and has spread into other European countries, has been discovered in Ohio. Three trees in Cleveland and one in Cincinnati have been definitely identified as harbouring the disease and destroyed. A number of other suspected trees in the State are under observation, and State and Federal pathologists are on the look out for new infections. The Dutch elm disease was first observed in Holland soon after the War. Its symptoms are sudden wilting, followed by yellowing and dropping of the leaves. Death of the tree follows, either at once or after a few years of struggle. No cure is known.

Nature of Lake Eyre.—Although Lake Eyre covers about four thousand square miles, little was known of its nature or surface conditions until Mr. C. T. Madigan investigated it, first by air and later by motor-car and on foot, last year. Some of his results are given in a paper in the *Geographical Journal* for September. There is no permanent water and the whole bed is dry at times. Two-thirds of the surface is covered by a salt crust from one inch to seventeen inches in thickness. This crust is 95 per cent common salt with some gypsum and small amounts of calcium, magnesium, and potassium chlorides. Underneath there is a damp gypseous clay to a depth of about eighteen feet, below which is a bed of dolomite. The salt has no seasonal banding, which shows that muddy waters do not flow into the basin. There is no probability that the crust is periodically dissolved. Mr. Madigan notes that the most generous calculation could admit a flooding of only 56 inches a year, against an evaporation of 100 inches. The conclusion, apart from the absence of banding in the salt, is that river floods scarcely affect the lake. Local rain would only affect the first third of an inch of the salt, which is soiled with blown debris. Mr. Madigan favours the theory that the salts date from Upper Tertiary to recent times and are cyclic in origin.

Band Spectra of Tin Monoxide.—In a communication received from Mr. P. C. Mahanti, University College of Science and Technology, Calcutta, it is announced that a number of bands occurring in the spectrum of the tin arc in air, most of them already recorded by Eder and Valenta in the oxy-coal gas flame, have been allocated to three distinct systems. The constants for these have the following approximate values in $cm.^{-1}$:

System *A*	29,631	589	830
,, *B*	23,018	800	1045
,, *C*	22,676	589	800

Further particulars will shortly be published elsewhere.

Forbidden Lines of Neutral Oxygen.—In a short note in the first August number of the *Physical Review*, Dr. I. S. Bowen points out that two weak lines at 6302 A. and 6364 A., which occur in the spectra of certain nebulæ, are almost certainly forbidden lines of the oxygen arc spectrum (O I). An analysis of the ultra-violet arc spectrum of this element has been given by Dr. R. Frerichs in the same issue of this journal, fixing for the first time the value of the low metastable terms from which the auroral green line (5577 A.) arises, and from this it follows that new 'forbidden' lines should occur at 6299 ± 5A. and 6363 ± 5A. It is also mentioned that Prof. Paschen has succeeded in obtaining these lines in the laboratory, and has fixed their wave-lengths accurately at 6300·00 A. and 6363·86 A., so that the assignation of the nebular lines is reasonable. The auroral green line itself has now also been produced from a discharge tube with almost the same isolation as in the spectrum of the night sky, a source having been described by Prof. McLennan and Mr. Ireton in the September number of the *Proceedings of the Royal Society*, which yields only this and λ6965 of argon.

Raman Spectra.—The July issue of the *Indian Journal of Physics* contains a group of eight papers on the Raman effect, which add considerably to our knowledge of infra-red vibrations. The substances which have been investigated include both a number of elements (chlorine, sulphur, carbon, and phosphorus) and some fifty organic and inorganic compounds, chosen mainly in groups which permit of the assignation of more or less definite frequencies to definite radicles. An investigation of the polarisation of Raman lines is described, which shows that there is a close similarity between the polarisation characters of the spectra of compounds of similar structure, and so indicates that polarisation is controlled by the geometry of the oscillations. The utility of the Raman effect in the investigations of physico-chemical properties is also well illustrated by one paper on the influence of polymerisation and molecular association on Raman spectra, with special reference to sulphur trioxide, and by a second on the determination of the characteristic frequency of the diamond by this method; whilst there are numerous good reproductions of the actual spectra from which the measurements have been made.

Anti-fogging Agents in Developers.—Since nearly seventy years ago, many and very various substances have been proposed and added to either the emulsion or the developer to prevent fogging, that is, the deposition of metallic silver during development where the plate has received no exposure to light, and probably a decreasing increase of deposit in other parts. It has been generally supposed that these agents slowed development and so gave time for the denser deposits to increase in opacity before the 'fog' began to show. But P. Wulff patented in Germany several organic bodies for eliminating fog when added to emulsions and claimed that they do not affect the densities of the image. This claim is new, so A. P. H. Trivelli and E. C. Jensen, of the Kodak Research Laboratories (*Jour. Franklin Institute*, p. 287, Sept. 1930), investigated the anti-fogging action of 6-nitrobenziminazole when added to the developer using hydroquinone, pyrogallol, and *p*-aminophenol as developers. They give a large number of curves and tables to show their actual results, and conclude that 6-nitro-benziminazole with these developers is superior to potassium bromide and potassium iodide, giving the least depression of image densities with the same fog-removing quality. With the *p*-aminophenol developer, there was no change of image densities up to 12 minutes development at 20° C. The work is being continued.

Oxidations by Iodic Acid.—Iodic acid has not been much used in organic chemistry, and exclusively in acid solutions. In the September number of the *Journal of the American Chemical Society*, Evans and Dehn show that it can be applied in acid, neutral, and alkaline solutions, and appears to be very selective in its action. The use of iodic acid was shown to lead to improvement in various preparations. A 92 per cent yield of purpurogallin was obtained with sodium iodate and pyrogallol, and benzoin is directly convertible into benzilic acid by the action of sodium iodate in concentrated sodium hydroxide.

Dielectric Polarisations of Normal Paraffins.—In the September number of the *Journal of the American Chemical Society*, Dornte and Smyth describe measurements of the polarisations of normal paraffins from pentane to dodecane over ranges of temperature. The polarisations calculated from the dielectric constants and densities increase about 1 per cent per 100° rise in temperature. The polarisation appears to be an additive property, as would be expected. The values of the electric moments of the molecules are regarded as approximately zero, and the conclusion is drawn that the bonds of alkyl radicals possess no polarity detectable through electric moments arising from them.

Turbulence in Internal Combustion Engines.—The effect of turbulence upon the charge of an internal combustion engine is of great importance, since a stagnant mixture could not be burned in the time available for its combustion in the engine cylinder. In a paper read before Section G (Engineering) of the British Association at Bristol, which appeared in full in *Engineering* for Sept. 5, Messrs. T. F. Hurley and R. Cook attempt to elucidate some points associated with this phenomena; in their efforts to control the condition of turbulence within the engine cylinder they have obtained some interesting data. The paper is in two parts, the first of which deals with experiments when an engine is motored round. In these tests the condition of port entry is varied by means of shaped vanes and the movement of the particles of the incoming charge deduced from photographs of the path of sparks, etc., travelling with the air flow. The second part of the paper presents the results of actual running tests upon the same engine and with the same modifications of inlet port flow, the authors noting the effect upon highest useful compression ratio (H.U.C.R.) of the different conditions of turbulence so set up. It must be borne in mind, however, that the data given refer to only one shape of combustion head, and therefore it would not be wise to generalise from these results. Also, it seems a little difficult and misleading to determine the value of the H.U.C.R. so expressed, when knocking actually occurs at a compression ratio well below the figures given, namely, 5·15 to 1.

Conduction of the Heart-beat.

THE mode of propagation of the wave of contraction in the wall of the heart was thought, up to fifty years ago, to take place along nerve trunks. Gaskell was the first (1882) to show definitely that not only does the heart-beat arise spontaneously in muscle cells but also that the conduction of the excitation from one part of the heart wall to another takes place by muscular tissue. No difficulty was encountered in demonstrating that muscular continuity existed in the case of the lower vertebrates such as the frog and the tortoise. It was generally believed, however, that no such muscular continuity existed between the auricles and ventricles of the mammal; thus, in the human heart, auricle and ventricle on each side were supposed to be united solely by a fibrous ring.

It was not until the year 1892 that Prof. Stanley Kent observed certain muscular bands running from auricle to ventricle which he described in the following terms: "Between the auricle and ventricle and lying in the connective tissue ring are modified muscle cells, usually spindle-shaped, nucleated, granular, becoming extremely narrow in parts and then swelling out again, transversely striated" (*Proc. Jour. Physiol.*, **6**, Nov. 12, 1892). In the following year Kent in Great Britain and His in Germany established the existence of a definite bundle of specialised muscle joining auricle to ventricle. This *A-V* bundle (bundle of His) was further worked out by Tawara (1906), who showed that it had its origin in the *A-V* node of similarly specialised tissue situated at the base of the auricular septum on the right side below and to the right of the coronary sinus. He traced the *A-V* bundle along the top of the interventricular septum just below its membranous part where it divides into the right and left septal divisions; these pass down in each ventricle on the interventricular septum into the papillary muscle arising from the septum. Each half of the bundle gives off several branches which break up more and more, finally forming a reticulated sheet of tissue over the greater part of the ventricles just under the endocardium.

The fibres composing the tissue are distinguished by their primitive character. They are more granular in appearance, due to a higher glycogen content, and consequently appear less striated. The *A-V* bundle forms the only continuous muscular tissue between auricles and ventricles and destruction of it causes complete abolition of the normal sequence of beat between auricles and ventricles. It is now universally accepted that the transmission of excitation in the mammalian heart takes place by means of this muscular bundle.

In 1913 Kent described in the *Journal of Physiology* (*Proc.*) another band of muscular tissue near the auriculo-ventricular groove on the *right* lateral aspect of the heart. In 1914 he demonstrated that this right lateral auriculo-ventricular junction exists in the human heart and establishes connexion between the auricular muscle (right auricle) and the ventricular muscle of the right lateral wall of the heart (right ventricle).

This observation of Kent has either been overlooked or not accepted by other investigators. The division of the well-established auriculo-ventricular bundle (bundle of His) into two to supply both ventricles has adequately accounted for the phenomena observed up to the present in disease and laboratory experiments. Also search by other observers for other conducting paths by the method of combined dissection and serial sectioning has not met with any success; Kent attributes this to the difficulty and tediousness of the task.

In a meeting of Section I (Physiology) of the British Association at Bristol on Sept. 4 last, Prof. Kent brought forward new evidence for the existence of his 'right lateral connexion'. He now backs up the earlier morphological demonstration with experiments on the beating heart proving that the right lateral bundle is a functional entity. If all structures between the auricles and ventricles are severed, leaving only a bridge of tissue between right auricle and ventricle on the *postero-lateral* position, co-ordination persists.

Further, he has found it possible by successive cuts to diminish gradually the breadth of this bridge until it is no more than *one millimetre* across and still co-ordination persists. This co-ordination is of such a kind that the normally occurring contractions of the auricle are followed regularly by contractions of the ventricles, and when spontaneous beats have ceased, artificially excited contractions of the ventricle pass through to the auricle and are followed by auricular beats. Prof. Kent comes to the conclusion that a conducting path exists in this postero-lateral region, which in the absence of the main *A-V* bundle may function in such a way as to maintain the co-ordination of the chambers of the heart.

Meteorology in Agriculture.

AT a time like the present, more than usual interest attaches to any attempts to derive economic advantage from applied science. At the annual paper-reading conference held at the Meteorological Office on Sept. 25 and 26 last under the auspices of the Ministry of Agriculture and Fisheries, all the papers had direct or indirect applications in this direction. The subject of agricultural meteorology is one of those which, through its hybrid nature, is apt to be regarded as the business of neither the meteorologist nor the agriculturist, and it was a recognition of this fact that led to the inauguration a few years ago of the crop-weather scheme and of these annual conferences, where the two classes of investigator can meet and pool the knowledge gained in their special subjects.

Of the five papers read on the first day, the first, by Mr. E. V. Newnham, was mainly meteorological in interest but had an agricultural application in that the subject under discussion—nocturnal radiation from the earth's surface—is one of importance for its bearing upon the damage done to crops by night frosts. A brief summary was given of observations made in this field since Dr. Wells wrote his classical "Essay on Dew", more than a hundred years ago. A qualitative discussion of various factors controlling the temperatures of objects freely exposed to the clear sky at night was followed by a consideration of the desirability of replacing the present form of terrestrial radiation thermometer by an instrument capable of giving quantitative measurements of the heat lost to space in the course of a whole night. Emphasis was laid on the need for further information about the relative powers of common substances for emitting the long-wave radiations appropriate to bodies at low temperatures.

Mr. I. J. Schapringor followed with a paper on the effect of weather on sugar beet. Tracing the effects of weather upon the various stages of cultivation of this crop, it was shown that the equable climate

of England gives us a distinct advantage over Continental countries, where the harvesting of the beet has generally to be completed by the end of October, owing to the probability that frost and snow will intervene if matters are delayed longer. Where this does not happen, harvesting can be spread over a longer period, extending up to Christmas, and the sugar factory can be employed at a moderate pressure of work over a correspondingly lengthened period. The dampness of the climate of England is no obstacle; the fact that our output per acre is about 25 per cent less than on the Continent is explainable largely by the fact that English farmers have not yet discovered the varieties of beet best suited for the climate—a handicap resulting from the seventy extra years of experience in the industry possessed by their rivals abroad.

Mr. J. Hammond showed interesting diagrams illustrating the variation in the proportional size of different parts of Herefordshire cattle at different ages, in the course of a paper on the effects of climatic conditions on animal production. He showed also how variations of weather affect the chemical composition of plants and, through this agency, the character of the growth made by animals feeding on these plants.

The effect of weather on soils was shown by Dr. Ogg to be greater than had at one time been supposed. Owing mainly to the work of certain Russian investigators, modern soil classification is being made on new and much more satisfactory lines than in the past, the principal difference being that formerly the importance of the geological character of the parent rock, the breaking up and transformation of which is responsible for a particular soil, was over-estimated. Wet climates tend to give acid soils and dry climates alkali ones, temperature coming in as a modifying factor. Without any other data than a knowledge of mean temperature and rainfall and of the character of the humus-supplying vegetation, the distribution of the principal types of soil can be roughly mapped out in any country, and work on these lines is being carried out internationally.

In the course of an account of work at Rothamsted Experimental Station on the relationship between the weather of different months and the effectiveness of various artificial manures, Sir John Russell showed the necessity for employing modern mathematical statistical analysis in order to separate the influence of different weather factors. Once this has been done, the result often leaves for solution a comparatively simple relationship that can be explained by chemical experiment in the laboratory. Stress was laid upon the economic importance of a scientific variation of the chemical proportions of artificial manures in accordance with the predominant weather factors for the crop in question, and on the extent to which the application of such a principle can make the yield independent of the meteorological character of the season.

The second day of the conference was occupied mainly with a consideration of the influence of weather upon insect pests. The general impression gained from these papers was that the subject is a harder one to investigate than that of simple plant growth. This arises partly from the fact that many of the pests are of very small size, and the meteorological data available normally do not define exactly the conditions which the pest experiences. There is the added difficulty that the parasites that exercise so large a control over the severity of the attack of a pest are not normally affected in a similar way to their hosts by abnormal weather. Mr. A. Roebuck, who spoke on this subject, showed that where the host and parasite are oppositely affected, great fluctuations of severity of a pest are to be expected; and that, on the other hand, similarity of reaction to weather tends towards limited variation, and therefore to an absence of epidemics. Dr. W. M. Davies described how humidity affects Collembola (springtail): types with a very primitive breathing system are absolutely dependent upon high humidity, whereas those possessing a more advanced tracheal system can withstand relatively dry conditions.

The conference closed with a very interesting account by R. T. Parkhurst of the way in which fowls can be induced to lay as many eggs in the autumn and winter as during the remainder of the year by artificially increasing the hours of light during the dark days, the result being a satisfactory yield at the time when prices are highest. The method is being applied successfully in the United States, especially where cheap electricity is available.

Migration in Butterflies and Moths.*

IT is well known that locusts migrate, but few realise that similar movements take place in other insects, and particularly in the dragonflies and the butterflies and moths. The evidence for such movements is chiefly of two kinds. First, it is found that some insects exist over large areas only for a short time, and after a period of absence may appear again suddenly in large numbers. Secondly, observers, particularly but by no means entirely in the tropics, have often seen hundreds of thousands of butterflies moving steadily in one direction, sometimes passing for hours on end and sometimes even for days or weeks.

By collecting such evidence it has been possible to get an idea of the regular movement made by some species. Thus the Monarch or Milkweed butterfly of North America is found during the summer throughout the greater part of the continent, even reaching so far north as Hudson Bay. In the autumn all the individuals in the north collect together in great bands and fly a thousand or so miles south to the Gulf States or Southern California, where they spend the winter clinging in masses to trees. In the spring the bands break up and the butterflies fly north, laying eggs as they go, to repopulate the whole area—some completing another thousand or fifteen hundred miles flight on the return journey.

In West Africa, Europe, and western Asia, the greatest migrant is the Painted Lady butterfly, which in the spring crosses the Sahara and Egyptian deserts from some almost unknown sources to the south; crosses the Mediterranean, often in hundreds of thousands; flies more or less northward through Europe, usually reaching the shores of Great Britain in early June, and sometimes individual stragglers are seen in the extreme north of Iceland or within a few degrees of the Arctic Circle. The total distance covered by these flights may be between two and three thousand miles, but at present it is not possible to say with certainty if any one individual flies the whole distance or if it is covered by two successive generations. The butterflies lay eggs as they go and in England a local-bred generation may result in August or September, but there is practically no evidence of the survival of this butterfly in north and central Europe from one year to the next. Another remark-

* Substance of a paper read by Mr. C. B. Williams before Section D (Zoology) of the British Association at Bristol on Sept. 8.

able fact is that there is at present little or no evidence of any return movement towards the south in the autumn.

The common Large Cabbage White butterfly is also a migrant, particularly in central Europe, where about July large swarms seem to originate either in Scandinavia or on islands in the Baltic, and fly southward through Germany in clouds like snowstorms. Some of these flights deviate to the west and may cross the North Sea and appear on the eastern shores of Great Britain.

Similar flights occur in all parts of the world: West Africa, East Africa, South Africa, India, Ceylon, Central and South America, and Australia, all have their migrant butterflies. The sight of hundreds of thousands of butterflies passing a point steadily in a fixed direction day after day is one never to be forgotten. Mr. Williams stated that in East Africa he has seen a 'skipper' butterfly flying to the south on every fine day for more than six weeks, in numbers which reached a maximum of more than five hundred per minute on a 22 yards front. On another occasion at the same station there were simultaneous flights of two different species of butterflies going on in exactly opposite directions for nearly a month, each species keeping strictly to its predetermined path. Further, on one day while these two flights were going on, there was a third flight of millions of locusts moving diagonally across the other flights and not in any way interfering with them.

Nothing is yet known of the reasons for these movements or of the factors which determine the direction of flight. It can, however, be stated quite definitely that the insects are *not* blown by the wind. Examination of a large number of records show that the flights are as often directly against the wind as with it, and may cross it any angle.

Butterflies in migration appear to have an urge to fly continuously in one fixed direction; they appear to be conscious of that direction and make every effort to keep to it in spite of the disturbance due to wind and the presence of obstacles in their path. They usually avoid small obstacles by flying over them, or more rarely round them, but have been seen beating themselves against the wall of a house or entering open windows. Efforts to keep to the desired path have often been observed, and they have been recorded as flying through railway tunnels or in at one side and out at the other of partly constructed buildings, rather than depart from it.

Similar movements occur in many species of moths, but information about them is much more difficult to obtain, owing to the fact that the majority of these migrations take place at night.

Fishing Methods of the Maori.*

THERE appears hitherto to have been little information placed on record concerning Maori fishing methods and devices. Mr. Elsdon Best's monograph, in which every aspect of Maori fishing activity is clearly and fully described, is therefore a welcome addition to the scanty literature which already exists.

Fishing operations in all the countries of the world have connected with them many strange beliefs, weird superstitions, and quaint ceremonies to celebrate special occasions such as the launching of a new boat or the first dip of a new net. Fishing in Maoriland was no exception to the rule, and many strange and interesting rites and usages connected with the craft are described. Many of these have their counterpart in other lands; a few seem to be peculiar to the Maori.

Sea fishing was considered by the Maori to be essentially a task for men. The boats, however, were almost invariably met by the women, to whom the entire subsequent care of the catch was left. Women also were expected to collect shellfish and allowed to take part in the capture of small fresh-water fish, but eel-fishing was confined entirely to men.

The most useful and interesting part of the bulletin is the section dealing with fishing implements, their manufacture and use. Where the conditions were suitable, nets of various kinds were mainly used, chief among them being a kind of giant seine which might be anything up to 1000 yards in length. The making of such a net, the material of which was unscraped flax, was the work of all the inhabitants of a village and was made use of to benefit all the part proprietors of it. These nets were five to six feet in depth, provided with sinkers along the bottom and floats of very light wood (instead of the usual cork) along the top. A point of unusual interest about these seines and the other nets of the Maori is that so far back as can be traced, the knots used for making the meshes were exactly the same as those of our own European nets. How this knot came to be discovered and adopted in net making by peoples and tribes all over the world amongst whom intercommunication must have been impossible is a riddle yet to be explained.

In addition to the great seines, many smaller nets were employed, including drag nets and set nets, but no mention is made of drift nets. These do not appear to have been used in Maoriland. Line fishing also was largely practised, especially along rocky coastlines where drag-nets could not be employed. Wood, bone, stone, and shells were all used by the Maori in the manufacture of fish hooks. When Europeans arrived in the country, however, the natives soon learned the advantages of metal for the making of such implements.

The bulletin is attractively produced and well illustrated, but appears to suffer slightly from the fact that the author, apart from his researches in producing this work, seems previously to have had little intimate contact with fishermen and fisheries.

* Fishing Methods and Devices of the Maori. By Elsdon Best. Dominion Museum Bulletin No. 12. 1929. Dominion Museum, Wellington, New Zealand. Also obtainable from New Zealand Government Offices, 415 Strand, London, W.C.2. Price: Paper Cover, 9s.; Cloth Cover, 11s. 6d.

Recent Work on Buttercups.

AT the present time considerable attention is being paid to these familiar wild flowers, comprising the genus *Ranunculus*, the largest one in that attractive family the Ranunculaceæ. Parkin has in recent years (*Annals of Botany* 42; 1928) emphasised the fact that in this genus two distinct types of petal occur—one yellow and *glossy*, typical of the common buttercups of our fields and meadows; and the other white (occasionally yellow or even red), with a *mat* surface, exemplified only in Great Britain by the water buttercups (Batrachium section). The former type of petal is probably unique among flowers, possessing peculiar structural features, one of which is the large amount of starch contained in it and restricted to the part that is glossy. It is suggested that this large genus might be conveniently and perhaps

also phylogenetically divided into two sub-genera—one containing the glossy and the other the mat petalled species.

Marsden-Jones and Turrill are collaborating in a genetical study of this genus, and last year they published a preliminary account of their results with the two common buttercups, *Ranunculus acris* and *R. bulbosus* (*Jour. of Genetics*, **21**, abstract in NATURE, **124**, p. 928). One of the most interesting points connected with these species is the occurrence of plants functionally only female. Reference to these was made in the correspondence columns of NATURE last year (**123**, pp. 568, 798, and 911).

A Japanese botanist, M. Kumazawa, has this year published the results of his morphological and anatomical study of the species of *Ranunculus* occurring in his own country (*Jour. Faculty of Science*, Univ. Tokyo, Botany 2, pt. 3). The island empire of Japan is sometimes regarded as the eastern counterpart of the British kingdom, and in keeping with this it so happens that the number of species (sixteen) found there is about equal to the number usually recognised in Britain. Furthermore, as in the British flora, the only species that have not yellow and glossy petals are white water buttercups.

Two endemic species present interesting vegetative features. *Ranunculus Zuccarini* has root tubers suggestive of those of the Lesser Celandine (*R. Ficaria*). *Ranunculus flagellifolius* has filiform leaves monocotyledonous in appearance. Evidence is brought forward to show that these foliar organs have evolved through the transformation of the whole of an ordinary leaf and are not merely modified leaf stalks (phyllodes).

The main part of the paper is taken up with vascular anatomy. Interesting points in connexion with the endodermis are described. There is a marked tendency in the stem to closed bundles of the monocotyledonous type.

From the morphological and anatomical point of view *Ranunculus sceleratus*, a widely distributed species and fairly common in Britain, is regarded probably as one of the most primitive members of the genus.

Autumn-sown Cereals.

THE choice of a good variety of cereal may make a difference of more than twenty per cent in a farmer's returns, and yet the crop will cost him no more to grow. For this reason the National Institute of Agricultural Botany, Cambridge, has issued a number of recommendations, based on careful trials at a number of stations, as to varieties of cereals suitable for autumn sowing. These do not necessarily apply to the north of England, but may be accepted with confidence in other districts.

The reaction of different varieties of wheat to diseases such as foot-rot or whiteheads is as yet far from complete, but there is no reason to believe that any one variety is markedly more resistant or susceptible to them than another. As regards winter hardiness, it should be borne in mind that other factors besides frost resistance are important in England, and that on the whole, Scandinavian and Dutch wheats are less adapted to our conditions than such a variety as *Squarehead's Master*. The value of change of seed is still a vexed question, but there seems no evidence (given equal purity and germination) that foreign-grown seed is preferable to stocks of the same variety grown in England.

Wilhelmina or *Victor* are the most trustworthy high-yielding varieties on soils in good condition; *Yeoman* or *Yeoman II* possess unique bread-making quality and are the varieties to grow on the richest soils or under intensive manuring; *Little Joss* should be chosen for the lighter wheat soils, particularly in Norfolk, or where fertility is low; *Iron III*, though less trustworthy than *Wilhelmina* and apt to develop rust, like *Weibull's Standard*, finds a place on heavy soils. *Rivett*, or *Blue Cone*, probably outyields all other varieties on heavy soils in the south of England, and *Squarehead's Master* stands by itself in its adaptability to all sorts of conditions and the regularity with which it gives a certain crop.

Grey Winter is the only really trustworthy variety of oats, but its weak straw is a serious disadvantage. If strength of straw is an essential point, black-grained *Bountiful* is suggested. There is no winter-hardy white oat on the market. As regards barley, the ordinary six-row winter variety gives a satisfactory crop, but the grain is not of malting quality. However, although none of the malting barleys are winter-hardy, *Plumage Archer* and *Spratt Archer* can usually be grown successfully, if exposed situations and badly drained soil are avoided, and when autumn-sown, outyield similar spring-sown crops. Anyone wishing for fuller particulars is advised to write to the National Institute of Agricultural Botany at Cambridge.

University and Educational Intelligence.

BIRMINGHAM.—The celebration of the jubilee of Mason College and the thirtieth anniversary of the granting of a charter to the University commenced on Oct. 13. The Chancellor, the Viscount Cecil of Chelwood, in the course of his address, referred to the foundation in 1880, by Sir Josiah Mason, of Mason College as a college of science and technical knowledge for Birmingham, at a cost of £200,000. The College became the University in 1900, and the first principal was Sir Oliver Lodge, who was present at the celebrations. The honorary degree of doctor of laws was conferred on the following, among others: Sir Henry Hadow, Sir William Hardy, Sir Thomas Lewis, and Dr. F. E. Smith.

CAMBRIDGE.—At Trinity College, J. W. Brunyate, L. H. Gray, and R. E. A. C. Paley have been elected to fellowships. At Corpus Christi College, Dr. G. S. Carter, formerly lecturer in zoology in the University of Glasgow, has been elected to a fellowship.

The John Winbolt Prize has been awarded to S. Steele, of Christ's College, for a dissertation on "Chemical Changes in Fuel-air Mixtures in an Internal Combustion Engine during Compression".

LONDON.—Two courses of advanced lectures have been arranged in the Faculty of Engineering at King's College. Mr. T. G. Rose is giving three lectures on "Management", on Tuesdays, beginning Oct. 21; and Col. C. H. Bressey, Chief Engineer, Roads Department, Ministry of Transport, will deliver three lectures on "Modern Road Construction", on Tuesdays, beginning Nov. 11. Particulars can be obtained from the College.

MANCHESTER.—The Council has accepted with regret the resignation of Prof. O. T. Jones, who has held the chair of geology and the directorship of the Geological Laboratories since 1919. Prof. Jones has been elected to the Woodwardian chair of geology in the University of Cambridge, and will vacate his Manchester appointment in December. The Council has also accepted the resignations of Dr. John Walton, senior lecturer in botany, who has been elected to the Regius chair of botany in the University of Glasgow, and of Mr. L. J. F. Brimble, lecturer in botany.

Dr. J. H. Frazer (Johns Hopkins) has been appointed lecturer in mathematical physics.

ST. ANDREWS.—At the graduation ceremonial on Oct. 10, the honorary degree of LL.D. was conferred upon J. A. C. Kynoch, emeritus professor of midwifery, University College, Dundee.

APPLICATIONS are invited by the Zoological Society of London for an aquarium research fellowship for three years, of the annual value of £350. The successful applicant will be expected to do research in connexion with aquatic life, principally in the laboratory attached to the Society's aquarium, under the general advice of some naturalist appointed by the committee, and to report quarterly to the committee on the progress of the research. Applications should be addressed to Sir Peter Chalmers Mitchell, Zoological Society, Regent's Park, N.W.8, and received on or before Nov. 3.

AN arrangement has existed for the past six years whereby, when a candidate for a Higher National Certificate in Mechanical Engineering at the termination of an advanced course includes a specialised automobile engineering subject in his final examination, the signature of the president of the Institution of Automobile Engineers can be added to any certificate awarded. This arrangement has now been extended to ordinary certificates awarded at the termination of senior part-time courses. Applications should be addressed in the first instance to the Board of Education.

THE following research fellowships are open to members of the British Federation of University Women: A Senior International Fellowship (offered by the International Federation of University Women), value £250; an American International Fellowship (offered by the American Association of University Women), value approximately £300; a Caroline Spurgeon International Scholarship in Arts (offered by the Directors of the Crosby Hall Association), value £100 a year for two years; an International Residential Scholarship at Crosby Hall (offered by the British Federation of University Women), value £100; and a German International Fellowship (offered by the German Federation of University Women), value approximately £100. Application forms and regulations are obtainable from the Secretary, British Federation of University Women, Crosby Hall, Cheyne Walk, S.W.3.

FOR the tenth year in succession, Trinity College, Cambridge, announces the offer of a Research Studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the Studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1931. The same College offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial universities. These Exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the exhibitioner's financial circumstances, and the Council has power, if it sees fit and if funds are available, to award an additional payment. Candidates must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1931.

Historic Natural Events.

Oct. 19, 1800. Hailstorm in Bedfordshire.—During a violent thunderstorm in Bedfordshire, hailstones fell, shaped like oblate spheroids, six to nine inches in circumference.

Oct. 19, 1917. Unexpected Upper Winds.—A fleet of thirteen Zeppelin airships attacked London on Oct. 19 in weather conditions which appeared settled. Owing to the unexpected development of a barometric depression, however, a very strong cold north-east wind sprang up at some height above the ground. Fog and cloud prevented the raiders from determining their position, and they were carried southward over France, where they were discovered. The motors being handicapped by the intense cold, the greater part of the Zeppelin fleet was destroyed.

Oct. 20, 1743. Hurricane at Port Royal.—A furious hurricane began at 6 P.M. at Port Royal, Jamaica. Many houses were blown down, but most of the damage was done by the sea, which rose many feet and destroyed all the wharves, while the streets were several feet under water. Out of 105 ships in the harbour only one rode out the storm, and a great number of marines were drowned. The hurricane was followed by a pestilence which caused still greater loss of life.

Oct. 22-25, 1805. Trafalgar Gales.—After the battle of Trafalgar violent south-westerly gales blew on the south-west coast of Spain, and it proved impossible to get the majority of the captured French and Spanish ships into Gibraltar.

Oct. 23-24, 1924. Typhoon off Coast of Annam.—A typhoon of exceptional violence, accompanied by torrential rains and a storm wave, travelled along the coast of Annam, causing floods, loss of harvests, and great damage to buildings, roads, bridges, railways, and telegraph lines. The regions which suffered most were the provinces of Kinhoa and Song Ba.

Oct. 24, 1847. Aurora Borealis. A brilliant display was observed from London on the night of Oct. 24-25. As described by J. Glaisher, it began with a bright red streamer in the north-west at 6.30 P.M., but was not well developed until 9.55 P.M., when a pyramid of red and orange light appeared in the north-west, 5° in diameter at the base, and resembling the glow from an immense conflagration. At 10 P.M. this had become deep crimson, and a similar one had formed to the east-north-east, these two pyramids forming the boundaries of a fan-shaped mass of vibrating silvery columns converging to a point a few degrees south of the zenith. About 10.20 P.M. the moon, which had been shining from a cloudless sky, was suddenly surrounded for a few minutes by a fine corona, with concentric circles of grey, violet, green, and red. Soon after 11.15 a bright arch appeared extending from north-west to south-east, with flickering streamers both above it and below it. This continued until 1 A.M. There were magnetic disturbances at Greenwich on Oct. 22 and 24.

Oct. 25, 1665. Gale in London.—There was a violent gale in London with much rain. It is stated in the *Philosophical Transactions* that during this storm the barometer stood at 28½ in., and that on the evening of Oct. 26 it descended nearly to 27½ in.

Oct. 25, 1859. ***Royal Charter*** **Storm.** During a terrible storm the *Royal Charter* was wrecked on the coast of Anglesea, with the loss of nearly five hundred lives. This disaster led directly to the establishment of a meteorological service in England and to the issue of gale warnings by Admiral FitzRoy. In the same storm the *Great Eastern* narrowly escaped destruction at Holyhead, while Stephenson's viaduct at Penmaenmawr was carried away, the old Chain Pier at Brighton was destroyed, and great damage was done to the railway on the beach below the cliffs at Dover.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 8.—W. Vernadsky: The radium in aquatic organisms. The amounts of radium in different species of *Lemna* growing in lakes containing known amounts of radium have been determined. The concentration of radium in the living plant is 100-650 times that present in the water. The amounts of radium vary considerably with the species of *Lemna*, and this variation does not depend on the weight of the individual plant. The question as to what is the function of radium in the vital processes of *Lemna* still remains unanswered.—**Auguste Lumière** and **Mme. R. H. Grange**: The protective action of cholesterol against shock caused by floculates. The facts cited prove that injections of cholesterol protect the animal (rabbit) against shocks of the anaphylactic type. **Joergen Rybner**: Nomograms for transformations between rectangular and polar co-ordinates and for complex hyperbolic functions. **Cl. Chevalley**: The theory of normic residues. **Radu Badesco**: Logarithmic solutions of an integral equation.—**Luca Teodoriu**: A partial differential equation which occurs in the problem of average.—**F. Charles** and **J. Flandrin**: Contribution to the study of Cretaceous soils in the north of Anatolia (Asia Minor).—**P. Fallot, A. Marin,** and **M. Blumenthal**: The limestone chain of the Spanish Rif between Xauen and oued M'ter.—**Th. Biéler-Chatelan**: The polysynthetic quaternary glacier of Monti Simbruini (Central Apennines). The causes of its extension. The author concludes that in the Apennines, in spite of the altitudes being lower than the Alps, the quaternary glaciers could have reached dimensions comparable with those of Alpine glaciers, this being due to the heavy rainfall which has always characterised these ranges. **Jules Amar**: The diaphragm origin of respiration. **Angelo Migliavacca**: The lipochrome interstitial cells of the uterus.—**Rémy Collin** and **Pierre Florentin**: The growth of the nuclei in geometrical progression in Lœwenthal's gland.—**Mme. Y. Khouvine, E. Aubel,** and **L. Chevillard**: The mechanism of the transformation of pyruvic acid into lactic acid in the liver.

GENEVA.

Society of Physics and Natural History, July 3.—H. Decker: System of organic combinations. The author has constructed curves permitting the prediction of the possible combinations; carbon and hydrogen are plotted on rectangular co-ordinates. For the more complex combinations, he combines several networks with a parallelogram mesh, such that all possible combinations find their place at the nodes of a parallelopiped mesh.—**R. Cherbuliez** and **G. de Mandrot**: The disaggregation of casein in acetamide. By heating casein in acetamide a true depolymerisation of the casein can be brought about without the chemical intervention of a foreign substance. This depolymerisation is accompanied by a profound modification of the original molecular edifice, but does not destroy the groupings which give on hydrolysis the amino-acids characteristic of the original proteid.—**A. Georg**: The determination of the constitution of the disaccharides by the method of methylation and its application to Fischer's isomaltose. By this method, the author deduces two possible constitutions for isomaltose; either that of a 6-α-glucoside (1·5)-glucose (1·5) or that of a 5-glucoside (1·5)-glucose (1·5). The first appears to be the more probable.—**Eugene Pittard** and **Juan Comas**: The condylo-diaphysary angle (angle of divergence) of the femurs of Bushmen, Hottentots, and Griquas. The authors find differences between the averages for the two sexes and others between the right and left sides. These differences are not the same in the Hottentots and the Griquas; granted a common origin, these differences may perhaps be attributed to the mode of life.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 1, 1930).—**F. Loewinson-Lessing**: A contribution to the petrography of Kamtchatka. Analyses of a series of specimens of lavas from Kamtchatka are given; most of the lavas are characterised by the presence of basic plagioclase phenocrysts, of basaltic hornblende, and by vitrophyric texture; lavas containing pyroxene are rare.—**I. Vinogradov**: The least primary root.—**I. Medvedev**: The problem of bios. The question as to whether yeast cells can develop in an artificial medium, without living elements in it, has been decided by various authors differently. This difference is due to neglecting the possible osmosis of physiologically active substances (bios) from the yeast cells themselves into the medium. Removing the substances so diffused by quick washing proved that they play a very important part in the development of yeast in an artificial medium.—**N. Dneprovsky**: The fundamental systems of the declination of stars.

Comptes rendus (No. 2, 1930). **A. Tchitchibabin**: (1) Non-tanning substances in the extract from the rhizome of *Saxifraga* (*Bergenia*) *crassifolia*. (2) Arbutine. Both the rhizome and the leaves of *S. crassifolia* contain up to 10 per cent of the dry weight of the glucoside arbutine, which has so far been known only in the plants of the family Ericaceae and in *Pyrola*.—(2) Non-tanning substances of *Statice*: (1) Myricetine. A species of *Statice* from Turkestan was found to contain up to 1 per cent of the glucoside myricetine.—**A. Tchitchibabin** and **N. A. Preobrazhenskii**: The synthesis of the pylopic acids and the structure of the pylocarpine.—**N. N. Jakovlev**: (1) The genus *Petschoracrinus* and the transition from the dicyclic crinoids to the monocyclic ones. A series of specimens of *Petschoracrinus* exhibited a complete transition from the monocyclic to the dicyclic type, and the use of this character for the separation of the two sub-classes appears not to be justified.—(2) The primary pores of *Cystoblastus*. The madreporite of *C. kokeni* is kidney-shaped, perforated, and placed over the three interradial plates. On the concave side of the madreporite there is an orifice which must represent the gonopore. **E. Perepelkin**: (1) The alteration of the rotation of the sun with the height. Prominences in different layers of the sun's atmosphere rotate with the same velocity.—(2) The separation of velocities of different gases in the prominences.

J. Medvedev: The theory of the simultaneous action of the external factors on the yield of crops. A method is offered for the calculation of the optimum combination of factors.

ROME.

Royal National Academy of the Lincei, May 4.—E. Paternò: The origins of stereochemistry. So long ago as 1869, Paternò proved the existence of two isomeric compounds of the formula C_2HCl_5 and attempted to explain their isomerism by means of spacial structural formulæ.—**F. Zambonini** and **Silvia Restaino**: Double sulphates of rare earth and alkali metals (13). Sulphates of praseodymium and ammonium. In addition to the compound, $Pr_2(SO_4)_3$, $(NH_4)_2SO_4$, $8H_2O$, described by von Scheele in 1898,

these sulphates form the anhydrous double compound, $Pr_2(SO_4)_3, 5(NH_4)_2SO_4$, which is stable at 25° in contact with solutions containing from 63 to 56 per cent of ammonium sulphate and from 0·2 to 0·6 per cent of the praseodymium salt. The crystallographic characters of this double salt are described.—**S. Franchi**: The non-existence of the 'nappe de l'Embrunais' in Italian territory, indicated to the south of Mont Blanc in a geological map by Léon Moret.—**F. Zambonini** and **A. Ferrari**: The identity in crystalline structure of the cancrinite of Monte Somma with that of Mias. The recent and most satisfactory analyses of cancrinite indicate the formula, $3(Na_2, Ca)Al_2Si_2O_8(Na_2, Ca)CO_3$, with a slight excess of carbonates and a variable proportion of water.—**Giulio Bemporad**: The significance of the principle of the arithmetic mean. **R. Caccioppoli**: A general theorem on the existence of unit elements in a functional transformation. **M. Brelot**: The integrals of $(1)\Delta u - c(M)u(M)$ $(c \geq o)$ in the neighbourhood of a singular point 0 of $c(M)$. **Enrico Volterra**: The deformation of an elastic medium due to a small displacement of an immersed rigid sphere.—**B. Caldonazzo**: Plane irrotational motions of perfect liquids in the presence of a movable disc. **A. Consiglio**: A further exception to the Kutta-Joukowski theorem. The case of Joukowski's pisciform obstacle, with a single cuspidal point, is considered.—**Luisa Pelosi**: A new demonstration of a theorem of Painlevé-Levi-Civita on dynamic equations.—**Anna Eredia**: The coefficient of persistence of rainy days. The probability of the occurrence of rainy days, singly or in groups, was studied for Hamburg (1876-1900) by Grossmann, who, on the assumption that the various groupings were equally probable, derived formulæ for calculating the mean number of rainy days out of two, three, or more consecutive days. The values so calculated did not, however, agree with observations made over a considerable number of years, a result which was recently confirmed by Besson in the case of Paris, and by Domingo y Quilez in that of Saragossa. For Rome, the author finds that the coefficient of persistence of rain varies throughout the year, the maximum being in March and the minimum in July. The coefficient of probability of rain increases with increase in the preceding number of wet days, up to five in the case of Saragossa and to four in that of Rome.—**E. Segrè**: Intensity of the lines in the Raman effects of diatomic molecules. The quantum mechanical formula for the intensity of the Raman lines for the molecule O_2 is explained and is found to furnish results in good agreement with the experimental values.—**B. Rossi**: The action of the counter tube of Geiger and Muller.—**G. Racah**: An example of the quantistic treatment of an interference phenomenon. **A. Ostrogovich**: Investigations on γ-triazines: synthesis of phenylaminohydroxytriazine. This compound may be synthesised by the interaction of benzamidine hydrochloride on guanylcarbamide acetate, and it seems likely that other aminohydroxytriazines may be similarly obtained.—**A. Debenedetti**: The determination of plagioclases by measurement of the angles of extinction in the zone normal to (010).—**Giulio Cotronei** and **Aldo Spirito**: Zoological constitution and grafting (3). New experiments on Anura and Urodeles.—**M. Comel**: Studies on parathyreoprive syndrome (2). Preventive action of irradiated ergosterol in excessive doses.

SYDNEY.

Linnean Society of New South Wales, July 30.—**J. R. Malloch**: Notes on Australian Diptera (25). This paper contains (*a*) additional notes on Ortalidæ, Sapromyzidæ, Clusioididæ, and Neottiphilidæ, (*b*) a revision of the Calliphorid subfamily Metopiinæ, and (*c*) some notes on Empididæ, with a key to the subfamilies. Thirty species are dealt with, fifteen of which are described as new. Three genera of Metopiinæ are also described as new. Keys are given for separation of the genera of Metopiinæ and species of *Tapeigaster*, *Miltogramma*, and *Protomiltogramma*.—**Rev. H. M. R. Rupp**: Notes on the autumn orchids of the South Maitland coalfields. Notes on nine species of *Pterostylis* and *Acianthus exsertus*. One species of *Pterostylis* is described as new.—**A. A. Lawson**: The origin of endemism in the angiosperm flora of Australia. This paper gives the author's observations on the sterility of various members of the Proteaceæ and Myrtaceæ. The percentage sterility of the pollen is very high in some types, amounting to as much as 95 per cent. The pollen sterility is generally associated with low seed-output. The view is expressed that the sterility of the pollen is the result of natural hybridisation.

Official Publications Received.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 8-9, August September 1930. Abstracts Nos 1496-1853. (London: H.M. Stationery Office.) 1s. 6d. net.

Indian Central Cotton Committee. Technological Laboratory. Technological Bulletin, Series B, No. 7: The Weight per Inch of Fibres of Different Lengths, and the Numbers of Fibres of Different Lengths per Seed, for each of the Standard Indian Cottons. By R. L. N. Iyengar and Dr. A. J. Turner. Pp. ii+24. 8 annas. Technological Bulletin, Series B, No. 8: The Foundations of Yarn-Strength and Yarn-Extension. Part 3: The Clinging Power of Cotton. By Harras Navkal and Dr. A. James Turner. Pp. ii+15. 8 annas. (Bombay.)

University of London. University Extension and Tutorial Classes Council. University Extension Lecture Courses and University Tutorial Classes, Session 1930-31. Pp. 45. (London.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 44: Investigations on "Spotted Wilt" of Tomatoes. By Geoffrey Samuel, J. G. Bald and H. A. Pittman. Pp. 64. (Melbourne: H. J. Green.)

Transactions of the Optical Society. Vol. 31, No. 3, 1929-30. Pp. iv+113-168. (London.) 10s.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1929. Pp. 38+45 plates. (Perth: Fred. Wm. Simpson.)

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1929. By Dr. W. Small. Pp. D28. (Colombo: Government Record Office.) 55 cents.

Indian Journal of Physics, Vol. 5, Part 2, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 2. Conducted by Sir C. V. Raman. Pp. 113-236. (Calcutta.) 2.4 rupees; 3s.

South Australia. Department of Mines: Geological Survey of South Australia. Bulletin No. 14: Geological Structure and other Factors in relation to Underground Water Supply in portions of South Australia. By R. Lockhart Jack. Pp. 48+4 plates. (Adelaide: Harrison Weir.)

FOREIGN.

University of Washington Publications in Anthropology. Vol. 3, No. 2: Mythology of Southern Puget Sound. By Arthur C. Ballard. Pp. 31-150. 1 dollar. Vol. 4, No. 1: The Indians of Puget Sound. By Hermann Haeberlin and Erna Gunther. Pp. 84+2 plates. 1 dollar. (Seattle, Wash.: University of Washington Press.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 168: Progress of Work in Terrestrial Magnetism of the U.S. Coast and Geodetic Survey, July 1, 1927, to June 30, 1928. By Daniel L. Hazard. Pp. 6. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 9: The Joule-Thomson Effect in Air. Second Paper. By J. R. Roebuck. Pp. 287-334. 90 cents. Vol. 64, No. 10: Diffuse Matter in Interstellar Space. By J. S. Plaskett. Pp. 335-346. 45 cents. Vol. 64, No. 11: A Photographic Investigation of Twenty-five Southern Cepheid Variable Stars. By Harlow Shapley. Pp. 347-464. 1.70 dollars. (Boston, Mass.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1929. Pp. 25. (Weltevreden: Landsdrukkerij.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 27, Part 1: Vergleichende Untersuchungen über die Qualitäten, insbesondere die Elastizität und Festigkeit der Tannen- und Fichtenhölzer Hokkaidos. Von Masayuki Ohsawa. Pp. 225. Vol. 28, Part 2: Ein Beitrag zur Kenntnis der Gattung Rhizopus, II. Von Yoshihiko Yamamoto. Pp. 103-327. (Tokyo: Maruzen Co., Ltd.)

Monographs of the Rockefeller Institute for Medical Research. No. 23: The Treatment of Human Trypanosomiasis with Tryparsamide; a Critical Review. By Dr. Louise Pearce. Pp. 339. (New York City). 2 dollars.

CATALOGUE.

Supplément au Catalogue de Photographies Documentaires. Quatrième édition. Pp. 144+8 planches. (Paris: Jacques Boyer.)

Diary of Societies.

FRIDAY, OCTOBER 17.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District) (at Liverpool), at 2.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—J. P. Andrews: (a) A Simple Approximate Theory of the Pressure between Two Bodies in Contact; (b) Experiments on Impact; (c) Observations on Percussion Figures.—Dr. R. Hase: Some Physical Radiometric Investigations of Technical Interest.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. St. L. Pendred: Presidential Address.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—F. Scholefield: Chairman's Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas' Café, Swansea), at 7.—E. E. Ayling: Some Applications of the Electronic Theory in Organic Chemistry.

IRON AND STEEL INSTITUTE (Glasgow Section, jointly with West of Scotland Iron and Steel Institute) (at Royal Technical College, Glasgow), at 7.15.—R. Hamilton: Presidential Address.—Discussion on papers by H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice; and J. Šárek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—Lt.-Col. W. A. Vignoles: An American Tour and Experiences.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. H. Flowers: The London Automatic Telephone System.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Dr. G. I. Strachan: Vaginal Metastases in Uterine Carcinoma. Dr. W. H. F. Oxley: The Organisation and Methods of Practice of the East-End Maternity Hospital.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Prof. J. M. W. Morison: Radiology—its Progress and Future (Presidential Address).

MONDAY, OCTOBER 20.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Dr. Barbara Dale: An Investigation on the Use of Intelligence Tests with University Students.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.45.—A. E. Hamblin: Mass Production of Tin Containers.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—A. J. Pratt: The Development of the Telephone System.

HUNTERIAN SOCIETY OF LONDON (at Simpson's Restaurant, Cheapside), at 7.15.—Prof. A. W. Sheen: The School of Health (Presidential Address).

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—J. Starkie: Artificial Silk Weaving.

TUESDAY, OCTOBER 21.

ROYAL GEOGRAPHICAL SOCIETY (in New Hall), at 3.—Reception, and Inauguration of Centenary Proceedings.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: (a) Report on the Additions to the Society's Menagerie during the months of May, June, July, August, and September 1930; (b) Exhibition of Photographs of Elephants taken by Mr. M. A. Wetherall in the Belgian Congo. Dr. S. M. Manton: Exhibition of Photograph of a Living *Anaspides tasmaniae*.—Miss Rachael M. Renton: On the Budding of a *Scyphistoma*. Dr. W. H. Thorpe: The Biology, Post-embryonic Development, and Economic Importance of *Cryptochaetum iceryae* Will. (Diptera, Agromyzidae) parasitic on *Icerya purchasi* (Coccidae, Monophlebini).—Baron Francis Nopcsa: Notes on Stegocephalia and Amphibia.—P. Gray: The Attachments of the Urodele Rib to the Vertebra and their Homologies with the Capitulum and Tuberculum of the Amniote Rib.—Dr. C. Walter: Report on the Hydracarina (Mr. Omer-Cooper's Investigation of the Abyssinian Freshwaters (Dr. H. Scott's Expedition)).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. D. Johnston: Presidential Address.

ROYAL GEOGRAPHICAL SOCIETY (in New Hall), at 8.30.—Centenary Meeting: Addresses on the History of the Society by Sir Charles Close (President), D. Freshfield, Sir Francis Younghusband, the Marquess of Zetland, and Dr. H. R. Mill.

WEDNESDAY, OCTOBER 22.

ROYAL GEOGRAPHICAL SOCIETY (in New Hall), at 10.30.—Papers on The Habitable Globe by Invited Geographers, British and Foreign.

INSTITUTE OF FUEL (in Incorporated Accountants Hall, Victoria Embankment), at 11 A.M.—Sir David Milne-Watson: Presidential Address.—J. Lubbock: The Industrial Uses of Fuel Oil.—Dr. E. W. Smith: The Use of Coke Breeze for Industrial Purposes.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—J. L. Adam: Notes on Surveys of Ships.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—S. F. Burford: Progress of Chemistry.

TEXTILE INSTITUTE (Midland Section) (at University College, Nottingham), at 8.—A. N. Shimmin: Some Reactions of Foreign Competition on British Trade.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8.30.—Dr. T. R. Hill: Emotion from the Neurological Standpoint.

THURSDAY, OCTOBER 23.

ROYAL GEOGRAPHICAL SOCIETY (in New Hall), at 10.30.—Continuation of papers on The Habitable Globe.—At 3.—Incidents in the History of Exploration: Brief papers by Lord Lugard, Sir Martin Conway, Sir Francis Younghusband, Sir Halford Mackinder, Col. H. Bury, J. M. Wordie, and others.

INSTITUTE OF FUEL (in Incorporated Accountants Hall, Victoria Embankment), at 10.45 A.M.—S. B. Freeman, Dr. W. W. M. Meijer, W. J. Muller, W. L. Roxburgh: Symposium on Fuel Problems in the Mercantile Marine.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—C. C. Paterson: Presidential Inaugural Address.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. Kerr: The Whole Child.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—F. W. Meredith: Air Transport in Fog.

CHEMICAL SOCIETY, at 8.—A. W. Chapman: Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part II. The Intramolecular Character of the Amidine Rearrangement.—A. W. Chapman and C. H. Perrott: Dynamic Isomerism Involving Mobile Hydrocarbon Radicals. Part III. Some Effects of Substitution on the Velocity of Interchange and Position of Equilibrium of Isomeric Triarylbenzenylamidines.—G. G. Davies, Prof. I. M. Heilbron, and W. M. Owens: The Unsaponifiable Matter from the Oils of Elasmobranch Fish. Part VII. The Synthesis of α-glyceryl Ethers and the Constitution of Batyl, Selachyl, and Chimyl Alcohols.—Prof. I. M. Heilbron and D. G. Wilkinson: The Unsaponifiable Matter from the Oils of Elasmobranch Fish. Part VIII. The Structure of the Naphthalene Hydrocarbon derived from Squalene.—Prof. I. M. Heilbron and F. S. Spring: Studies in the Sterol Group. Part X. Hydrocarbons of the Ergosterol Series and the Nuclear Structure of Ergosterol.—Miss N. I. Fisher and Miss F. M. Hamer: A General Method for the Preparation of Thiocyanine Dyes. Some Simple Thiocarbocyanines.

FRIDAY, OCTOBER 24.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—J. McGovern: Presidential Address.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. L. Hodgson and others: Discussion on What are the Desirable Objectives of the Age of Power?

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Morris: Bitumen Emulsions, with Particular Reference to their Use on Indian Roads.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. Lomas: Pure Silk Manufacture.

INSTITUTION OF CHEMICAL ENGINEERS (Graduates' and Students' Section).—J. E. Duckham: Lubrication as applied to Chemical Engineering.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University).—Dr. P. Lewis-Dale: Chemistry in the Service of the Railway.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

PUBLIC LECTURES.

FRIDAY, OCTOBER 17.

LONDON HOSPITAL (in Bearsted Clinical Theatre), at 4.15.—H. S. Souttar: Radium in the Service of Surgery (Schorstein Memorial Lecture).

SATURDAY, OCTOBER 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Uses of a Tail.

MONDAY, OCTOBER 20.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. K. Freudenberg: Some Aspects on the Structure of Cellulose and other Polysaccharides; with Remarks on the Constitution of Lignine. (*Oct. 20 and 21.*)—Researches on the Constitution of Insuline. (*Oct. 22.*)

UNIVERSITY COLLEGE, LONDON, at 5.30.—W. N. Weech: More Roman Towns in North Africa.

TUESDAY, OCTOBER 21.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Population.

GRESHAM COLLEGE, at 6.—Sir G. Newman: Physic. (Succeeding Lectures on Oct. 22, 23, and 24.)

WEDNESDAY, OCTOBER 22.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. S. Lazarus-Barlow: The Prevention of Pre-Cancerous States and the Arrest of Cancer.

BRITISH SCIENCE GUILD (at Liverpool University), at 5.30.—Lt.-Col. Sir David Prain: Science Discipline (Alexander Pedler Lecture).

THURSDAY, OCTOBER 23.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—A. Goodman: Some Medico-Legal Aspects of Contraception.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Prof. L. T. Hogben: Some Biological Aspects of Population.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Leonard Hill: Clothing and Climate.

BRITISH MEDICAL ASSOCIATION (Hastings Hall, Tavistock Square), at 5.15.—Dr. F. Bach: Rheumatism: its Significance in Youth and Middle Age (Chadwick Lecture).

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Miss L. Grier: Changes in Occupations and Leisure of Women from 1830 to 1930.

KING'S COLLEGE, LONDON, at 5.15.—Dr. A. D. Lindsay: Hegel and the German Idealists. (Social and Political Ideas of some Representative Thinkers of the Age of Reaction and Reconstruction.)

FRIDAY, OCTOBER 24.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. Penck: The Relations of Europe and Central Asia. (Succeeding Lecture on Oct. 27.)

SATURDAY, OCTOBER 25.

UNIVERSITY OF BRISTOL (in Henry Herbert Wills Physical Laboratory), at 11.45 A.M.—Prof. J. Franck: Relations between Spectroscopy and Chemistry (Henry Herbert Wills Memorial Lecture).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Stories told by Hairs and Fibres.

SATURDAY, OCTOBER 25, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Professional Registration.

A SIGNIFICANT feature of professional life in post-War Europe to which the Committee on Intellectual Co-operation of the League of Nations has several times directed attention, is the tendency of professional workers to organise themselves in defence associations and frequently to attempt to establish a register of those qualified to practise, accompanied by legal restriction of professional practice to such persons. The case of the accountant, against which a Departmental Committee has recently reported, is the latest in sequence of a series of unsuccessful attempts to establish such registers in Britain. Restrictive registration was granted to the profession of dentistry in 1921. An architects registration bill was unsuccessfully introduced into the House of Lords in November 1928, and a similar attempt to obtain registration of opticians proved abortive in 1927, strong opposition being displayed in the House of Commons by the medical profession. In the profession of science, like tendencies are to be discovered, notably in the profession of chemistry, and it is probably largely the anomalous position in which the chemist finds himself in Great Britain, where the title of chemist is already restricted by law to the pharmacist, that has delayed the presentation of a bill before Parliament. The Pharmacy Bill which was presented to Parliament by certain private members in 1923, although it proposed to restrict the title of chemist to persons registered by the Institute of Chemistry, was drafted without consulting the professional organisations of chemists, such as the Institute of Chemistry and the British Association of Chemists, and did not represent a professional movement for registration.

While such attempts have in some cases proved premature from various causes, they indicate a tendency towards a definite change in the social structure of the country. To the more artificial system of political parties the growth of professional organisations, like that of the trades unions, opposes an occupational organisation similar to that of the medieval guild system. It is not, of course, contended that until recently professional organisation has not existed or that professional registration has not been tried. What is new is the expansion in the numbers of scientific workers and the growth of the professional spirit. Such workers have almost inevitably contrasted their own position with that of members of the medical profession, and the development of the medical profession since the passing of the Medical Act of 1858 has proved

a powerful stimulus to other and younger professions to seek similar lines of development as they become sufficiently numerous or important. In the field of science, the activities of the Association of Scientific Workers and of the British Association of Chemists illustrate this tendency. The former has debated the formation of a General Scientific Council and the institution of a Science Act, while the latter has recorded among its definite objects the legal re-definition of the term chemist and the formation of a legal register of all who are qualified to practise chemistry.

The newer branches of the profession of science, however, in contrast to the older professions of medicine and law, suffer the handicap that their members are rarely in direct relation with the public but are mostly themselves employed persons, and this factor constitutes a main difficulty in a movement towards registration.

There are two main obstacles to the activities of both these organisations. The Association of Scientific Workers is handicapped by sectionalism among scientific workers and the absence of real co-operation between different branches of science. In particular, the Association has not yet received any full measure of support from the most numerous class of scientific worker at the present time—the chemist—probably in consequence of the relatively highly organised position of the profession of chemistry. Indeed, while there is a profession of chemistry, it is doubtful whether we can speak with as much truth of a profession of science. The British Association of Chemists, while not altogether free from the handicap of lack of co-operation between different branches such as the consultant or analyst and the industrial chemist, finds a main obstacle to its progress in the question of title and the existence of the Pharmacy Acts. In a memorandum upon the questions submitted by the Departmental Committee on the Poisons and Pharmacy Acts, the Council of the Pharmaceutical Society recently recognised that other persons than those registered under the Pharmacy Acts practise chemistry in its different branches without statutory recognition. While persisting in the view that the title chemist could not be relinquished by pharmacists, the Council suggested that the creation of a register of chemists in which persons registered under the Pharmacy Acts took their place as pharmaceutical chemists would overcome the difficulty. The suggestions as to the means of producing such a register are left to the initiative of organisations representing chemists. Such an inclusive register might well remove the immediate difficulty, but the drawbacks to a register including the members of two entirely distinct professions are obvious. Alternative titles have been suggested, and the term "chemical practitioner" adopted by the British Association of Chemists, although cumbersome, has found some support. When, however, a sufficient volume of organised support for the registration proposal is forthcoming from the profession of chemistry, the question of title is unlikely to prove a permanent obstacle.

Even the failure of movements towards professional registration may indicate or emphasise the conditions essential for success. Primarily the desire for professional registration arises from a belief among members of a profession that such a step would result in an improved status and economic position for the members of that profession. While such aims are justifiable, they would not be accepted as a main reason for closing the profession. It must be shown that the enhanced status by, for example, increasing the efficiency of the services rendered would be an industrial or public advantage.

Although formed largely to defend the economic interests of their members and to fill a definite gap among the existing organisations of science, the Association of Scientific Workers and the British Association of Chemists have never pursued a narrow policy, but have endeavoured to awaken a wider sense of public responsibility among scientific workers and secure their fuller participation in public affairs. Although the latter body is still registered under the Trade Union Acts, neither organisation has ever shown any tendency to associate itself with the militant side of trades unionism. Trades unions have their own value in the present structure of industry, and scientific professional organisations deeply imbued with a spirit of service might well exercise an influence out of all proportion to their numerical strength, given the right opportunities of contact.

As it is, in such newspaper references as are made to the activities of either the Association of Scientific Workers or the British Association of Chemists, there is a tendency to stress unduly their material or economic interests and to ignore their wider aims. The two are, however, inseparable. No branch of science can render its full service to the State whilst its members are relatively handicapped in status or pay. First-class work, or the necessary proportion of first-class men, cannot be expected as the result of second- or third-class treatment. On the other hand, any great improvement in such respects can only come as scientific workers succeed in bringing home to the general

public their wider aim and educating the community in the value and place of pure science.

Under present conditions both these aims are of urgent importance. We have alluded recently to the dearth of first-class recruits for pure research. It is equally important to the community that science should assume a fuller share of responsibility for leadership and take a much wider part in public affairs. The relation between the scientific worker and the control and ordering of the life of the community under the impact of applied science presents a difficult problem for democracy. Some of the most complex situations confronting statesmen to-day can be traced directly to the indifference of those responsible for the discoveries of science to the consequences attending their utilisation. Scientific workers have been so absorbed in the progress of their researches that they have frequently neglected to take their share in assisting the control of forces which have been released by their work. This is the point on which Prof. Zimmern and other workers in the field of intellectual co-operation insist, and the wider recognition to-day of the importance of a right relationship between science or learning and leadership is largely due to their efforts.

Those scientific workers who have most clearly envisaged the contribution which science can make to the security and welfare of the State, and who are eager to see scientific workers taking full responsibility in the community, are among the most convinced supporters of the movement towards professional registration. The professional organisation which must precede registration offers some prospect of counteracting the political impotency of science in Great Britain. The publicity which such a movement requires and obtains serves to give a much-needed platform from which the services the chemist or other scientific worker renders to the community can be broadcast. The influence of science on public affairs as well as upon industry is now so profound and so rapidly increasing that in most branches of science an effective case could probably be presented for registration as in the public interest. The fact that the benefits of registration accrue slowly—a space of anything up to fifty years is required to eliminate from the register the lesser qualified persons who must be admitted in the first instance—only adds urgency. In a society the structure of which is increasingly dependent on the results of modern scientific discoveries, and in which ignorance or disregard of scientific facts can have far more serious consequences, measures to maintain or enhance high standards of qualification and integrity in those who practise in any branch of science are essential and demand public support.

For another reason the growth of professional organisation, if not of professional registration, among scientific workers may prove a public advantage. The solution of many important problems to-day is determined by factors which can be resolved by impartial and scientific inquiry. No forum exists from which those findings can be effectively made known without distortion by vested or political interests and from which, if necessary, unprejudiced public opinion can be organised to secure appropriate action. It is at least possible that the growth of professional registration will assist in the removal of one of the fundamental defects of modern democracy—the difficulty of securing for the community the advantages which would result from the enforcement of the recommendations of an impartial tribunal when its findings are not entirely in accord with the declared policy of any powerful party, or are, as is usually the case, regarded with disfavour by those whose interests are most immediately concerned.

The Problem of Epigenesis.

(1) *Grundriss der Entwicklungsmechanik.* Von Prof. Dr. Bernhard Dürken. Pp. vii + 208. (Berlin: Gebrüder Borntraeger, 1929.) 12·50 gold marks.

(2) *Die Determination der Primitiventwicklung: eine zusammenfassende Darstellung der Ergebnisse über das Determinationsgeschehen in den ersten Entwicklungsstadien der Tiere.* Von Prof. Dr. Waldemar Schleip. Pp. xii + 914. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 85 gold marks.

(3) *Experimentelle Zoologie: eine Zusammenfassung der durch Versuche ermittelten Gesetzmässigkeiten tierischer Formen und Verrichtungen.* Von Prof. Dr. Hans Przibram. Band 6: *Zoonomie; eine Zusammenfassung der durch Versuche ermittelten Gesetzmässigkeiten tierischer Formbildung (Experimentelle, theoretische und literarische Übersicht bis einschliesslich 1928).* Von Prof. Dr. Hans Przibram. Pp. viii + 431 + 16 Tafeln. (Leipzig und Wien: Franz Deuticke, 1929.) 40 gold marks.

THE question of epigenesis may be justly said to constitute one of the two root problems of zoology. For if we think it out there are two main things to be discovered about an animal, namely: (1) How does it fulfil its functions?—in a word,

considered as a machine, how does it work? and (2) How does it come into being?—that is, how did it develop and grow? A subsidiary question to the last is: If there be such a thing as evolution, how and why did the powers of growth change from generation to generation? For, as the late Dr. Bateson reminded us so long ago as 1894, the conception of evolution as the remoulding of the adult structures of an animal as we could alter the features of a wax doll by melting the wax and remodelling it, is an entire illusion, since the members of the parent species and of that to which it gives rise both begin as tiny formless germs and what is changed is *the powers of growth*. Now when we begin to analyse growth, we can either directly observe its successive phases—and this is the scope of descriptive embryology; or by operating on the germ by chemical and physical agencies we can seek to discover the part which each visible element plays in the upbuilding of the adult individual—and this is the object of experimental embryology.

How this science has grown since its first beginnings with His in 1874 ("Unser Körperform und die physiologische Problem ihrer Entstehung") is witnessed by the three splendid works which are the subject of this review. Each of the three is worthy of unstinted praise: though we may differ from the authors in some of the conclusions reached by them, yet in each case the collection and setting forth of the matter is worthy of our sincere admiration. We hope that too long a time may not elapse before all are translated into English.

As an introduction to the subject Dürken's manual is to be preferred, because it is concise, well illustrated, and includes only typical cases which serve to exemplify the main principles of the subject, so that a beginner can get a good grasp of these principles without being overwhelmed by too much detail. Schleip's large and well-illustrated volume attempts to give a more or less complete account of the present state of our knowledge of the subject, and it will for a long time constitute a classic work of reference. Przibram's work—thorough and excellent as all his work is—is even more ambitious in its scope than that of Schleip, for it includes not only the facts of experimental embryology in the narrower sense, but also a considerable amount of the results of Mendelian experiments. It is, however, extremely condensed and, not being adequately illustrated, somewhat difficult to follow: it seems to us that its chief value will reside in its being a manual in which references to all the important papers on the subject can be easily looked up.

It must be obvious to the reader that, within the limits of the longest review for which space can be found in Nature, it would be impossible to refer to a tithe of the new matter contained in these volumes, and so we must limit ourselves to a discussion of the main problems involved and to the attitude of the three authors towards them. In fairness, however, it should be added that this new matter is almost entirely confined to an elaboration of subjects dealt with by the older authors such as Roux, Hertwig, Driesch, Herbst, Boveri, Conklin, and Wilson, and does not consist to any considerable extent of discoveries in newer fields. The number of animals the eggs of which can conveniently be handled and which are tolerant of experiments is limited, and the same familiar figures crop up in successive text-books of experimental embryology. After all, as Driesch has wisely remarked, the biological experimenter cannot produce life at will—he must wait until he finds it, and he is therefore in the same position as a physicist would be if he could only study fire when he found it in the crater of a volcano.

When we approach the analysis of the development of the egg, the first question we encounter is whether the organs of the adult exist in the egg preformed in miniature and development consists essentially in an unfolding and growing bigger of these rudiments, or whether the egg is at first undifferentiated material which from unknown causes afterwards becomes more and more complicated and development is consequently an 'epigenesis'. This problem is *the* problem of experimental embryology; in varied forms it reappears in every experiment on development which has been made.

The answer to this question given by the earlier experiments of Driesch was that some eggs, such as those of starfish and sea-urchins, consist of undifferentiated material; but others, like those of Ctenophores, show a specialisation into parts destined to form particular organs of the adult. The experiments of Wilson, Conklin, and Crampton proved that the eggs of Annelida and Mollusca belong also to this latter category. To eggs of the first kind Driesch gave the name of 'equipotential systems', since when the egg had divided into eight cells any one of these was capable of forming a tiny larva perfect in all details, and, moreover, when the egg had developed into a hollow sphere or blastula, any considerable piece of this blastula would round itself off and form a perfect blastula of reduced size, which would give rise to a correspondingly reduced larva. On these results, which were a complete surprise to him, Driesch founded his

theory of vitalism, arguing that if the organism were to be regarded as a physico-chemical machine, such things could not happen, for no conceivable machine could be divided into parts, each of which would function as a similar machine of reduced size. He inferred that there must be in every egg a non-material force or 'entelechy' which was capable of controlling the physical and chemical changes taking place in the germ, so as to direct them towards a definite end. This power of direction was named by Driesch 'regulation'. This revolutionary idea of Driesch, transcending the bounds of materialistic explanation, evoked the fiercest opposition amongst those biologists by whom life was regarded as nothing more than complicated chemistry. Yet the arguments of Driesch have never been successfully met. The utmost that can be urged against them is the assertion that, although we cannot explain life by physics and chemistry now, some day in the distant future, when we have made further discoveries, we may possibly be able to do so.

Of the authors reviewed in this article, Dürken is inclined to favour Driesch whilst Schleip and Przibram oppose him, but the alternative explanations of the two latter authors when examined in detail resolve themselves into saying the same things that Driesch said, in different phrases. All three authors agree in showing that between equipotential and specialised eggs every conceivable grade of intermediate exists, and that even the eggs of *Echinus* itself are not quite so equipotential as Driesch imagined. Schleip quotes the work of Hörstatius as proving that when the upper half of a blastula is cut off, though it will round itself off so as to form a reduced blastula, yet this will never form endoderm or proceed any further in development. The vegetative half, however, when severed will produce a completely viable gastrula. By a triumph of manipulative skill, Hörstatius succeeded in separating the vegetative pole of a blastula and grafting it in various positions on another blastula in which an appropriate defect had been produced. He thus proved that in all cases development begins in the graft, and that this graft can change cells that would otherwise produce ectoderm into endoderm, in other words, act as an 'organiser' of development.

Driesch attributed specialisation in eggs to a 'premature stiffening of the cytoplasm' which prevented the 'entelechy' from moulding the fragment of the egg into a reduced whole. Przibram in other language comes to exactly the same conclusion. He says that the formation of definite organs is in all cases due to a *solidifying* of a portion of the cytoplasm, forming what he calls an 'apoplasm' which, if we understand him right, he does not regard as fully alive. In proportion as 'apoplasms' are deposited the potentialities of the germ are successively limited, and the reason why the higher animals approximate in their working to mechanisms is the large number of 'apoplasms' included in their make-up. Only fluid cytoplasm is completely living and possesses all the potentialities of the race, and Przibram is driven to conclude that these potentialities, so far as embodied at all, must be contained in the molecules of the cytoplasm, and that, therefore, these molecules constitute the real entelechy. Schleip similarly concludes that there must be an ultra-microscopic structure in the cytoplasm which, like a crystal, tends to assume a definite form and to complete itself when a fragment is severed.

In making these admissions, however, it seems to us that both Schleip and Przibram deliver themselves into the hands of Driesch. For in the crystallisation of an inorganic substance from a solution, the crystal assumes a definite form because its molecules have definite corresponding shapes, as Sir William Bragg has taught us. But what kind of structure, whether molecular or super-molecular, are we to envisage in cytoplasm? When the limb of a young newt is cut off and the stump proceeds to regenerate a new limb, are the molecules in the stump in the form of infinitesimal fingers and toes? Moreover, when the stump is cut at different levels and only the missing piece is regenerated, are we to assume that at each level in the limb before amputation the molecules are miniatures of the part distal to them? If we are able to swallow these fantastic assumptions, what are we to say of the experiment recorded by Dürken in which the tail bud of one newt embryo was grafted into the body of another near its forelimb and developed into a new limb? Presumably the cytoplasm of the tail bud was 'organised' so as to produce the tissues of an adult tail. How then was this organisation so completely changed as to produce a limb instead? No wonder that Dürken says that in cases like this, physical and chemical explanations leave us completely in the lurch, and we must have recourse to the conception of the 'biological field', an influence not in the living matter itself, but in the space, presumably the ether, around it.

Schleip seeks to disprove Driesch's theory by pointing out that the supposititious entelechy sometimes does foolish things, as in the case of the eggs

of Nematoda subjected to centrifugal force each of which produces two partial embryos instead of one whole one. But in this objection lurks the childish conception that the entelechy, if it exists, must be the embodiment of Divine Wisdom. The entelechy is not all-seeing—it is a rudimentary 'striving' which reacts to its immediate environment, in this case the 'apoplasm' or ball of dead matter ejected from the egg by centrifugal force.

The term 'organiser' we owe, of course, to Spemann, who wisely abstains from giving any chemical explanation of it. In the course of his marvellous experiments on the newt, Spemann showed that a piece of the dorsal lip of the blastopore of one newt gastrula grafted on the flank of another would change the fate of all the cells in its neighbourhood and force them to develop into a supplementary nerve-cord and underlying notochord. The reviewer might humbly plead that exactly the same conception was reached by him and published in a paper which appeared in 1918 entitled "The artificial production of Echinoderm larvæ with two water-vascular systems and also of larvæ devoid of a water-vascular system" (*Proc. Roy. Soc.*, B, vol. 90). In this paper he showed that when under the stimulus of hypertonic sea-water a second hydrocœle bud was produced in the pluteus, it completely altered the fate of all the tissues near it. It unfortunately did not occur to him to invent the term 'organiser'.

Of what nature is the influence emitted from the 'organiser'? Here again all physical and chemical analogies fail to help us. If the influence were merely a physical or chemical force it would *combine* with the growth-forces of the organised tissue, and what we should observe would be the *resultant* of the two forces. The complete domination of one part by another is not a physical but a vital phenomenon and an instance of Driesch's 'regulation'.

It would be a fair conclusion to draw from all that has been discovered in the field of embryology to say that in broad outline there are three stages in development, namely: (1) Division of the egg into cells—that is, segmentation; (2) differentiation of these cells so as to form the three primary layers—ectoderm, endoderm, and mesoderm; (3) the action of portions of one layer on the neighbouring parts of other layers so as to form definite organs—that is, the action of organisers.

The ultimate question, however, whence the original organisation of the cytoplasm of the egg is derived, must now be faced. The only answer possible is the nucleus. It is true that, as we have seen, many eggs when ready for fertilisation have an already differentiated cytoplasm. But the cytoplasm of these eggs *when young* is undifferentiated, and during ripening their nuclei are engaged in emissions into the cytoplasm. In particular the nucleolus has been repeatedly observed to become broken into fragments which pass through the nuclear membrane and become dissolved in the cytoplasm. If we take such a specialised egg as that of the Nematode *Ascaris*, Boveri has shown that if it is subjected to centrifugal force *when young*, large portions of the cytoplasm can be shorn away and yet the reduced egg will give rise to a typical embryo. To this conclusion Schleip and Przibram also consent. But it seems to us that a further conclusion follows which they have not clearly envisaged. When differentiation of the cells of the blastula takes place, this must be due to further emissions from the nuclei. But the nuclei in these early stages of development are all alike, and by means of pressure experiments, these nuclei, as Hertwig has put it, may be juggled about like a heap of marbles without altering the result. Moreover, so far as can be judged by the most minute cytological examination, they remain unchanged in their essential make-up throughout the whole of development. So we reach the conception of an *intermittent action of the nuclei on the cytoplasm* giving rise to successive differentiations, that is, stages of development; and as it is by means of these stages that development is directed towards a definite end, if there be an entelechy, we may conclude that the mode of its action is by nuclear emissions. These emissions are the physical correlates of what Uexküll in his "Theoretische Biologie" (1927) calls the 'Impulse' to development and the distinguishing of which, he avers, constitutes the utmost limit to which biological analysis can go.

Comparative embryology, however, can go further, and Schleip rightly insists that experimental embryology ought to be comparative. These embryonic stages are soon discovered to be merely smudged and simplified forms of larval stages which in allied forms lead a free life in the open, seeking their own food and combating their own enemies. These larval forms in turn are seen to be nothing but modified and simplified editions of adult forms in the past history of the race. Therefore, in the last resort, development is found to be due to the successive coming to the surface of a series of racial memories, and the entelechy might be defined as a 'bundle' of such memories.

The so-called Mendelian 'genes', however, constitute a problem for the embryologist; for the

conception of the hereditary make-up which they induce in the minds of geneticists is totally at variance with that which the embryologist draws from the study of development. Schleip and Przibram struggle valiantly to reconcile the two conceptions and fail. Dürken alone boldly questions the validity of the whole conception of the genes and points out how much it is purely arbitrary and theoretical. If the results of a crossing experiment agree with expectation based on the ordinary Mendelian rules, then it proves the reality of genes; if the results do not agree, the geneticist denies that it disproves them, because he immediately postulates the action of an undiscovered 'gene' which complicates the result. The real answer to the conundrum was given by Johannsen, when, in his latest publication, deploring the damage and confusion of thought caused by the invention of the word 'gene', he states that it represents a mere superficial disturbance of the chromosomes and gives no insight into the real nature of heredity. Even Przibram points out that X-rays will produce "unzählige" mutations, and that there is no correlation between the rays and the nature of the mutation. With these remarks we thoroughly agree.

E. W. MACBRIDE.

Fourier's Series.

Introduction to the Theory of Fourier's Series and Integrals. By Prof. H. S. Carslaw. Third edition, revised and enlarged. Pp. xiii + 368. (London: Macmillan and Co., Ltd., 1930.) 20s. net.

PROF. CARSLAW'S excellent book is so well known that it needs little general introduction. The first edition, published in 1906, was a work on "Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat". The second edition followed in 1921, in two volumes. The great advances in the theory of Fourier's series had caused the earlier chapters to develop into a self-contained book on analysis, including much matter on sequences and integration in addition to the theory of Fourier's series. It is of this work that the present book is the new edition.

Though there has been no radical change in character, much new matter has been introduced. In the old edition the discussion of the convergence of Fourier's series was limited to functions satisfying Dirichlet's conditions. This was unsatisfactory, because the sum of two such functions need not satisfy the conditions. The notion of functions of bounded variation has now been introduced, and the discussion has been enlarged so as to include them. Perhaps at this point it would have been well to make clear that (as is proved in a later chapter on the Riemann-Lebesgue lemma) the condition of bounded variation need only be satisfied in an arbitrarily small interval surrounding the point at which the convergence is considered. The difficulty could have been avoided by proving the Riemann-Lebesgue lemma at an earlier stage. In passing, it is perhaps worth while to suggest that the familiar and cumbrous condition "if x is an interior point of an interval (a, b) in which $f(x)$ has bounded variation" might well be shortened to "if the limits $f(x \pm 0)$ exist absolutely". The relation between the condition just mentioned and the condition "if the limits $f(x \pm 0)$ exist" is exactly parallel to that between absolutely and non-absolutely convergent series.

An account of Parseval's theorem (for a bounded R-integrable function) is another noteworthy improvement. In the excellent chapter on Gibbs's phenomenon, Prof. Carslaw records his interesting discovery that the phenomenon was pointed out by one Wilbraham, of Trinity College, Cambridge, more than fifty years before Gibbs's famous letter to NATURE.

There is again an appendix on practical harmonic analysis and periodogram analysis. The first part of this is the 'practical' complement to the real variable theory of the preceding chapters, but the later work is still without a counterpart in real variable analysis. The analogy between the practical methods of periodogram analysis and certain results concerning almost periodic functions suggests a possible source for the appropriate theory.

In place of the bibliography in the old edition, there is an appendix on the theory of sets of points, leading up to the Lebesgue integral and its application to Fourier's series. Like all the rest of the book, this is clearly and attractively written. One can only wish that there had been more of it and that it had been incorporated into the book at an earlier stage. If the theorems on Fourier's series which involve the notion of measure are harder than those which do not, they are far more interesting and illuminating. Moreover, there is need for an English book on the subject of moderate size. In taking leave of the third edition, we may express the hope that in the fourth Prof. Carslaw will enlarge or again subdivide his book to supply this need.

Scientific Nominalism.

Les concepts scientifiques. Par Hélène Metzger. Ouvrage couronné par l'Académie des Sciences morales et politiques. (Bibliothèque de Philosophie contemporaine.) Pp. x+196. (Paris: Félix Alcan.) 12 fr.

THE twentieth century, and especially the last decade, has seen a remarkable development of consideration by working scientists of the philosophic implications of their labours. Biologists, as well as workers in the physical sciences, are studying the theory of knowledge in the light of their own work.

In the volume before us, Madame Metzger endeavours to generalise the categories within which scientific concepts may be grouped. She starts from the thesis that classification is a primal need of the human mind. We need to sort out the infinite complexity of experience, to make some choice of the matter of our own thought. Only by what is in ultimate analysis a process of classification can we embrace many phenomena in a single series of considerations.

Classification, Madame Metzger points out, is necessarily based on analogy, which may be to a greater or a lesser extent the construction of the mind itself. In considering a group comprising a number of phenomena or of series of phenomena, the mind so frames the boundaries, both of the group itself and of each series within the group, that they may conform to the analogical framework within which the mind chooses to work.

Having established the thesis that classification, based on analogy, provides the foundation of all mental activity, including that of the scientist, Madame Metzger proceeds to the analysis of the various patterns of those groupings of experience that underlie the formulation of various hypotheses that have held the field in science, and especially in chemical science. In each theory she traces the use of analogy as the basis of the concept of scientific law. Almost as pervasive as the concept of analogy is, she shows, that of evolution or development, which she distinguishes as "divergent, parallel, or convergent", each in turn based on analogy, that is, on a grouping of phenomena in such a fashion that it may be possible to ascribe to each group certain common properties or common relationships, while the groups themselves, considered as entities, may be similarly connected by common properties or relationships. "Perhaps", says Madame Metzger, "the complete image of Nature cannot be embraced in the monument erected by human intelligence . . . but the partial success attained assures us that evolutionist frameworks are, at least to some extent, in harmony with reality."

The final part of the work considers to what extent 'scientific nominalism' does in fact extend our interpretation of scientific concepts, and ends on a warning that classification tends always to be based on a process of abstraction which gives only a partial reflection of Nature.

DOROTHEA WALEY SINGER.

Our Bookshelf.

The Science of Folk-Lore. By Dr. A. H Krappe. Pp. xxii + 344. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

DR. KRAPPE was inspired to write this survey of the field of folk-lore by his visit to the congress held in London in 1928 to celebrate the jubilee of the Folk-Lore Society. The necessity for such a handbook was presented to him through his opposition to the methods and outlook of the so-called 'anthropological school'. Hence the existence of a handbook, published by the Society and prepared under the editorship of the late Miss C. S. Burne, is not mentioned. Throughout Dr. Krappe is very critical of Andrew Lang and the colleagues who with him were the foremost exponents of the anthropological method in Great Britain, nor will he admit the historical point of view of the late Sir Laurence Gomme. Nevertheless, he recognises the results achieved by the anthropological method in the hands of such a master as Frazer, whom indeed he regards as transcending all schools. He himself belongs to the school which subjects the material of folk-lore to the strict canons of literary and historical criticism.

Dr. Krappe, of course, has no difficulty in showing that the results attained by the uncritical application of the anthropological method are often unwarranted and sometimes absurd. That, indeed, might apply to any method injudiciously used. On the other hand, while the method of which he is the exponent may prune away some exuberances in the handling of fairy tale, folk-tale, and myth, as has already been done by certain English writers, yet even in Dr. Krappe's treatment of such subjects as magic, ritual, and superstition, the interpretation of the ultimate residuum after the application of the literary method must rest with the comparative method of the anthropologist whether the matter *sub judice* be an independent invention or the result of diffusion from a single origin.

Romance of the Planets. By Mary Proctor. Pp xii + 272 + 8 plates. (New York and London Harper and Bros., 1929.) 7*s.* 6*d.* net.

MISS PROCTOR must certainly be counted unfortunate in having brought out this little book just before the discovery of the extra-Neptunian planet, Pluto She has narrowly missed being the author of the one up-to-date book on the planets, and the romance

of the discovery is by no means the least interesting aspect of it. However, she is in time for the forthcoming opposition of Eros, and her diagram of the path of the asteroid on that occasion should be of particular interest just now. The book is the fourth of a series dealing with the various bodies in the solar system. "These books have no scientific pretensions," says the preface, "nor do they deal with heavy celestial mechanics or troublesome mathematics; rather do they incline to an account of the latest theories and advances in astronomical research given in an entertaining, conversational manner." Books of this kind will always have their use, and "The Romance of the Planets" may be recommended as a very readable and accurate account of its subject, requiring the minimum of intellectual effort on the part of the reader. The question of the habitability of the planets is well to the fore, and is treated historically with numerous quotations. Quotations, in fact, are a prominent feature of the book, and are usually apt, though it is with something of a shock that we find Tennyson's almost hackneyed lines:

"the great world's altar-stairs
That slope through darkness up to God",

attributed to F. A. Pouchet! The illustrations are well chosen and moderately well reproduced.

Alternating Current Bridge Methods: for the Measurement of Inductance, Capacitance and Effective Resistance at Low and Telephonic Frequencies; a Theoretical and Practical Handbook for the Use of Advanced Students. By Dr. B. Hague. (The Specialists' Series.) Second edition, revised and enlarged. Pp. xvi + 391. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15*s.* net.

THIS book is a theoretical and practical handbook for the use of advanced students. The best methods at present in use for measuring inductance, capacitance, and effective resistance both at low and at telephonic frequencies are given. The considerable amount of new matter in this edition has in our opinion increased its usefulness.

During the past six years, several notable uses of the alternating current bridge method to practical measurements have been made and these are duly described. An immense amount of research work has recently been done on the measurement of dielectric losses in cables and insulators at very high voltages, and bridge methods have been found as a rule better than wattmeter methods.

The principle of the Kelvin double bridge has been usefully extended to making alternating current measurements. The theory underlying the use of bridge networks is given, and the author's treatment will be easily understood by students. We think the book would be still more useful if the author had included methods of making measurements at radio frequency.

Hints, however, are occasionally given which will be a help to those working at very high frequencies. In particular, the sections dealing with bridges using condensers and the various methods which have to be adopted for shielding them will be found useful.

Deposition of the Sedimentary Rocks. By Prof. J. E. Marr. Pp. vii + 245. (Cambridge: At the University Press, 1929.) 7*s.* 6*d.* net.

PROF. MARR's little volume gives a general account of the conditions which have controlled the distribution of the sedimentary rocks in time and space. It is not concerned except incidentally with the actual characters of the various types of sediments. These are divided according to their mode of origin—primarily into land and sea deposits. The latter are further divided according to the particular belt of sedimentation in which they are believed to have been laid down. These belts are—(i) the 'belt of variables', in which occur those sediments originally deposited nearest the shore line; (ii) the intermediate or 'mud belt'; and (iii) the 'organic belt'.

The introductory chapters discuss chronology and the use of fossils in correlation. The final two chapters consider the relationship between climatic belts and belts of sedimentation, and between the principle of uniformitarianism and organic evolution.

The author's treatment of his subject is throughout philosophical, with a refreshing absence of dogmatism. Detail is only introduced where necessary to illustrate points under discussion. The book forms an excellent introduction to the study of stratigraphy, and may also be recommended to those whose interest in geology is cultural rather than professional.

Morphologic Variation and the Rate of Growth of Bacteria. By Prof. Arthur T. Henrici. (Microbiology Monographs: General, Agricultural, Industrial, Vol. 1.) Pp. xiii + 194. (London: Baillière, Tindall and Cox, 1928.) 13*s.* 6*d.* net.

THIS book comprises a series of personal researches of a statistical character undertaken with the view of attempting to bring order out of the chaos which has so far filled the field concerned with the form and structure of bacteria.

The object of the book is to show that, contrary to orthodox teaching, the cells of bacteria are constantly changing in size, form, and structure in obedience to the operation of relatively simple laws. The author's investigations tend to show that the growth of bacteria in artificial culture is governed by the same laws that affect the development of multicellular organisms; the cells in turn exhibiting an embryonic form during a period of rapid growth, a mature or differentiated form during a period of slow growth or rest, and a senescent form during the period of death.

Altogether a most interesting and stimulating monograph. R. ST. J.-B.

Solvents. By Dr. Thos. H. Durrans. (Monographs on Applied Chemistry, Vol. 4.) Pp. xv + 144. (London: Chapman and Hall, Ltd., 1930.) 10*s.* 6*d.* net.

THIS is a book which deals mainly with the newer solvents for nitrocellulose. Its interest is for the technician engaged in the manufacture of nitrocellulose lacquers and enamels rather than for the general scientific reader.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Fechner-Weber Law in Wool Sorting.

IN the course of research work regarding the determination of the fundamental basis upon which wool 'quality' is assessed, an interesting illustration of Fechner's law has been brought to light.

An examination of a range of worsted tops comprising all qualities usually accepted by the trade from 48's to 80's has yielded interesting results. The tops were selected and vouched for by several authorities in the trade as being typical of their particular quality, and investigation revealed the interesting fact that the mean finenesses of the fibres comprising the samples of successive qualities of wool form a geometric progression. This result is in direct agreement with the Fechner-Weber law which states that "in order that the intensity of a sensation may increase in arithmetic progression the stimulus must increase in geometric progression, or in Fechner's notation $I = c \log S$".

An examination of French, German, and Italian standards has revealed that the same law is followed with, of course, a different number of grades in each country. It is not surprising to find that this should be the case, since the wool sorter's estimate of quality is made through the visual and tactile senses. The fact that the results of wool sorting follow Fechner's law affords a convenient basis for international agreement for an agreed scale of fibre fineness. So far as we are aware, the confirmation of this psycho-physical law, in its application to the wool industries, has not previously been noted.

S. G. BARKER
(Director of Research).

Wool Industries Research Association,
Torridon, Leeds, Oct. 6.

Natural Transport of Stones and Marine Animals.

AN article on the "Transport of Stones by Attached Seaweed" in NATURE of Feb. 8 suggests some interesting lines of thought. During the last two years, I have explored some 600 miles of coast in Western Australia, but have seen nothing comparable to the cases cited below or in the paper quoted, the only feature of interest in this connexion being the *Cymodocea* drift; the long ribbon-like leaves are rolled together by the waves and masses of several tons commonly present a wall two feet high and a chain long to the waves, and so give the beach a temporary degree of permanence, with shallow temporary pools on the landward side.

The case is very different in New Zealand. The coasts of Canterbury include cliffs, reefs, shingle, and sand, and the algal vegetation is luxuriant, including numerous float-bearing fucoids, notably *Cystophora retroflexa*, and also the immense kelps *Durvillæa antarctica* and *Macrocystis pyrifera*. One would expect that under such conditions supporting evidence could be found for Mr. Symington Grieve's views, as quoted in the above article, but although I have several curious observations to offer, I have never seen anything to suggest that stones attached to the holdfasts of algæ contribute materially to the breaking down of cliff faces or to the building up of stone beaches.

The article referred to mentions an account by my former teacher Dr. Charles (not James as given) Chilton, on the transport of stones by ascidians. Sponges are much more frequently concerned; at Timaru, for example, drift sponges may be seen in great numbers on a shingle beach, attached to stones or to the sessile queenshells *Chlamys*. No doubt the increasing size of the sponge leads to the dislodgment of the object to which it is attached, as also happens with fucoids attached to stones or to crumbling limestone or papa rock, or *Macrocystis* on the pinna shell *Atrina zelandica*. But the sponges did not accomplish much in the building up of the Timaru stony beach, which was small until a large mole was built out into the sea a few years ago; the mole not only stops the shingle as it drifts northwards from the mouths of the Pareora and Waitaki Rivers, but also it holds the beach permanently there in a way that *Cymodocea* or sponges could never do. As for the battering of cliffs by suspended stones, the latter are by no means hurled at the cliff, but trail sluggishly along the bottom with the upper fronds of the weed swaying backwards and forwards nearer the surface, and the usual fate of the stones seems to be to get wedged in between other larger stones and held firmly. There is a narrow range in the size of stones transported by any such means, and a small stone and a weed would seem a poor combination in comparison with a good Pacific breaker.

I am, however, the more ready to think that the differences between Mr. Symington Grieve's views and my own impressions are due to genuine local differences, because I can mention a number of curious phenomena which, though possibly paralleled in the North Atlantic, are not mentioned in any accounts which have come under my notice. First, there are rocks in New Zealand which, so far as mechanical forces are concerned, must be more kelp-worn than water-worn. *Durvillæa* invariably grows between tide marks in channels or exposed points where there is a maximum disturbance of the water; at a rough estimate, the discoid holdfasts, which commonly overlap or fuse, are 10 in. across, the stipe is cylindrical and 1½ in. in diameter, the fronds are ½ in. thick, and the whole plant 10 ft. in length. The fronds, which are torn into ribbons by the continued impact on the rocks, are full of air-spaces, and very buoyant, but nevertheless extremely tough. As a wave recedes these fronds trail outwards after it, slithering over one another and over the rock in a dense mass, and the next wave hurls them back by the ton with terrific force against the rock. In some places more kelp strikes the rock than water, and the wearing effect must be much greater. But by a strange oversight, experimental work in New Zealand on the wearing effect of shingle grinding together has not yet been extended in the present direction. Similarly, rocks half buried in sand are devoid of life within a foot or so of the sand, and are no doubt worn down by the suspended sand.

Macrocystis grows below low water mark, at a sufficient depth for its fronds, though many yards in length, to be safe from laceration on the rocks; it thus forms a continuous fringe outside the *Durvillæa* belt. It is chiefly of interest in that its large branched holdfasts, like the discoid holdfasts of *Durvillæa*, harbour a varied community of animals, and differences of opinion have been expressed as to the efficacy of drifting kelps in transporting these animals. The late Dr. Chilton used to emphasise the view, as finally stated in the "Subantarctic Islands of New Zealand" that faunistic similarities between New Zealand and South America are, at least predominantly, indication

of a former close geographical relationship, but later work, such as that of Dr. Mortensen on the echinoderms, emphasises rather the distributing agency of currents, which transport pelagic larvæ or drifting organisms. I have recently shown (*Rec. Cant. Mus.*, vol. 3, pt. 4, p. 255; 1930) that *Halicarcinus planatus* White, famed as the only circum-austral decapod, is a recent arrival in the South Atlantic, and its predilection for kelp is suggestive.

It would be of much interest to determine what proportion of the common elements in the marine fauna have such possible methods of distribution. Perhaps the members of the further expedition to the Antarctic next summer may have an opportunity of studying the fauna of kelp roots at Kerguelen Island, a certain half-way stopping place for drift from the west at least. The important point is the survival or otherwise of such animals after a voyage from the original reef to the place of stranding, and therefore it may be of interest to quote some such organisms which I have observed still alive on drift kelp on the New Brighton Beach, New Zealand. Such kelp, of course, has drifted for only a few miles. Apart from such organisms as *Lepas anatifera* and *Balanus decorus* on drifting wood, and many smothered animals embedded in the kelp holdfasts, such as *Mytilus planulatus*, *Terebratella rubicunda*, *Elminius modestus*, and many others, and miscellaneous polyzoans and sponges and others attached to the stipe or holdfast, and other animals such as *Halicarcinus tridentatus* not noticed alive on the stranded kelp, the following living organisms have been observed on stranded *Durvillæa*: the above barnacles, *Plaxiphora egregia*, *P. zigzag*, *Onithochiton neglectus*, *Saxicava australis*, *Irona reflexa*, *Calyptræa novæ-zelandiæ*, *Microlenchus tenebrosus*, *M. dilatatus*, *Mytilus planulatus*, *Lumbriconereis sphærocephala*. On *Macrocystis*: many of the above, also *Mytilus canalicus*, *Chlamys zelandiæ*, *Terebratella rubicunda*, *Elminius modestus*, *Chamæsipho columna*, *Limnoria segnis*, *Eulalia microcephala*, *Nereis amblyodonta*, *Trypanosyllis gigantea*. The last-named species has hitherto been known only from the southern islands. Some of these animals, chiefly the limpets, feed on the kelp, and hollow out the *Durvillæa* holdfast, which in old specimens is attached only round the rim.

Two further cases, not affecting geographical distribution, may be mentioned. The massive trough-shell *Spisula æquilateralis* is commonly stranded at New Brighton, no doubt through the agency of an epizoic hydroid which attains a length of more than a metre, and a smaller species, apparently undescribed, forms short, but dense, tufts on *Amphidesma forsteriana*, which occurs between tide marks on the same beach. It can survive burial in the sand, and indeed depends on the agility of the mollusc in burrowing to prevent the stranding of both, which, however, frequently occurs. The second case is one demonstrated to me by the late Mr. John Hardcastle, of Timaru, who showed me water-worn stones in a gully leading on to the shingle beach at Timaru, previously mentioned. The stones were too far from the beach to have been washed there, and too numerous to have been thrown by boys, and some were too deeply buried (though I did not verify this point) to have been ploughed under to that depth. Mr. Hardcastle believed that they were used by the seals (*Arctocephalus forsteri*) as ballast during former northern migrations, and regurgitated at this resting place. Corroborative evidence on this point would be of interest.

E. W. BENNETT.

Dept. of Biology,
University of Western Australia,
Perth.

Inhibition and Mechanism of Photochemical Reaction in Eder's Solution.

A SYSTEMATIC investigation of kinetic aspects of the reaction in Eder's solution has revealed the fact that, although in a pure solution the reaction goes on in a somewhat different manner when it is subjected to the action of the X-rays [1] than under ordinary light rays, the difference is not an essential one and is due only to a faster rate of the reaction in the former case. Under the X-rays, for example, we do not observe an induction period, which is a conspicuous feature of light reactions; but if the intensity of the X-radiation is very small, the induction period is observed as usual. The presence of oxygen or increase in acidity tends to inhibit reactions in both cases.

If, however, the X-rays act in the presence of certain optical sensitisers, a striking difference is observed. I have studied reactions in the presence of ferric chloride, potassium permanganate, uranyl salts (nitrate and acetate), various fluorescent dyestuffs (uranin, eosin, erythrosin), and quinine bisulphate, and have found that these substances, all of which have a sensitising effect under the ordinary light, appear to be strong inhibitors when X-rays are used. Among them, potassium permanganate appears to occupy a peculiar position, for it undergoes a reaction itself under the influence of the X-rays (the solution changes its colour), and after the reaction has been completed, the inhibition stops and calomel begins to come down copiously from Eder's solution, which process goes on also in the absence of insolation.

Ferric chloride in small concentrations (c. 10^{-3} gm./c.c.) does not affect the rate of the reaction. But in concentrations from c. 10^{-2} gm./c.c. upward, it acquires the inhibitory power, and with the rise of concentration the rate of the reaction asymptotically falls to zero. These figures are quoted only to illustrate the orders of the magnitude involved, for actually the inhibiting action of ferric chloride is complicated by the influence of the concentration of dissolved oxygen. Uranyl salts act almost in the same way, though in this case the absorption of the X-rays increases very considerably, heavy atoms of uranium entering the solution. In this case even small concentrations produce the inhibition.

The behaviour of fluorescent sensitisers (dyes and quinine) is of still greater interest. A very small admixture of dye, quite inappreciable to the naked eye, is sufficient to produce a strong inhibitory effect. For example, erythrosin in concentrations of the order of 6×10^{-6} gm./c.c. delays the reaction by 64 per cent. The inhibitory property of all these substances increases at the same rate as their sensitising action under light. For example, uranin (sodium salt of fluorescein) has the weakest sensitising and inhibiting effect, whereas erythrosin is the most powerful in both directions.

In explaining these peculiarities it is natural to divide the substances into two groups according to the concentrations necessary to produce the inhibitory effect. The one group comprises ferric chloride and uranyl salts; dyestuffs and quinine belong to the other. The absence of sensitising effect in either group is accounted for by special conditions of X-ray absorption. The substances belonging to the first group owe their inhibitory property to a secondary effect, namely, to a considerable rise of hydrogen ion concentration as a result of hydrolysis of ferric chloride and uranyl salts. On the other hand, in the inhibitory effects of dyes and quinine sulphate, we have an obvious case of negative catalysis produced by traces of a substance.

According to Christiansen's theory, a negative

catalysis is good evidence of a chain reaction. Taking into consideration that free chlorine atoms, which are likely to arise in this case under the action of light (and X-rays),[2] enter very readily into chain reactions, we can argue that Eder's reaction is probably also a chain reaction, its mechanism being similar to that of the combination of hydrogen and chlorine. The available data in the literature, though not very exact, suggest that the quantum yield for Eder's reaction in any case is more than unity. By an indirect method, based on intensity of the inhibition, I can conclude that the length of the chain in this case is very considerable. E. SHPOLSKY.

Institute of Physics and Biophysics,
3rd Miusskaja, 3, Moscow, Sept. 7.

[1] T. Molody and E. Shpolsky, *Jour. appl. Physics* (Russian), **3**, 57; 1926; **6**, 159; 1929; E. Shpolsky, *l.c.* **7**, 83; 1930.
[2] *Cf.* K. Butkow, *Z. Physik*, **62**, 71; 1930.

Field Populations and Natural Control of *Lucilia sericata.*

SINCE the spring of 1929 I have been engaged at Toulouse on a study of the biological agencies which play a part in regulating numbers of the sheep 'blow-fly', *Lucilia sericata* Meign. The effect of parasites and predators was first sought by a quantitative study of the puparia derived from carrion in which the flies had bred. However, it soon became evident that the only way by which reasonable understanding could be obtained of the inter-relations of the various biological forms in the carrion and the magnitude of their action was by a quantitative study of the carrion insect populations, from the beginning of putrefaction to the disappearance of all consumable parts.

Suitable technique for obtaining a census of all species of the populations, both in the carrion and in the soil beneath it, has been developed by exposing simultaneously uniform baits of a number equal to the number of readings required, arranging to counteract any slight variation in bait attraction or field density and sacrificing a bait per census.

These quantitative studies have demonstrated the following points:

(1) The end result, taken at pupation or emergence, gives no indication of the magnitude of the reduction in numbers of *Lucilia sericata* by biotic agencies and little idea of the way in which the reduction is accomplished.

(2) Any significant effect which parasites and predators can have on the ultimate numbers of the fly surviving takes place after the bulk of the population has been destroyed by other means.

(3) The greatest factor in the reduction of the fly population within the carrion is Dipterous competition and its associated predatorism.

(4) The species concerned are, in addition to *L. sericata*, *L. cæsar*, *L. ampullacea*, *L. sylvarum*, *Calliphora erythrocephala*, *C. vomitoria*, *Sarcophaga* spp., and *Chrysomyia albiceps*.

(5) The magnitude of the competition and the fauna taking part differ according to the season, ather, and the type of bait used.

(6) There is in the insect fauna of carrion a definite ecological succession, comprising in the main the Diptera, species of Staphylinidæ, Silphidæ, Histeridæ, Hymenoptera, Dermestidæ, and Carabidæ, which, as regards the species concerned, varies according to the season. Within a family there may be species characteristic of an early stage in the succession and other species characteristic of a later stage.

(7) *Lucilia sericata* is the first member of this ecological succession and plays the part of a coloniser. Oviposition begins a few minutes after exposure in fresh meat or within a few hours of death in entire animals.

(8) All subsequent species of Diptera in the succession contribute to accentuate the competition and ultimately reduce the population of *Lucilia sericata*; the greatest reduction found has been that by the larvæ of Sarcophagids and the semi-carnivorous larvæ of *Chrysomyia*, both of which are most abundant during the summer, and the relative effect of which in carrion is largely determined by the type of bait used; the part played by Sarcophagids in meat baits is played by *Chrysomyia* in baits comprising entire animals (rabbits). The type and rapidity of putrefaction dependent on the kind of bait determines which of these forms gains the strongest hold and the ultimate ascendancy in the carrion.

(9) The part played by certain of the carrion beetles is negligible in the light of the part played by Dipterous competition, while the relation of forms, such as Histerids, more definitely associated with the Diptera during their late larval and puparial stages, is more significant. Dermestids are of little consequence to the fly population, for they are largely concerned with the drying carrion rather than with the Diptera.

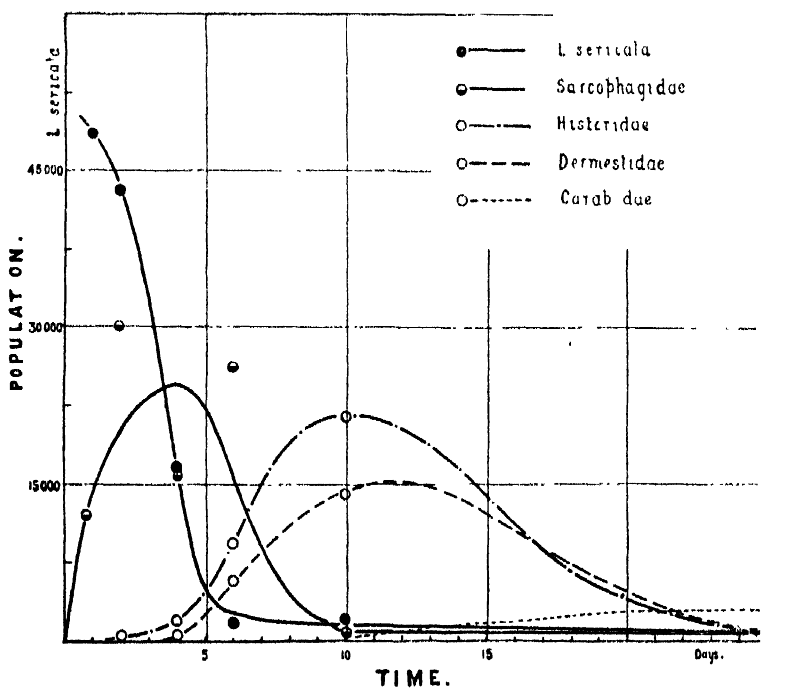


FIG. 1.—Graphic representation of carrion insect populations, showing ecological succession. (*L. sericata* scale on the left. Scale for other forms on the right.)

(10) No absolute idea can be obtained of the real effect of parasites or predators on the adult population of *Lucilia sericata* without an understanding of the inter-relations of the fauna of the carrion complex, particularly in the light of the differences associated with type of carrion, season, and also, no doubt, size of the carrion.

The accompanying illustration (Fig. 1) indicates

the type of results obtained. These particular results, given as live units, were secured under midsummer conditions in 1929; the bait, half a sheep's head laid on a piece of mutton, contained approximately 1 kgm. of consumable meat. The initial population of *L. sericata* was approximately 50,000 (the decreasing population twenty-four hours after exposure was 48,562), while the final field emergence was 231 flies. During the summer of 1930, under slightly hotter conditions, with a rabbit bait of approximately equal weight of consumable meat, and with *Chrysomyia* playing a rôle comparable to that of Sarcophagids in the former bait, an initial population of approximately 60,350 *L. sericata* plus 2850 *L. cæsar* yielded a final *Lucilia* population of 30 while the final *Chrysomyia* population was 2611.

F. G. HOLDAWAY.

Faculté des Sciences,
Toulouse, France.

Determination of the Abundance Ratios of Isotopes from Band Spectra.

IN band-spectroscopic determinations of the abundance ratio of isotopes, an important but hitherto neglected point of view appears as soon as one attempts to make any calculations of greater accuracy.

Suppose the isotopes A_1 and A_2 exist in the abundance ratio m. In molecular compounds with atoms B they will form molecules A_1B and A_2B also in the abundance ratio m. Now raising the temperature of the mixture, so that several vibrational states of the molecules come into play, this abundance ratio will not remain fixed for each state. Provided there is a thermodynamical equilibrium, the molecules will be distributed according to the Boltzmann expression $Ae^{-E/kT}$, where E, the vibrational energy of the molecules, is different for different isotopes.

Carrying out such calculations on boron monoxide, $B^{11}O$ and $B^{10}O$, at room temperature, the abundance ratio of their normal state ($v = 0$) is found to be approximately equal to m. But already in the first excited vibrational state ($v = 1$) this ratio is changed into $1{\cdot}3m$. From the Condon parabola of the intensity distribution in the β-bands of boron monoxide one finds by the aid of the Franck-Condon principle that transitions from the normal state ($v = 0$) chiefly will hit the first three vibrational levels ($v' = 0, 1, 2$) in the excited electronic state. A. Elliott (NATURE, **126**, 203; 1930) photographed this spectrum, using activated nitrogen as the source of emission. From intensity measurements on different plates he finds an approximately constant abundance ratio m for bands corresponding to transitions from $v' = 1, 2$ in the excited state. However, in bands corresponding to transitions from $v' = 3$ he finds a remarkable increase of 30 per cent in this value. This observation is in perfect agreement with our calculation above, as the population of molecules in the vibrational state $v' = 3$ is chiefly fed through collisions between active nitrogen and the boron monoxide molecules from $v = 1$ in the normal state. Moreover, the results of Elliott indicate that the Franck-Condon principle is valid also in this special case of low temperature, where the electronic transition is caused through collisions between particles of approximately equal masses.

Occasionally, Naudé's results on the determination of the abundance ratio of O^{16} and O^{18} (*Phys. Rev.*, **36**, 333; 1930) may be correct as based on intensity measurements of bands corresponding to transitions from the normal state $v = 0$ in the NO (β) spectrum.

Generally, however, correct values of the abundance ratio m from band-spectroscopic data afford determinations of m as a function of v, taking their weighted mean values from the energy distribution in the gas. Practically correct values are also obtained through intensity measurements on absorption bands belonging to $v = 0$ in the normal state, if the absorption gas is kept at low temperature.

G. STENVINKEL.

Laboratory of Physics,
University of Stockholm,
Sept. 12.

Change of the Dielectric Constant of Ethyl Ether with Temperature.

I HAVE made a study of the dielectric constant of ethyl ether as a function of temperature with the aid of high frequency electromagnetic oscillations, using the method described by M. Wolfke and W. Keesom, *Comm. Leiden*, 190 *a*.

The construction of the measuring condenser has permitted the cooling of ethyl ether down to $-150°$ C. by the use of petrol ether as a cooling liquid, which was contained in a Dewar vessel, provided with a special refrigerator, cooled with liquid air. The uniformity of temperature throughout the substance under investigation was ensured by the use of a double stirrer and by the thinness of the layer of the cooling liquid. Temperatures were determined by means of

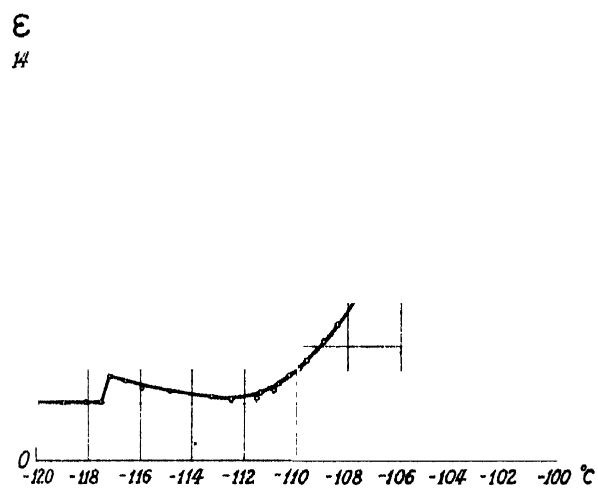


FIG. 1.

a platinum resistance thermometer, wound on the surface of the measuring condenser and calibrated with the aid of the normal thermometer of the Cryogenic Laboratory at Leyden.

The dielectric constant of very carefully purified ethyl ether increases with the lowering of temperature from 4·18 at 30·6° C. up to the highest value 12·39 at $-105{\cdot}4°$ C. and decreases very rapidly beyond that point. At the melting point, $-117{\cdot}2°$ C., there appears a distinct change in the dielectric constant, which was not observed by any of the previous workers. At temperatures lower than $-118{\cdot}9°$ the dielectric constant has a nearly constant value, equal to 2·04.

The changes of the dielectric constant of ethyl ether with the temperature described above are represented on the accompanying graph (Fig. 1).

J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Sept. 30.

The Scope and Aims of Human Geography.*

By Prof. P. M. ROXBY.

IT is to Ritter and Humboldt that we owe the real beginnings of human geography as an integral and, indeed, from Ritter's point of view, the crowning part of the subject matter. To appreciate the greatness of their work we must realise how critical for the whole future of geography was the period in which they lived. It was a period in which great masses of new geographical data were being accumulated, but so long as these remained unsystematised and unrelated, they tended only to increase the inchoate and amorphous character of a subject which was rather a torture to the memory than a stimulus to the mind. It was a period, too, in which many independent, specialised sciences dealing with particular aspects of earth lore such as geology and meteorology were rapidly developing so that the domain left to geography itself, according to the prevailing conception of its character, was increasingly uncertain. It was Ritter and Humboldt who rescued what seemed indeed to be a moribund subject and gave it coherence, individuality, and an immensely enhanced significance. This they did by claiming for it not a distinctive segment in the circle of knowledge—which is to destroy its very essence—but a distinctive method and objective in the handling of data common to other subjects. Ritter gave the keynote to the whole modern development of geography when he said (in his "Comparative Geography") "It is to use the whole circle of sciences to illustrate its own individuality, not to exhibit their peculiarities. It must make them all give a portion, not the whole, and yet must keep itself single and clear." Geography, he maintained, could only escape disintegration "by holding fast to some central principle; and that principle is the relation of all the phenomena and forms of nature to the human race".

The framework which the great pioneers of the early nineteenth century defined for the building up of a geographical synthesis, which in Ritter's view culminated in man's relationship to the earth, was sufficiently wide to permit of many converging contributions. Workers in many fields of geography were henceforth guided by the same fundamental principles and methods, and whether in geomorphology, in climatic or human geography, the central object became to exhibit the earth as a whole made up of related and interacting parts.

It is no doubt true that some of the workers in contributory fields have been initially trained in the special science which supplied the data, that is, have been in the first instance geologists or zoologists, but it is equally remarkable that many of them, when once they have acquired the geographical outlook have changed their objective and become primarily interested in placing or interweaving their contribution in the geographical synthesis as such. For it is from these main sources—geomorphology, climatic and biological (plant and animal) geography that we derive the data for building up that systematic geography of natural environments which is at once the objective of 'physical' geography and the starting-point of human geography.

The fundamental objectives of geography are the same to-day as those which the Greek philosophers of Asia Minor and Alexandria conceived. There is a 'modern geography' only in the sense that there has been a restatement of its scope and content in the light of all the new knowledge of the earth which more specialised branches of inquiry have revealed. It was the work of the great pioneers of the nineteenth century to disentangle it from these associated subjects and to ascertain the guiding principles through which and the means or technique by which contact and relationship with them could be most fruitful and helpful in the attainment of the ends for which all science stands. This clarification of its scope and methods was essential if geography was to be in a position to seize the opportunities for increased usefulness afforded by the conditions of the modern world. For the two circumstances which, granted vision and understanding on the part of its exponents, have inevitably enhanced the significance and value of our subject are surely these: that on one hand our more complete knowledge of the earth and of the distribution of phenomena over its surface has made it possible to formulate far-reaching and valuable generalisations as to their co-ordination and relationship for which the material had hitherto been lacking, and on the other that the rapidly increasing interdependence and inter-sensitiveness of the different regions and peoples of the planet have made a synthetic view of the world as of a whole made up of interrelated parts which is the prime object of geography—essential to human progress.

It is against this background of modern geography as a whole that the special aims and contributions of that part of it which we call human geography must be considered. The separate, departmental 'political geography' of the early nineteenth century is for ever discredited. Whatever value human geography may have is involved in its association with all the rest of the subject matter. It is on the question of the precise nature of the relationship that difference of view arises.

From the ranks of geographers themselves—as distinct from the views on the influence of natural conditions on human societies put forward from time to time by philosophers and economists such as Feuerbach, Engels, and Marx, or historians such as Buckle and Meyer—the two chief contributions have come from the school of thought associated with the name of Ratzel and that associated with the name of Vidal de la Blache.

* From the presidential address to Section E (Geography) of the British Association, delivered at Bristol on Sept. 5.

'Determinism' and 'possibilism' are the respective labels which have been attached to the two schools, and although labels, here as elsewhere, are liable to mislead, they sufficiently indicate a fundamentally different emphasis and attitude between the two in their treatment of the relationship of human societies to their natural environments. In the first or Ratzelian School the main emphasis is undoubtedly on the control of human activities by natural conditions, on the limitations which these impose, on the permanency of the stage, "always", as Ratzel insisted, "the same and always situated at the same point in space", and of the influences which it exerts, on the inevitability of particular developments, given a certain milieu. This attitude is even more pronounced in the works of some of the disciples of that other school of French human geographers or, as it is perhaps better to call them, geographical sociologists, who drew their inspiration from Le Play's "Les ouvriers européens", although Le Play himself cannot be identified with all their views. Geographical 'determinism' reaches its culmination in the "Comment la route crée le type social" of Demolins, who maintains that if history were to begin all over again it must in all essentials follow the same lines, given the same setting of the stage. Apart from the question of bias on the compelling power of physical circumstances, a criticism which has been levelled, as I think rightly, against the Ratzelian School, is that it is excessively dogmatic, and that, notwithstanding the vast amount of material which Ratzel himself and many of his disciples have sifted and classified with great skill, we are far as yet from having the data necessary for many of the big generalisations which they make.

The same criticism can certainly not be brought against Vidal de la Blache and his followers, whose discussions of these issues, while often extremely suggestive and illuminating, are rarely dogmatic or final in their conclusions or implications. The master himself did indeed deal in his larger works with what may justifiably be called 'principles' of human geography, but his teaching was always that the larger generalisations could only gradually emerge from a series of detailed and exact regional studies, and we shall all admit, I think, that his disciples have been very true to his precepts. The conception appears in the approach and particularly in the form even of the more ambitious work of Brunhes which bears the title "La géographie humaine". It is scarcely possible in a few sentences to characterise la Blache's concept of human geography, but I find its dominant note and one which brings it into salient contrast with the Ratzelian School in the following paragraph:

"L'être géographique d'une contrée n'est point une chose donnée d'avance par la nature, une offrande du monde inanimé ; elle est un produit de l'activité de l'homme, conférant l'unité à des matériaux qui, par eux-mêmes, ne l'ont point. . . . Si une contrée est une personne, c'est par l'effort de ceux qui l'habitèrent." The emphasis here and throughout his work is not so much on the determinative influence of the stage *per se*, although this is always presented as a vital factor, as on the creative power of human groups to adapt themselves to and, within limits, to mould the natural environment, to leave their impress upon it and thus in the course of generations to transform it and give it a personality which is the outcome of the interaction. This personality is not constant. It may change with man's use or abuse of his habitat.

With this indication of some dominant tendencies in the setting and perspective of human geography I pass to an attempt to define more closely its subject-matter and its different aspects. I believe that in essence human geography consists of the study of (*a*) the adjustment of human groups to their physical environment, including the analysis of their regional experience and of (*b*) inter-regional relations as conditioned by the several adjustments and geographical orientation of the groups living within the respective regions. The term 'adjustment' I take to cover not only the 'control' which the physical environment exerts on their activities but also the use which they make or can make of it. Human geography is the study of an interaction rather than of a control. The adjustment has distinct but usually closely related aspects which form the main branches of human geography. The relationship between them is from the geographer's point of view as intimate as that between the different branches of physical geography. The four principal aspects may be distinguished as the racial, economic, social, and political.

The racial aspect implies an adjustment of a different character from the others, one over which man has had little control but which he can increasingly influence through his better understanding of the issues involved. I am well aware that in touching on racial geography I am treading on dangerous and controversial ground. Yet I am convinced that it is as necessary to find the right relationship between human geography and anthropology as it is between physical geography and geology and that racial geography is as significant and essential a part of the geographical synthesis as is geomorphology. I think it is true to say that racial determinism, that is, the explanation of characteristics in terms of race alone, apart from environmental conditions, is becoming as discredited as geographical determinism, the explanation of everything in terms of physical environment.

The tendency in anthropology is certainly not in the direction of appraising racial types, so far as they can be definitely distinguished, according to an absolute scale of value or efficiency, but relatively to the geographical environments in which they are found. Their somatic traits are discussed in terms of regional adaptations and the fruitful hypothesis is put forward that so far from racial varieties being unchanging and fixed for all time they are continually undergoing slow modification and in process of becoming. Now the unit of the geographer's study is not race as such any more than it is climate as such or any other physical element. His unit is the place or region. It is this concept—and I do not think it can be emphasised too strongly—which gives distinctiveness and

individuality to his work. With the relationship of climate and other physical factors to race in a region, the geographer is closely concerned and there are few more important aspects of his study than the composition, actual or potential, of the societies occupying the region.

In the world of to-day there are many regions of 'closed' human associations, if I may borrow a useful term from plant geography, regions such as China or the Mediterranean lands as a whole where the dominant racial type or types in possession are so numerous and well adjusted that the entry of any important new racial element is extremely unlikely. But there are other regions of 'open' human associations, at present thinly peopled but capable of holding a much larger population, whose racial future is uncertain. Such, for example, are tropical Australia and parts of Malaya, of Africa, even of Asia. Is it possible or desirable for the geographer in his study of these regions to confine himself to their resources and economic possibilities and not to consider at all, in the light of all that he can learn from anthropology, the relative aptitudes and adaptability, climatic and otherwise, of various racial groups for developing them and the extent and manner in which co-operation between different groups may be secured for this end?

Take, for example, the highly important pronouncement made by General Smuts last autumn in one of his Rhodes' lectures at Oxford. In the course of his plea for the advance of native Africa through the introduction of a higher civilisation in the form of white settlement, he advocated "a strong forward movement in the policy of settling the highlands of Eastern Africa which stretch in an unbroken belt, hundreds of miles broad, from Kenya to South Africa". It is not for me to express an *a priori* opinion on the wisdom of this suggestion, but it raises vitally important issues of human geography.

These issues are at once racial and economic in character. Do we yet know enough about the effects of a high plateau climate in equatorial latitudes on peoples of North European stock? Even if it be granted that satisfactory acclimatisation of such peoples in the Kenya Highlands can be achieved, are the conditions of the plateau belt as a whole intervening between them and 'temperate' South Africa sufficiently similar to warrant the prospects of an equally good adjustment? The tentative generalisation has been made that, from the point of view of the success of 'white' plantations, there is a vital difference between the 4500/6000 feet altitude of the Kenya Highlands and other smaller mountainous 'islands' to the south and the 3500 feet level which seems to characterise most of Tanganyika. Or again, what are the prospects of making the 'fly belt' suitable for white settlement? Or, granted favourable climatic and other physical conditions, have the economic relations likely to be established between the proposed white settlers and the native Bantu tribes been sufficiently considered from the point of view of the uses which the two groups are likely to make of the land? It is not cartographical surveys alone—although these are vital and the basis of all others—which need to be made before such questions can be answered.

Similar questions arise concerning the future of southern Brazil, Malaya, parts of central and eastern Asia, and many other regions where groups with different racial characteristics and aptitudes are in competition. The racial aspect is only one of several, but the study of racial distributions, based on anthropological material in the same sense that geomorphology is based on geological material, seems an essential element in the content of human geography. Personally I feel it to be a distinct gain that, in at least one university, geography should be closely associated with anthropology, so long as it is not identified with it, just as in others it is more closely associated with economics or history or with physical science.

It is unnecessary for my present purpose to elaborate what is implied in that aspect of man's adjustment the study of which forms the subject-matter of economic geography. It is of course a fundamental and basic aspect, including the geography of production (with agricultural and industrial geography as its principal subsections) and the geography of exchange (commercial geography in the more technical sense).

Economic geography serves one of its highest functions if it is closely linked with other aspects of human adjustment to physical environment which have so far received less attention. Of these one of the most interesting and profoundly important is that which for want of a better term we usually call social geography. This may be broadly defined as the analysis of the regional distribution and interrelation of different forms of social organisation arising out of particular modes of life which themselves represent a direct response—although we may concede to M. Febvre not necessarily the only possible response—to distinctive types of physical environment. A classical example of the importance of this aspect is of course the age-long conflict between nomadic, patriarchal pastoralists and peasant cultivators, socially organised on a territorial basis, along the grassland borders of the hot deserts in Africa and Arabia and round the edges of the steppe-belt in Euro-Asia.

In modern times the problems connected with the interregional relations of differently organised groups in Africa and elsewhere have been greatly complicated by the impact of industrial Europe on their lives. It has particularly affected the traditional societies of intertropical Africa, the monsoon lands, and the South Sea Islands, where mode of life and social organisation, once established as an adjustment to their milieu, often remained in essentials unchanged until they were so suddenly, and in some cases so tragically, drawn into the maelstrom of modern commerce. In the last analysis this disturbance is one of the chief causes of world-wide unrest, since equilibrium with environment is the first essential of happiness for human groups.

One of the greatest needs of our time is to discover what for each type of regional environment or

milieu are the real factors in readjustment through which alone the recovery of equilibrium can be attained. What is involved is readjustment to all the local conditions of the habitat in the light of its new contact with other regions, its new place in the total scheme of world relationships. Modern Denmark would seem to be an admirable example of a successful readjustment of this kind. Statesmanship in such an Empire as ours is increasingly concerned with the task of harmonising the interests of many groups cradled in different environments, diverse in race, mode of life, and experience, but, under the conditions of the world to-day, increasingly interdependent. Particularly is this apparent in the problem of the readjustment of African societies, one of the most critical and complex of our time and one for the solution of which Great Britain has incurred heavy responsibilities. Such problems are as much geographical in character as those concerned with the regional planning of English districts, and equally demand detailed surveys by investigators capable of analysing the social life and experience of human groups in their whole geographical setting and of appreciating the significance of the new elements in their environment.

The modern tendency in geography to think of the earth in terms of natural as opposed to artificial divisions should not lead to the neglect of political geography in the proper sense of the term; for the function of political geography is to study and appraise the significance of political and administrative units in relation to all the major geographical groupings, whether physical, ethnographic, social, or economic, which affect mankind. It is essentially an aspect of adjustment to geographical environment, and it is precisely because it is so closely related to other aspects of adjustment, which in the influences that they exert are often conflicting, that equilibrium is so difficult to attain. The study of the mode in which geographical conditions have helped to mould the evolution of States in the past is of absorbing interest, however complex and difficult. The existence of favourable areas of characterisation possessing a considerable amount of natural protection, such as the English Plain and the Central Lowlands of Scotland, within which the social contact of orginally different racial and social groups was easy, certainly provided the medium through which in western Europe strong nation-States tended to take shape. The group consciousness which we call nationality seems to have followed rather than preceded the actual formation of such States. Nationality arose in relation to environment and widened its scope and allegiance with the increase of economic and political contact.

Since the forces promoting the contacts and economic interdependence of regions are operating on a much bigger scale in the world of to-day than ever before, we might expect to see this process of political integration even more strongly marked, and the rapid territorial growth of the United States and other large political entities can be quoted as examples of it. But in Europe we see this process arrested and even reversed.

Nationality, as tested by linguistic and cultural affinities, rather than the economic orientation indicated by the physical conditions, has been accepted as the main criterion of the new units, although there is frequent departure from this principle. The new Europe is admittedly a great experiment in political geography. Its success would seem to depend on the possibility of reconciling the different factors. The most stable political units are undoubtedly those which most correspond to geographical realities, but these realities are not wholly limited to considerations of physical and economic geography. The distribution of groups related in culture and language is also a geographical reality. The ideal State from the geographical point of view is one which neither divides groups culturally related nor interferes with the flow of trade along natural arteries and between regions economically interdependent. It may be, although as yet the indications are not very hopeful, that the urgent need of Europe for greater economic integration can be reconciled with the desire of the small nationality groups for cultural and political autonomy. It may be that economic federation or agreement among small sovereign-States within the framework of the League of Nations will prove the only alternative to the 'super-State' solution of the problem of European political geography propounded by Naumann in his "Mittel Europa". At any rate, nationality, considered apart from its geographical setting, may be a very dangerous conception.

I have tried to indicate the essential character of the principal aspects of human geography, each of them from the point of view of the adjustment of human groups to their geographical environment. It is permissible and desirable to pursue special studies of these various aspects of our subject, but they find their fullest fruition when they are brought together and inter-related in a full and comprehensive treatment of regions. We can never really appreciate the problems of such countries as India, China, and Russia until we have a comprehensive interpretation of their human ecology, to use the expressive term employed by the American geographer Barrows. In the future it is probable that geographical specialism in the universities will be less concerned with aspects (such as geomorphology, climate, and economic geography) —although this will always have its place—and more concerned with regions (the Mediterranean, tropical Africa, the Far East, and so on). The geographer's parish must indeed be the world, but it is too large a parish for all parts of it to be studied in detail by any one man. He must, if he is entrusted with a university department, delegate responsibility for as many regional chapels-of-ease as he can find associates and colleagues to work them.

We may claim for human geography that, rightly studied, it is a vital element in training for national and international citizenship. It can enable us "accurately to imagine the conditions of the great world stage" and the place of the different regions within it. It is a valuable mental discipline, calling

for an exact sense of proportion in appraising the value of many factors and more specifically developing the great quality of sympathetic understanding. The point of view and type of outlook which it fosters were never more needed than in the present critical stage of human development. Yet not only through its value as an educational instrument, but also through the programme of constructive work which it advocates, can it contribute to the realisation of the ideal of "unity in diversity", and that seems the only possible ideal for the life of humanity on a planet which, however small applied science may make it, will always retain its infinite variety.

Chemical Measurements by Colour.

By Dr. L. C. MARTIN.

IT is a pity that the word 'colorimeter' has been applied to two entirely distinct classes of instrument. The name is given most appropriately to those instruments which actually measure colour, albeit in relative terms, and not to those in which the chemical concentration of a solution is the subject of determination. The latter, which form the topic of the present article, are strictly colour comparators, and it would be an advantage if they could so be called. The alternative names chromometer and chromatometer also fail to give the proper indication, but would be preferable to 'colorimeter'.

There are many chemical substances which, although difficult to determine quantitatively in very dilute solutions by chemical methods, have the property of strong selective absorption of light. According to the law of Beer, the absorption coefficient of a solution is directly proportional to the concentration. Since this law holds with fair accuracy for most dilute solutions, it follows that the colour change in transmitted light obtained by varying the concentration (within certain ranges) can be exactly imitated by increasing the thickness of the medium which must be traversed; thus, if 1 cm. of solution A gives the same colour as 10 cm. of solution B, we should expect (provided that the above law held) that the amount of material dissolved in unit volume of A is ten times that of B. The application of this principle to find the concentration of a solution of unknown strength, given one of the same material and of known strength, is quite clear. Failing a means of using different thickness of solution, the alternative is to prepare a number of samples of known concentration and to endeavour to place the unknown in its relation to the rest a method much less elegant, but of value when Beer's law is likely to break down. In practice, no such liberties as indicated above in the 'ten to one' example are advisable. According to Thorpe, if the strength of the standard differs by more than 10 per cent from that of the test liquid, it is usual to dilute one or the other (in a known ratio) before comparison, so that the lengths to be compared are approximately equal.

It is not possible in a short article to do more than indicate some of the numerous applications of the method. It is used in the estimation of small quantities of the salts of copper, tin, lead, iron, cobalt, manganese, and other metals; also in the determination of dyes and natural colouring materials. Krüss mentions the estimation of salicylic acid in surgical wadding, and the examination of the coloration given by animal charcoal. Other applications are met in the operations of the oil, sugar, and brewing industries. Special instruments with artificial standards are applied in the determination of the sugar content of the blood of diabetic patients. An account of practical methods will be found in Lunge-Berl's "Chemische-technische Untersuchungsmethoden", vols. 1, 2, 3, and 4, and in books such as "Colorimetric Analysis", by B. Snell.

The early methods of application of the principle were of the simplest description; an account of them is given in Thorpe's "Dictionary of Applied Chemistry", vol. 2, p. 340. Flat-ended tubes placed side by side were often employed, sky-light being reflected through their lengths by a mirror. It is well known, however, that the exact comparison of separated colour fields is very difficult. In 1910 Autenreith and Königsberger[1] used a colorimeter with a Helmholtz 'Doppelplatte' for approximating the comparison fields. A movable hollow wedge affords the means of varying the thickness of the test solution. This was used for the determination of hæmatin in blood and other medical work. Another early suggestion aiming at better optical accuracy was that of H. Krüss,[2] who suggested the use of the Swan or Lummer-Brodhun double prism in order to secure a comparison field with an indefinitely narrow separation.

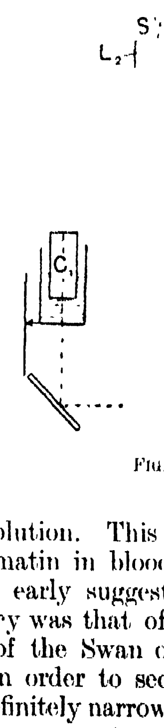


FIG. 1.

The most practical arrangement was, however, due to Duboscq,[3] who gave the instrument its most usual modern form, Fig. 1. The rays traversing the vertical cylinders holding the solutions are brought into one field by the use of two rhomb reflectors; or a single symmetrical rhomb can be employed. A lens brings these groups of parallel rays into one focus, where a telecentric stop is placed so as to prevent stray light from reaching the eye. The eye-lens helps to bring the sharp line of separation into exact visual focus in the field of view. In order to vary the thickness of solution traversed, the vessels containing the solution (shaded in the figure) can each be moved on vertical slides by rack and pinion. Thus the flat-ended cylinders, either closed tubes or glass rods

made of the finest and most colourless glass, dip more or less into the liquid, and the consequent thickness of the layer on each side can be read off on a suitable scale. Alternatively, the rods alone may be moved. The light is usually derived from the sky, and reflected upwards by a mirror through each tube; it is advisable, however, to use an artificial source with a 'daylight' filter and a suitable diffusing screen if inconsistencies due to the variation of the sky are to be avoided. A good example of such an instrument as described above is made by Messrs. Hawksley and Sons, Ltd.

There are numerous variations of the usual pattern, such as may be found in the catalogues of the various makers. We shall, however, only have space to mention efforts which have been made to overcome certain difficulties. The simple account above assumed that the colour is entirely produced by the substance in solution. It may be, however, that the solvent is coloured, or has other coloured substances present. To meet this difficulty, the Bürker compensating colorimeter of Messrs. Leitz, Fig. 2, is provided with two auxiliary vessels of the same depth introduced into the respective beams. One is filled with a solution of accurately known strength while the other is filled with the solvent only. The two cylinders or rods are now moved together; they dip into the two cups, one of which contains the solvent, and the other holds the solution under test. Naturally, the cup containing the solution is placed beneath the auxiliary vessel containing the solvent only, so that when balance is obtained the thickness of the strata of liquid in each beam is equal, which is not the case in the simpler form of the instrument. Hence any *difference* of coloration in the two fields must be entirely due to the solute; equality can be established by the adjustment of the plungers provided that the standard and test solutions are of comparable concentrations.

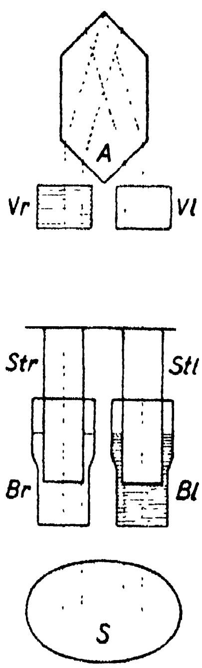


FIG. 2.

The accuracy of such measurements is naturally facilitated by the precision of manufacture of the parts. The cylinders should be accurately ground, and, in cases where the greatest accuracy in the thickness of the cells is required, the plane and pieces may be pressed on in optical contact and maintained in position by suitable clamps; thus the uncertainties and chemical objections connected with the use of cements can be avoided.

The accuracy of comparison also depends on the visual sensitiveness of the eye. Where pure intensity comparisons are concerned, the optimum sensitiveness of the eye corresponds to a difference threshold (dI/I) of about 2 per cent. If we may be permitted a little mathematical shorthand, the intensity of the light transmitted by a thickness t of a solution of concentration c is given by

$$I = I_0 e^{-kct},$$

k being the absorption coefficient for unit concentration. It is easily found that (dI/I) with t constant $= -kt\,dc$, while (dI/I) with c constant $= -kc\,dt$. With low concentrations we need a greater thickness to obtain a given absolute accuracy of measurement, and with small thickness we need greater concentrations. Let the transmission coefficient of the layer, that is, $I/I_0 = T$, then $-kt = (\log T)/c$, so that if $dI/I = 0{\cdot}02$ (say) $= -kt\,dc$, we obtain $dc/c = 0{\cdot}02/\log T$, so that the proportional accuracy would depend on having a fairly big absorption of light, but just as in the case of the polarimeter, this makes the visual accuracy smaller and a compromise must be reached. The settings, moreover, do not involve pure intensity comparisons and are likely to depend more on 'saturation discrimination'. The usual presence of dichroism may also cause here changes which help to make the settings more sensitive; in fact, the thorough discussion of the accuracy of the instrument is a very complicated matter. In certain cases the use of a suitable filter might vastly enhance the sensitiveness.

This note would be incomplete without a reference to the recently introduced instruments which effect the comparison by the aid of a photo-electric cell or cells, as in the equipment manufactured by the Cambridge Instrument Co., Ltd. There are a number of ways in which the photo-electric comparison can be effected. It is possible to use two cells in a bridge form of circuit as in the Cambridge instrument, the cells being exposed to beams passing respectively through a test solution and through a standard solution; any deviation from equality can be recorded by a suitable valve amplification system adapted for alternating current. Alternatively, the light may be passed alternately through two such tubes, the two beams falling intermittently into the same cell. A lack of equality of the photo-electric currents is detected by a synchronised rectifier and suitable amplification. Nor are photo-electric cells the only possibility for recording changes of absorption. The Moll 'nephelometer and absorptiometer' furnishes objective records of comparative absorption with the aid of a pair of balanced thermopiles of the Moll pattern. This instrument is made by Messrs. Kipp and Zonen. A considerable improvement on the visual accuracy is effected by the physical detectors.

Such instruments can obviously be applied for obtaining continuous records of fluid products during the course of manufacture, and illustrate once more the ways in which optical methods of control may save much time and trouble.

[1] *Chem. Zentr.*, **1**, 2032; 1910.
[2] *Zeit. anorg. Chem.*, **5**, 325.
[3] Duboscq lived about fifty years ago, and it has not been possible to trace any original description of the Duboscq instrument. The firm of Duboscq has now been succeeded by Pellin. Messrs. Jobin and Yvon, Paris, also make colorimeters.

Obituary.

SIR FRANCIS WATTS, K.C.M.G.

THE death of Sir Francis Watts, which occurred on Sept. 26, terminates a career of devoted service to the West Indies. The son of John Watts of Ilfracombe, Francis Watts was born in 1859. He was educated privately and at Mason College, Birmingham, the forerunner of the present University of that city. His official connexion with the West Indies commenced in 1889, when he was appointed analytical chemist in Antigua, but an earlier association with these islands was formed as chemist to the Montserrat Company, Ltd. It was this earlier association which directed his early studies to citric acid. He was transferred in 1898 to Jamaica for a brief period, but returned to the Leeward Islands as Government Chemist and Superintendent of Agriculture.

In 1898, on the recommendation of the Royal Commission appointed to report on the depression caused by the slump in sugar, was formed the Imperial Department of Agriculture for the West Indies. The first years of that Department saw a great development of the sugar industry throughout the West Indies, and Francis Watts played a prominent part in that development, notably in the establishment of central factories in Antigua and St. Kitts, which was rendered possible by the grant-in-aid given by the Imperial Government to the West Indies in 1902 to enable them to tide over the period between the signing of the Brussels Convention for the abolition of the sugar bounties and the date on which it came into force. When, therefore, the time came, in 1909, for the selection of a successor to Sir Daniel Morris, the first Commissioner and head of the Imperial Department, the choice naturally fell upon Francis Watts. This early association with sugar is reflected in a number of papers published in association with Tempany on the chemical problems associated with sugar production. But his knowledge of the industry covered a much wider sphere. He held decided views on the sugar problems of the Empire, as is shown by his virile contribution to the discussion on the report on the production and consumption of sugar within the Empire presented at the conference organised in 1919 by the Society of Chemical Industry.

Until recent times, when oil has assumed major importance in Trinidad, the prosperity of the West Indies has been based on agriculture. Of the major crops, sugar has always been subjected to vicissitudes, and not the least of the functions of the Imperial Department of Agriculture has been the search for subsidiary crops. In this search Watts was not backward, as his studies on lemon grass, pawpaw, and so on, indicate. The Imperial Department established, in the *West Indian Bulletin*, its own organ, and in that *Bulletin* is to be found a record of these investigations. The *Bulletin*, in fact, constitutes a record of his activities.

As a result of the report of the Tropical Agricultural College Committee appointed by Lord Milner in 1919, the West Indian College was founded in 1921 and installed on a site, at St. Augustine, presented by the Government of Trinidad and Tobago. At the same time the headquarters of the Imperial Department was transferred from its former location in Barbados to Trinidad, and Sir Francis Watts, who had received the C.M.G. in 1904 and been created K.C.M.G. in 1917, was appointed to the post of principal of the College. From April 1, 1922, the two institutions were amalgamated under the title of the Imperial College of Tropical Agriculture, and the joint post of Principal of the College and Commissioner of Agriculture for the West Indies was held by him until his retirement in 1924. What part he played in bringing to fruition a scheme so dear to his heart is hidden away in the archives of the Colonial Office.

After his retirement Watts settled down in Trinidad and threw himself with all his accustomed energy, both as a member of the Legislative Council and as president of the Agricultural Society, into the affairs of the community. His last public service was to pay a visit to Mauritius, where he was sent as commissioner to report on the sugar industry of that island at the same time as Lord Olivier and Mr. D. M. Semple visited the West Indies on a like mission. His report was published in March last, and his death occurred shortly after his return to Trinidad.

H. M. LEAKE.

PROF. CORNELIO DOELTER.

ANOTHER prominent member of the brilliant school of Viennese mineralogists has passed away at an advanced age. Cornelio August Doelter, who died on Aug. 8 last, was born on Sept. 16, 1850, at Arroyo, Porto Rico, in the West Indies, where his father was a German planter and slave-owner, who had emigrated from Emmendingen in Baden. His mother, Francisca Cisterich, was Spanish, and on this account his name was sometimes given as Doelter y Cisterich. At the age of six he was taken to Paris, and he studied later at Freiburg in Baden, Heidelberg, and Vienna, graduating at Heidelberg in 1872. For a time from 1873 he was attached to the Austrian Geological Survey, and in 1875 was a *privat-dozent* in the University of Vienna. From 1876 until 1906 he was professor of mineralogy in the University of Graz in Styria, where in 1906 he was also Rector of the University. In 1907 he succeeded G. Tschermak as professor of mineralogy and petrography in the University of Vienna, from which post he retired with the title of emeritus professor in 1922.

Doelter's earlier papers from 1873 dealt with volcanic rocks, during which period he produced monographs on the volcanoes of the Ponza Islands, the Cape Verde Islands, and of southern Tyrol. From 1884 he did intensive work on the synthesis of minerals and rocks and on silicate fusions. At a later period he was much interested in the changes in colour produced by the action of radium, X-rays, and other radiations on gem-stones and other minerals; and he wrote several papers on the cause of the blue coloration of rock-salt.

Doelter wrote a number of books on chemical mineralogy, petrogenesis, precious stones, colour of minerals, and the mineral resources of the Balkans and Asia Minor; but his *magnum opus*, by which he will be best remembered, is his "Handbuch der Mineralchemie". This great work of reference (not entirely free from misprints) was commenced by him in 1911, after he had reached the age of sixty, and, although nine large volumes have appeared, it unfortunately remains uncompleted at his death. L. J. S.

Rev. J. G. Hagen, *S.J.*

Rev. Johann Georg Hagen, *S.J.*, who had been director of the Vatican Observatory for more than twenty years, died in a nursing home in Rome on Sept. 5, at the age of eighty-three years.

Father Hagen superintended the photography of the plates of the Astrographic Zone for declination N. 55° to 64°, which had already been commenced when he went to the Observatory. The University Observatory at Oxford helped in the reduction of the measures of these plates after the completion of its own section of the Astrographic Catalogue. He also gave much attention to the distribution of obscure nebulosity: he claimed to see this in many regions where photography failed to show it, and pointed out that some of the regions had been noted as nebulous by Sir W. Herschel. Many astronomers now admit the reality of at least some of the nebulosities announced by Hagen.

Father Hagen's name was already widely known before he went to the Vatican Observatory; more especially for his "Atlas stellarum variabilium", with its numerous appendices. This contained accurate charts of the fields surrounding the variable stars, with magnitudes of suitable comparison stars. It has been of great use to observers of these objects.

We regret to announce the following deaths:

Capt. William Colbeck, magnetic observer and cartographer with the Southern Cross Expedition to the Antarctic in 1898–99, on Oct. 19, aged fifty-nine years.

Mr. S. L. Hinde, formerly Commissioner of the East Africa Protectorate, who contributed to the ethnological, anthropological, and natural history collections of the British Museum, and was the author of "Fall of the Congo Arabs" and "The Last of the Masai", on Oct. 18, aged sixty-seven years.

M. Philippe Glangeaud, professor of geology in the University of Clermont, *correspondant* of the Section of Mineralogy of the Paris Academy of Sciences, author of works on the Massif Central of France, aged sixty-four years.

M. Emile Godlewski, honorary professor of agricultural chemistry in the University of Cracow and *correspondant* of the Section of Rural Economy of the Paris Academy of Sciences, known for his work on vegetable physiology, on Sept. 11, aged eighty-three years.

Mr. E. H. Wilson, Keeper of the Arnold Arboretum, Harvard, since 1927, known for his botanical explorations, on Oct. 15, aged fifty-four years.

News and Views.

Homage was paid to the memory of a great chemist, the late Prof. W. H. Perkin, by the Chemical Society at the first ordinary scientific meeting of the new session on Oct. 16, which was devoted to the acceptance and unveiling of a memorial plaque and the delivery of a memorial oration. The plaque, which (like the Harrison memorial) is the work of Mr. Ernest Gillick, is one of three; the others are destined to commemorate Prof. Perkin's distinguished association with the Universities of Manchester and Oxford. In presenting the plaque to the Society on behalf of the Perkin Memorial Fund Committee, Prof. R. Robinson said that the intention to offer suitable congratulations to Prof. Perkin on the attainment of his seventieth birthday had, to the immense regret of his colleagues, been frustrated by death, so that an occasion of joy had been changed into a memorial. It was fitting that the Chemical Society should possess a visible memorial of one who had served it so long and so well. Elected a fellow in 1884, he served on the council and as vice-president for several terms. He received the Longstaff medal in 1900, and was president from 1913 to 1915. Almost his last labour in the cause of chemistry was the delivery of the first Pedler lecture. The gift was unveiled by Mr. A. J. Greenaway, formerly editor of the Society's *Journal*, a life-long friend and at one time a colleague of Prof. Perkin; it was received on behalf of the Society by the president, Prof. J. F. Thorpe, who also paid tribute to the distinction of its late fellow and former president.

Prof. W. N. Haworth, responding to the president's invitation, delivered an oration on the late Prof. W. H. Perkin's life and work. Perkin's span of life was, he said, coextensive with the rise and development of modern structural chemistry. A pupil of Sir Edward Frankland, he studied also under the guidance of Wislicenus and afterwards of Baeyer, in whose laboratory he commenced his series of researches on the synthesis of closed carbon chains. Before he left this subject he had synthesised every naturally occurring monocyclic terpene, and had investigated the constitution of camphor and its analogues. On his return to Great Britain, he worked for a short time at Manchester on the natural colouring matters brazilin and hæmatoxylin before being appointed to a chair at the Heriot Watt College, Edinburgh, where he commenced his researches on berberine and cryptopine. Invited to occupy the chair of organic chemistry in Owens College, Manchester, in 1892, he built up there a great school of research, while at the same time giving much thought and care to his lectures. He combined exceptional skill in manipulation with sound judgment and acute observation; moreover, the help and encouragement which he gave to his pupils resulted in an *esprit de corps* and a personal loyalty which were the greatest incentive to good work and to progress in research. Of his period at Oxford from 1912 until 1929, Prof. Haworth said that Perkin's great work is appreciated by none more than by Oxford itself. William Henry Perkin consecrated

his ability and intellect to the ideal "that original research is in itself and by itself the most powerful weapon that ever can be wielded by mankind in struggling with the great problems which Nature offers on all sides for solution".

THAT the Church Congress, which recently met at Newport, should have devoted a session to the discussion of eugenics, is a sign of the times; and eugenists may congratulate themselves upon having moved public opinion to this extent. The Dean of St. Paul's (Dr. Inge), who read a paper on the subject, confined himself to its moral aspects. He urged that Church-people ought to include their duties to posterity among the new moral obligations which the advance of knowledge has laid upon them. There is still a weight of prejudice to be removed, and it is the mental attitude of Churchmen to these questions that he [illegible]ires to see modified. The desire to improve the intrinsic qualities of future generations, or to stop their further deterioration, is a purely disinterested and public-spirited quest. Is the Church to help these disinterested workers, or is it to ridicule and misrepresent them? The Dean expressed the view, held by all who have studied the subject, that a civilisation which gives its whole attention to environment, and pays no attention whatever to the inborn qualities of the children, is heading for disaster. He declared that there is dysgenic selection going on, the cumulative effects of which must result in progressive degeneracy. He thinks that the Church should not be indifferent to a system of *laissez-faire* which largely increases the number of criminals, fallen women, and others who prey upon society.

THE scientific aspects of eugenics were dealt with at the Church Congress by Dr. A. F. Tredgold, a member of the Consultative Council of the Eugenics Society. He said that while the amount of social inefficiency due to physical unfitness is very great, that due to mental unfitness is still greater and of even more importance. While a proportion of cases of both physical and mental unfitness are caused by faulty environment, the great bulk of such cases are a consequence of hereditary defects and are transmissible. On this point he thought that the eugenists have made out their claim, and that the prevention of propagation by these mentally and physically unfit individuals would result in an improvement of the race and a considerable decrease of social inefficiency. Dr. Tredgold observed that increased medical knowledge and facilities for treatment, humanitarian sentiment, and the general trend of social legislation combine to encourage the survival and propagation of the unfit, and to make life easier for them than for the fit. There are indications that the number and ratio of the inefficient and the unfit are increasing. If this process be allowed to continue, national degeneracy will only be a question of time and a sum in arithmetic. Partial interference by man in the shaping of his racial progress can only end in disaster; and Dr. Tredgold is of opinion that eugenics is not only necessary, but also the logical consequence of the steps which man has already taken.

AMONG the early scientific worthies buried in Westminster Abbey is the famous Dr. Isaac Barrow, scholar, mathematician, and divine, who was born in London in October 1630, three hundred years ago. The son of Thomas Barrow, linen-draper to Charles I., he was educated at the Charterhouse and Felsted, entered Peterhouse, Cambridge, and in 1649 became a fellow of Trinity. Finding the times unfavourable to churchmen, he devoted himself to medicine, botany, chemistry, geometry, astronomy, and poetry, and in 1656, at Constantinople, read all the works of St. Chrysostom. Home again in 1659, in 1660 he became professor of Greek at Cambridge, in 1662 professor of geometry at Gresham College, London, in 1663 was included in the first list of members of the Royal Society after receiving its charter, and in the same year became the first Lucasian professor of the mathematical sciences. This last post he resigned five years later in favour of his brilliant pupil Isaac Newton; but Barrow was afterwards made Master of Trinity College, the King declaring that he had bestowed the post "on the best scholar in Europe". Three years later, in 1675, he was chosen vice-chancellor of the University, and he died of fever on May 4, 1677, while on a visit to London.

BARROW'S mathematical works included his edition of the "Elements of Euclid", 1655; "Lectiones Mathematicæ", 1683; "Lectiones Opticæ et Geometricæ", 1669; and his edition of the "Conics of Apollonius", 1675. As a divine, Barrow ranked with the greatest of his age. Described as "a person of the lesser size, lean and of extraordinary strength, of a fair and calm complexion", a portrait of Barrow by Lefebre has long been included in the catalogue of the National Portrait Gallery, but this is not now considered genuine. The Gallery, however, possesses a pencil portrait by the contemporary artist Loggan. Barrow's death took place, one account says, "in a mean lodging at a saddler's near Charing Cross"; but Dean Stanley wrote that "He had come, as Master after Master had come, to the election of Westminster Scholars, and was lodged in one of the canonical houses that had a little stair to it out of the cloister, which made him call it 'a man's nest'. He was there struck with high fever, and died from the opium which, by a custom contracted when at Constantinople, he administered to himself." His grave in the Abbey is to be found on the west side of Poets' Corner, opposite to those of Chaucer, Browning, and Tennyson.

AFTER an interval of three years, a second Science Exhibition was held on Oct. 14–18 in the White Rock Pavilion at Hastings. This time the whole building was used, and the committee of local electricians, engineers, medical men, chemists, science teachers, artists, musicians, and others, with the mayor as president and the headmaster of the Grammar School as organising secretary, got together a much more comprehensive collection of working apparatus to illustrate modern scientific discovery and invention. Demonstrations were given every hour on such subjects as television, ultra-violet light, sound vibration, and electric transformers; cinematograph films were

shown to illustrate natural history subjects; and on successive evenings Sir Leonard Hill, Prof E. N. da C. Andrade, Prof. E. V. Appleton, and Dr. Alexander Wood lectured to considerable audiences on the advances in science with which they are especially familiar. Admission in the mornings was limited to parties of school pupils. It is obvious that in a town such as Hastings some means should be found for giving popular instruction in science, and the crowds that attended and the interest shown have convinced the promoters that the Exhibition has served this purpose. The receipts from admission fees will, it is expected, cover the expenses, so that no call on the guarantors will be necessary. One advantage of the Exhibition is that the scientific talent of the town has been mobilised to carry it out, and an enthusiastic band of workers brought together which will be available for other concerted efforts.

At a meeting of the Newcomen Society held at the Science Museum on Oct. 15, Mr. H. P. Vowles read a paper entitled "An Inquiry into Origins of the Windmill". Though our Domesday survey, made between 1080 and 1086, mentions between five and six thousand mills, it is presumed these were all water-mills or cattle-mills. The earliest authentic evidence of a windmill in England refers to that erected by Herbert, the Dean at Bury St. Edmunds, about A.D. 1191, the event being recorded in the "Chronicle of Jocelin de Brakelond". The question as to whence England and other western countries obtained their ideas of a windmill Mr. Vowles attempted to answer by recalling the travel and trade of a thousand years ago, when the Vikings sailed the waterways of Russia and a great trade route extended from Asia Minor through Persia to China. Near this trade route, as it passed through Persia, lay Sijistan, now Seistan, a land of almost ceaseless winds, where windmills were apparently in common use by the tenth century, and where innumerable windmills of a primitive type can be seen to-day. Mr. Vowles's paper contained many references to the manuscripts and early works he has examined, and what he calls "a not altogether unreasonable theory" of the origin of windmills is certainly worth pursuing.

The presidential address of Mr. L. St. L. Pendred to the Institution of Mechanical Engineers, delivered on Oct. 17, was entitled "Random Reflections" and was addressed principally to young engineers—"I mean", Mr. Pendred said, "men under forty". Great inventions have generally been made by men still under middle age, and it is often the ignorance of youth, disregarding any opinion but its own, which carries its will against the inertia age inevitably brings. No doubt it is right schools should say "It is so", but it is to be hoped there will be students with enough folly to try the apparently impossible. In our own time we have seen the theory of gravitation shaken, the theory of light in the melting-pot, and the transmutation of metals brought almost within reach. "It is a glorious age for those who would let their thoughts run free", but reasonable restraint should be used. Breadth of view is also desirable, and, as John Bourne said long ago, "an engineer must be content to believe that there are other things in the world besides cast-iron and steam pressure". The plea for a broader cultivation for engineers is seen in America, Germany, and France, as well as Great Britain. But with all this, while avoiding the evils of specialisation or what Johnson called the "drowsy equilibration of undetermined counsel", the present requires vigorous action, for, as Lytton said, "So much depends upon action, that everything seems to say aloud to every man: 'Do something—do it—do it!'"

An interesting paper on the operation of overhead power lines at 15,000 volts was read by M. Polack, the engineer of the Nord Lumière Co., at the recent International Union of Power Engineers at Paris. It is printed in the *Electrical Times* for Sept. 18. The overhead lines have a total length of 728 miles and are supported by concrete posts. Glass insulators are generally used, as it is found that they have a large factor of safety. The conductors are stranded and the network is supplied from the huge Gennevilliers Central Station. The principal causes of trouble are tempests, trees, birds, malicious persons, and deposits of conducting materials on the insulators. About 80 per cent of the disturbances are only for a few seconds. Of the remainder, which cause a shut down for a longer period, thunderstorms cause about ten per cent, birds about one per cent, and breakage of posts less than one per cent. Engineers fear thunderstorms most, as they affect the lines over a wide region and interrupt at the same time the telephone service. On wooden posts the lightning discharges make helicoidal grooves, cause arcs to be established between the conductor and distant objects, and destroy apparatus. The breaking of the wires is the most frequent result of a storm. The fall of trees sometimes breaks the wires, and the blowing of branches across the conductors starts arcs which weaken them. Both small and large birds can start an arc between a conductor and 'earth'. Accidents due to this cause are not uncommon in spring and autumn, but are rare in winter and summer. Even such small birds as starlings have been known to start an arc. Malicious and thoughtless people have been known to throw wires or old bicycle rims at the wires to see what would happen.

The quarterly meeting of the Grand Council of the British Empire Cancer Campaign was held at the new offices at 12 Grosvenor Crescent, Hyde Park Corner, London, S.W.1, on Oct. 13. On the recommendation of the Scientific Advisory Committee, a further grant of £150 was made to Dr. J. C. Mottram, pathologist at the Radium Institute, London; £300 to Mrs. E. K. Dawson, of Edinburgh, for the continuance of investigations into mammary cancer; and £250 to Mr. E. Nevill Willmer, at the Physiological Laboratory, University of Cambridge. An application for affiliation from the Natal Radium and Anti-Cancer Fund, South Africa, was received and acceded to, thus completing the representation of the British Empire Cancer Campaign either by way of branches or affiliated

bodies in every one of the British Dominions. It was announced that a popular book, entitled "The Truth about Cancer", has been finally approved by all the technical committees of the Campaign and will be published by Messrs. John Murray at a cost of 2*s*. 6*d*. per copy. The Campaign has fixed the price of the book at this figure so as to make it available for all classes of the community. The Campaign has received an intimation that a legacy of more than £20,000 will become available shortly for its research into the causes and cure of cancer.

On Oct. 19, Wing-Commander Kingsford Smith landed at Darwin, Northern Australia, having completed a flight from England to Australia in just over 10 days. His machine is an Avro Avian Sports model, driven by a 120-h.p. Gipsy engine, and its maximum fuel load is 100 gallons. It is thus a light aeroplane comparable with that used in February 1927 by Mr. Bert Hinkler, whose time for the same journey was 15½ days. Incidentally it may be noted that Kingsford Smith did the same journey last year in a three-engined Fokker, taking about 12 days. The daily stages of his recent flight were as follows: Rome (1000 miles); Athens (700 miles); Aleppo (1100 miles); Bushire (950 miles); Karachi (1050 miles); Allahabad (950 miles); Rangoon (1100 miles); Singapore (1200 miles); Sourabaya (1000 miles); Atambua (900 miles); Darwin (500 miles).

The Fifth Congress of Polish Physicists, held at Poznań on Sept. 24–27, attracted more than three hundred members. The Congress was divided into two sections, nearly equal in numbers—an educational section and a scientific one. The members of the latter section represented all centres of physical research in Poland, many of which were created after the recovery of the political independence of that country. The Congress was held under the presidency of Prof. M. Wolfke, of the Technical Institute, Warsaw. Seventy-two experimental and nine theoretical papers were presented, showing a considerable increase of scientific activity since the last Congress, held at Wilno in 1928. The Physical Institute of the University of Warsaw, the director of which is Prof. Pieńkowski, contributed more than twenty papers.

It is interesting to note that some fields of research seem particularly to attract Polish physicists. These are, with the number of papers in each: molecular and atomic spectra (35); dielectric constants (9); electric arc (8); radioactivity (6). Special interest was aroused by papers on association of light quanta, by Wolfke; allotropic modification of liquid ether, by Wolfke and Mazur—the first case of allotropy in the liquid state was discovered in 1928 by Wolfke and Keesom in liquefied helium; X-ray investigation of the structure of wood, by Pieńkowski; resonance spectra of silver and zinc vapours, by Kapuściński, Warsaw; absorption spectra of sulphur, selenium, and tellurium, several papers, University Institute, Warsaw; a mercury arc of extremely high efficiency, by Reczyński, Lwów; isotopic effect in band spectra, by Curtiss and Patkowski, Wilno; dielectric constants, by Zakrzewski, Kraków; Raman effect at critical temperature, by Ziemecki and Narkiewicz, Warsaw; ionisation potential of radon, by Holweck and Wertenstein, Warsaw. The Congress has elected Mme. Curie and Prof. W. Natanson as honorary members of the Polish Physical Society.

Lord D'Abernon has accepted the office of president of the National Institute of Industrial Psychology, in succession to the late Earl of Balfour, its first president. Lord D'Abernon, like his predecessor, is keenly interested in the activities of the Institutes, both industrial and educational. He is a strong advocate of the value and necessity of the better methods devised and employed by the Institute for giving advice to young persons in their choice of a career.

The Horace Brown Medal of the Institute of Brewing is awarded by the Council for "eminent services on the scientific or technical side of the fermentation industries, at intervals of not less than three years". The first award was made to Prof. H. E. Armstrong in 1926, and the next recipient of the medal is to be Dr. E. S. Beaven, who, by his individual work, has done more than anyone to add to our knowledge of barley. The presentation will be made by the president, Mr. Percy Gates, in the lecture theatre of the Institution of Electrical Engineers, on Friday, Nov. 21, at 8.15 P.M., when Dr. Beaven will deliver the memorial lecture on "The Culture of Barley for Brewing".

Dr. A. W. Hill, director of the Royal Botanic Gardens, Kew, leaves England on Oct. 24 on a visit to South Africa at the invitation of the Government of the Union. Dr. Hill will examine the botanical and allied activities of the Union under the guidance of Dr. I. B. Pole Evans, chief of the Division of Botany, Pretoria. The visit has been made possible by a grant from the Empire Marketing Board to Kew for overseas visits. Dr. Hill expects to leave Beira on Jan. 2 to go to Uganda (where he will be the guest of the governor) and to Kenya; in both colonies he will visit the agricultural and botanical departments. The tour will end with a visit to the East African Agricultural Research Station, Amani, to attend the conference of directors of agriculture at the end of January.

King Edward's Hospital Fund for London has arranged the following series of demonstration-lectures: "A Hundred Years of Photography", by Dr. Walter Clark, director of the Research Laboratories, Kodak, Ltd., on Oct. 29; "Sound-Reproduction", by Mr. J. H. A. Whitehouse, head of the Technical Publications Department of the Gramophone Co., Ltd., on Nov. 5; "The Miracle of Sound-Photography", by Mr. J. L. Underhill, chief recording engineer of the R.C.A. Photophone, Ltd., on Nov. 10; "Dyes and Dyeing", by Major F. A. Freeth, research manager of Imperial Chemical Industries, Ltd., on Nov. 19; "A Light Talk on Illumination", by Mr. T. E. Ritchie, chief illuminating engineer of the General Electric Co., Ltd. All these demonstrations will be given at the Portland Hall, Regent Street Polytechnic, at 5.30 P.M. A further demonstration, "The Romance of a Lump of Coal", by Sir Francis Goodenough, controller of gas sales of the Gas Light and Coke Co., will be given at 6 P.M. on Dec. 8 at the Caxton Hall, Westminster. The feature of the series

is that prominence is being given to practical demonstrations illustrating the development of the subjects. Tickets can be obtained from the Secretary, King Edward's Hospital Fund for London, 7 Walbrook, E.C.4, or at the doors, prices 2*s.* 6*d.* and 5*s.* (seats numbered and reserved) each demonstration, or 12*s.* 6*d.* and 25*s.* for the series.

IN the article referring to the meeting at Stockholm of the International Union of Geodesy and Geophysics, which appeared in NATURE for Oct. 11, p. 585, a statement appears suggesting that an Auroral Atlas is in preparation. We understand that this Atlas is, in fact, already prepared and published, and its distribution is now being undertaken by Prof. C. Stormer, chairman of the Committee responsible for its preparation.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 1). A plant physiologist at the Agricultural and Horticultural Research Station, Long Ashton, Bristol—The Secretary, University, Bristol (Nov. 3). An assistant pathologist at the French Hospital and Dispensary, Shaftesbury Avenue—The Secretary, French Hospital and Dispensary, 172 Shaftesbury Avenue, W.C.2 (Nov. 4). An assistant pathologist to the Pathological, Bacteriological, and Clinical Research Department of the Royal Sussex County Hospital, Brighton—The Secretary-Superintendent, Royal Sussex County Hospital, Brighton (Nov. 10). A senior assistant pathologist at the Auckland Hospital—The Secretary, Auckland Hospital Board, Auckland, New Zealand (Dec. 15). A part-time master for electrical engineering at the Technical Institute, Ponders End, Enfield—F. G. Apthorpe, Education Offices, Gentleman's Row, Enfield.

Our Astronomical Column.

Magnetic Disturbance and Aurora.—A magnetic disturbance, classified as a 'small storm', commenced at 15h G.M.T. on Oct. 17 and lasted about ten hours. The range in declination at Greenwich was 55′, the oscillations of the needles being most rapid about 17h and 22h. There was an accompanying display of the aurora borealis, which seems to have been particularly well seen from the eastern counties of England. Mr. Charles Leaf, 7 Grange Road, Cambridge, states that at "1952 G.M.T. a low arch was visible stretching from north-west through north to north-north-east. This was bright green in colour, the lower edge being quite sharply defined, while the upper edge gradually merged into the clear sky above. At its highest point the arch was perhaps 15° above the horizon, and the extremities did not quite reach it. No streamers were observed." The arch persisted until 2130 G.M.T., when rainclouds finally hid it. Mr. H. W. L. Absalom, 9 Hillside Gardens, Wallington, Surrey, saw an auroral display between 6.30 and 6.45 P.M. (G.M.T.). "The phenomenon was first a comparatively short, thin, and rather diffuse arc of glow a few degrees below the three most westerly stars of the Plough. A few minutes later vertical structure became apparent, there being meanwhile a slow westward drift of the phenomenon, which, in its final form, seemed to consist of a nearly vertical shaft to the north-west. This shaft faded somewhat suddenly a minute or two before 6.45 P.M."

At this time there was a relatively small group of sunspots about two days' travel past the sun's central meridian. This group, seemingly unimportant, was more interesting spectroscopically; it was surrounded by a conspicuous area of bright hydrogen flocculi, and as another index of activity, small but fairly rapidly moving streams of hydrogen, shown as absorption markings, were associated with the rearmost spot on Oct. 18 and 19. Whilst in these respects alone the group of spots was not unusual, the region may be considered at least as suspect in a possible association with this magnetic disturbance and aurora.

Bright Lines in Long-period Variable Stars.—An examination of the behaviour of bright lines in the spectra of long-period variable stars is made by Merrill and Burwell in the *Astrophysical Journal*, vol. 71, p. 285. The wave-lengths of 58 bright lines are recorded originating in hydrogen, iron (including 'forbidden' lines), magnesium, silicon, manganese, and (doubtfully) strontium and iridium. The forbidden iron lines and a magnesium triplet in the ultra-violet have not previously been recorded. The most interesting results deal with line intensities. Intensity *ratios* rather than absolute values are used, in order to avoid photometric difficulties, and the ratio $H\gamma : H\delta$ shows striking variations throughout the light-period which are common to all the *Me* type stars examined. It rises rapidly from 1/8 up to 1/2 (reaching the latter value just before the maximum light-phase), then remains nearly constant for more than a fifth of the period, and finally rises rapidly again to about 5/2. Other intensity ratios show similar variations. The results are discussed, and it is shown that the bright lines behave as if they had little dependence upon the photosphere. It is also suggested that the band-producing titanium oxide exists at a higher level than that at which the bright lines are produced.

Pluto.—Mr. Bower has compared the recent observations of Pluto made by Prof. G. van Biesbroeck at the Yerkes Observatory with the ephemeris prepared by himself and Mr. Whipple using the elements that they derived from observations extending from 1919 to 1930. The mean correction to the ephemeris at the beginning of September last is only −0·3″ in R.A. and 0·2″ in Decl. This is so small that it finally clinches the correct identification of the 1919 images with Pluto. This was really quite certain already, but some astronomers preferred to wait for the autumn observations before accepting them; these should now be satisfied.

M. F. Quenisset succeeded in photographing Pluto at the Juvisy Observatory on Sept. 25, using a lens of only 5 in. aperture and 24 in. focal length. The exposure was for 2¼ hours. He estimates the magnitude as 15; Prof. Wolf thought it somewhat brighter than this; probably something depends on the type of plate used, as the light of Pluto appears to be yellowish. It is now near its stationary point, and will soon begin to retrograde. Messrs. Bower and Whipple have issued an appeal to all who have access to old plates that might contain images of Pluto to examine them carefully. They gave an ephemeris for past years in *Lick Observatory Bulletin*, No. 427. This is so near the truth that only a small region on each plate would need to be scrutinised. Two plates of each region are needed to distinguish the planet from a star, unless the exposure is so long that the planet has trailed appreciably.

Research Items.

A Survival in Sind.—Mr. Ernest Mackay, in the *Journal of the Royal Anthropological Institute*, vol. 60, pt. 1, in describing the pottery-making industry of Balreji village, two miles south-east of the ancient site of Mohenjo-daro, singles out a number of details in which he sees resemblances to the pottery of the ancient East and particularly to the painted pottery of Sumeria. The wheel is unlike that employed anywhere else in India except in the upper Punjab, having two discs, of which the lower is turned by the foot. The foot wheel is used in the Bahrein Islands and elsewhere in the Persian Gulf, whence it may have reached India either overland or by sea. In making small vessels a tall column is moulded from which the completed vessel is severed by a cord. This leaves a characteristic groove in the base. Similar grooves are to be detected in Sumerian and Mohenjo-daro pottery. Vessels were cut from the wheel by cord in Crete so early as Middle Minoan II. The larger jars are built up in three or four parts on a moulded base. The same method, except for the moulded base, is found in pottery of the pre-Sargonic period of Mesopotamia and in the painted pottery of Jemdet Nasr near Kish, *c.* 3500 B.C. The method of tapping the pottery before quite dry with a block and spatula may have been employed in the manufacture of some of the so-called hand-made pottery of the early East. Specimens of the tapping block have been found at Harappa and various sites in Northern Baluchistan. To decorate the pots, they are placed on a conical stand and a cover with a projecting knob is placed in the mouth of the pot, this being used to revolve the vessel with the palm of the hand. Similar covers are found at Mohenjo-daro and also at Jemdet Nasr. Though the designs show very little resemblance to those of Mohenjo-daro, except that the scale pattern of the Nal pottery may be attributed to the influence of the Indus valley culture, yet the very survival of the art may itself be due to a tradition handed down from the people of Mohenjo-daro rather than to a new introduction. It is certainly not Greek or Arab.

Characteristics of the Peoples of Central Asia.—During a long sojourn in Central Asia (1892–1908) J. Talko-Hryncewicz collected many skulls of the present-day and former inhabitants, which he found by the railways and in fields, forests, and cemeteries. Their abundance was due to the belief of the Buddhists that the most honourable sepulchre was in the interior of wild beasts, and to the consequent scanty burial given to corpses. A study of the skulls shows that the population is composed of two principal types (*Bull. intern. Acad. Polonaise Sc. Lett.*, Ser. B, p. 107, 1930). The first type, Mongolian and contemporaneous, comprises two varieties, an eastern and a western, the latter perhaps mingled with Turks. The second type, represented by a probably pure Turkish race, is extinct at the present day, the remains being found only in tombs. This 'Euro-Asiatic' race, which mixed with others, such as the Mongols, was once very numerous and had several branches. It spread even to the bounds of central Asia on the north-east, and its influence upon the Chinese there is marked by the presence of carriage roads, irrigation canals, and certain agricultural implements, while its rune-like inscriptions remain on the stone tombs of the Khans at Karakoram. The author believes that the characters of the skulls and the size and development of the skeleton indicate that this is the race to which the Huns belonged, and accordingly he does not hesitate to range the Huns as a race with Turkish rather than of Finno-Mongol with Slav affinities.

Birds of the Antarctic Seas.—The British Antarctic Expedition of 1910 on the *Terra Nova* made a collection, amongst other things, of bird skins, but the accidents of death, first of Dr. E. A. Wilson, the naturalist of the Expedition, and then of Mr. Ogilvie-Grant, have delayed the report until now. A casual glance at the report suggests that it is largely due to the pen and pencil of Dr. Wilson, and, indeed, its text and the many drawings in pencil and colour reflect the keen observation and skill of that ill-fated naturalist. But closer reading shows that the authors, Dr. P. R. Lowe and N. B. Kinnear, have contributed a great deal to the scientific value of the work, notably by their long series of measurements of specimens from different regions, and by their remarks on age and locality differences. Forty species and sub-species were observed and obtained during the voyage, and many interesting notes on habits, characteristic attitudes in flight and in feeding were made. One of the most striking was the observation near Cape Crozier that young and adult individuals of the Emperor penguin were frozen into the lower layers of the old bay-ice of the previous winter and dropped into the sea as the ice melted. That and the presence of adults with chicks of different stages, seen at various places from Dec. 19 until Jan. 4, confirmed the suspicions that the chick is very slow in shedding its first plumage and the egg has to be laid and hatched out during the winter months.

Swarming of Bees.—In an article on the phylogeny, physiology, and biology of the swarming of bees (*Biol. Zentralbl.*, Leipzig, Bd. 50, p. 219; 1930), G. Gotze discusses the investigations made on this subject at the Institute of Plant Diseases at Landsberg. Swarming, he holds, originates as a rule owing to lack of room, lack of food, or the unsafe condition of the old nest, and not, as Edwards and Latham have stated, as part of the nuptial flight. It is a division of the bee-stock in which the sex-impulse has no part, and most likely arises from an instinct impelling to migration towards favourable conditions of food and colonisation. It is an expression of the social relationship between the queen and her subjects, an election flight which leads to the division of the bee-stock as soon as several females have come to adult state. The social problem amongst bees has found, in different quarters of the globe, three types of solution. In America the stingless *Meliponi* exhibit the flight of young queens with partial swarming; in India the workers of *Apis dorsata* build new nests and this is followed by the swarming of the queen; and in Europe, the old queen of *Apis mellifica* flies off, and later there follow successive swarms with young queens. The author considers that such harmonious procedure as swarming in a state composed of so many castes could not be due to physiological reflexes to particular stimuli, and favours the view that a deep-seated hereditary instinct is involved.

Regeneration and Normal Growth.—Przibram's measurements of *Sphodromantis* and those of Křizenecky on *Tenebrio* reached analogous conclusions that a parallelism exists between regenerative and normal growth. Ubisch, on the other hand, regards differentiation, not growth, as the essential feature of regeneration. E. Godlewski and J. Latinik have attacked the problem afresh by determining during ontogenesis and during regeneration the growth of sectors of the tail of axolotl, the segments being so

far as possible equal and placed behind each other (*Bull. intern. Acad. Polonaise Sc. Lett.*, Ser. B, p. 79, 1930). The authors share neither of the opinions indicated above, for they regard growth and differentiation as complex general notions, indicating the resultant of several very different factors. Growth can indeed be distinguished in the ontogenetic and in the regenerative phase: in the former it is uniform in all the sectors; in the latter, apart from a generally accelerated movement, it shows stronger growth in the anterior than in the posterior sectors. It would appear, therefore, that factors take part in regeneration different from those involved in normal growth, and that a theory which limits regeneration to accelerated growth does not fully meet the facts of the case.

Graft Hybrids.—A valuable account of investigations in this interesting field is given by Prof. F. E. Weiss in *Biological Reviews*, vol. 5, No. 3, 1930. After some discussion of the vexed question of the influence of stock on scion, a very succinct historical account is given of the best known horticultural 'sports' which are now interpreted as graft hybrids, namely, the bizzarria orange, *Cytisus Adami*, and *Crataegomespilus*. In the last case, Weiss and Haberlandt regard the explanation of this plant as a periclinal chimæra as in doubt, because the shape of the epidermal cells, as seen in surface view, does not correspond with that of either of the original plants, from the graft union of which the sport has apparently arisen. It is not clear, however, why the authors should expect an epidermal cell to retain all its original characteristics of shape when it is subjected to a different amount of superficial extension, due to the fact that it is now spread over a core of different growth capacity. Baur's original explanation of some of these graft hybrids as chimæras, in which a skin of one parent is spread over the core of another, has been fully confirmed by the beautiful experiments in the artificial production of such graft hybrids from the region of graft union, which were initiated by Winkler. Prof. Weiss describes these experiments and shows how the further elucidation of the complex phenomena associated with the production of graft hybrids depends upon adequate cytological studies, and upon the developmental studies of the growth processes in the apical meristem. Many cases of graft hybrids have been brought under notice because the tissues from different parents show different capacities in the production of green chloroplasts. Prof. Weiss makes it clear, however, that the interpretation of the genetic and somatic factors involved in the production of variegation is a very complex and involved problem.

Land Mollusca from Caribbean Islands.—Visits during the expedition of the yacht *Mary Pinchot* were paid and land mollusca collected at Grand Cayman, the Swan Islands, Old Providence Island, and St. Andrew Island, the results of which are now described in full by Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci. Philad.*, vol. 82). Some work had previously been done on the land mollusca of Grand Cayman and the Swan Islands, but no land snails have hitherto been reported from Old Providence or St. Andrew Islands. Of the twenty-nine species collected at Grand Cayman, nineteen are restricted to it, and the author considers that it has existed well back into Tertiary times and has never been connected with Cuba. Its fauna can be most credibly accounted for by a former land connexion with Jamaica. Twenty-two species of land snails are now known from the Swan Islands, of which nine are special thereto. Sceptical as to the ability of land snails to make long sea voyages, Dr. Pilsbry regards their origin as obscure. The ridge on which Old Providence and St. Andrew Islands stand was formerly emergent and connected with the mainland, probably in Pliocene times.

Metamorphism and Geological Structure.—In an important paper by Gertrude L. Elles and C. E. Tilley, published in the *Trans. Roy. Soc. Edinburgh* (Vol. 56, Pt. 3, No. 25, 1930), the results are presented of many years' work on the structure of the Central and Southwest Highlands as shown by the metamorphic condition of the beds. In addition to very extensive field work, nearly 3000 rock specimens have been sectioned and examined in order to define with precision the limits of the various metamorphic zones that have been recognised. The distribution of the latter shows very conclusively that the fundamental structure of the entire region was one of large-scale recumbent folding of the type suggested by Bailey. The connexion between this folding and the metamorphism is so close that the two processes must be regarded as having taken place approximately at the same time. The early recumbent folding was followed by a simpler type of folding like that found in the southern uplands. This stage was unaccompanied by constructive metamorphism. The movement seems to have culminated in the development of a series of thrusts with an overdrive to the north-west. The impulse of the earlier folding, however, appears to have come from the north-west. The two sets of trend lines are not exactly parallel. The paper is well illustrated with maps and sections, and is a most valuable contribution to our rapidly growing knowledge of an area and a method in both of which Barrow was the pioneer.

Australian Rainfall.—The Commonwealth Meteorologist has produced the rain map of Australia for 1929. Twelve small maps show the monthly rainfall and a large one the annual rainfall. The maps are based on the record of 1300 stations that are well distributed except for a gap in the interior of the western half of Australia. Only fifteen per cent of the country had rain in excess of normal. This compares with thirteen per cent last year, but this year was really worse, because there were very dry conditions in the pastoral lands of South Australia, northwest of New South Wales, and south-west Queensland. In some of those areas the totals were the lowest on record. The wheat areas of Victoria had a lack of rain during the critical winter and spring months. The total wheat harvest of Australia has been estimated to have dropped from 160 million bushels last year to 126 million bushels. Wool production, however, was high, and the sugar plantations do not appear to have suffered from shortage of rain. Tasmania as usual had a good rainfall.

Ultra-violet Glazing.—In response to the frequent inquiries from the building industry as to the use of window glasses transparent to ultra-violet rays, the Building Research Board of the Department of Scientific and Industrial Research has issued a *Bulletin* of a dozen pages on the subject, prepared by Mr. H. E. Beckett. A number of glasses which, when in sheets of 0·23 cm. thickness, transmit 65 per cent of the therapeutic rays between 0·29 and $0{\cdot}32 \times 10^{-4}$ cm. are now available, but their transparency falls off to 55 per cent in the course of three months' exposure to sunlight, and any dirt which may collect on their surfaces reduces their transmission still more. To get the therapeutic benefit of a window of the glass, it is necessary to sit within a few feet of it, as the available radiation falls off rapidly with increasing distance from the window, and at most points within a room the amount available is small. Copies of the *Bulletin* can be obtained from H.M. Stationery Office (price 4*d.*).

Possibility of Collisions between Light Quanta.—If light has a corpuscular structure, collision phenomena might be expected to occur when two beams cross each other, and it would be possible, for example, for two similar quanta to give rise to a new one of a new frequency. A search for an effect of this nature is described by A. L. Hughes and G. E. M. Jauncey in the second August number of the *Physical Review*. Two beams of sunlight, filtered through red glass, were passed through a pair of large lenses, so that the beams, the axes of which were inclined at 120°, intersected at a common focus. The point of intersection, when examined through a green filter with a dark-adapted eye, showed no detectable light, and it is calculated, from the energy of sunlight and the sensitivity of the eye, that the collision area of the quantum, for an event of this type, is less than 3×10^{-20} cm.^{2}

Protecting Transmission Lines from Lightning.—During a severe thunderstorm the engineers of overhead transmission lines have an anxious time. They do not fear that the surges set up in the lines may do damage, as modern lightning arresters are very efficient; but they do fear, however, that direct flashes of lightning may strike the line. In *AEG Progress* for October the methods of protecting transmission lines from direct strokes are discussed. It is suggested that if all the lattice towers are connected with the earth through a suitable resistance and are connected together by an earth wire, then the line will be practically safeguarded. The author states that a lightning flash is non-oscillatory and a cathode ray oscillogram is shown to support this statement. A description is given of experiments carried out in the A.E.G. high tension laboratory to find the nature of the canal through which a high tension discharge takes place in air. Currents were varied from 1500 to 60,000 amperes. The diameter of the spark canal was measured photographically, every precaution being taken to prevent irradiation on the photographic plates. A curve is given to show the relation between the diameter of the spark canal and the maximum current. The record shows that with high discharge currents, the current density in the spark canal approximates to a constant value of ten amperes per square millimetre. A lightning current of 175,000 amperes would thus require a canal of diameter 15 centimetres. The spark canal in the experiments was constricted at the points where it started and finished. Similar constriction should occur when lightning flashes hit the ground. The author considers that a fulgurite of 5 centimetres diameter would be caused by a lightning flash of 175,000 amperes.

A New Distance Finder.—To meet the increasing need for a simple and inexpensive apparatus for measuring distances, Messrs. W. H. Harling, Ltd., of 117 Moorgate, E.C.3, have just introduced a "Popular Distance Finder" (price 27s. 6d. without staff: staff, 7s. 6d. extra), which should be of use to surveyors, engineers, architects, scouts, etc. The size of the instrument when set up is 12½ in. × 10 in., and, without the staff, packs up to 12½ in. × 2½ in. × 2½ in. It consists of a horizontal arm carrying a cross-bar and scale at one end and an eye-piece at the other, mounted on a staff. The scale arm is also provided with eye-pieces for observations along the chosen base-line. Two adjusting slow-motion gears are attached, one to turn the whole instrument about the staff, the other to turn the scale arm only. Each arm is fitted with a spirit level, and the scale is so graduated that, if the length of the base-line is 10 or 100 units, the required range may be read off the scale without calculation. Another feature in the simplicity of the design lies in the fact that there is no restriction as to the direction of the base chosen. Provision is made for reclamping the instrument on the staff in a vertical plane, so that heights may be as readily measured as horizontal ranges. Any distance from 50 feet to 5 miles may be measured; indeed, the range is limited only by visibility and the power of the eye, and, provided the base-line is not less than one-tenth of the distance to be measured, a 99 per cent accuracy is obtainable.

Sodium Vapour.—Measurements of the vapour pressure and density of sodium by Rodebush and Walters are described in the July number of the *Journal of the American Chemical Society*, from which the authors conclude that there can be no question of the existence of an appreciable amount of Na_2 molecules in the vapour. This conclusion is of interest in confirming the results of band spectra, which also indicate the presence of double molecules in the vapours of alkali metals, previously regarded as purely monatomic.

Rapid Estimation of Copper.—In the September issue of the *Berichte der Deutschen Chemischen Gesellschaft*, Prof. Fritz Ephraim describes some remarkable results which he has obtained in estimations of copper both in pure salts and in the presence of many other metals by means of the co-ordinated complex derivative which the metal forms with salicylaldoxime. The sensitiveness of this reagent is said to be greater than that of dimethyl-glyoxime for nickel. Moreover, it gives much more satisfactory results than cupron (benzoïn oxime), since it can be used in the presence of dilute acid, when its action becomes highly selective, the corresponding compounds with all other metals being held in solution. It is important to eliminate by careful washing all traces of excess of the reagent, otherwise the precipitate may decompose on drying. The dry compound contains nearly 19 per cent of copper and can be weighed accurately on a Gooch crucible.

Melting Points of Krypton and Xenon.—The melting points of the inert gases krypton and xenon have been redetermined by Dr. Kurt Peters and Kurt Weil (*Zeitschrift für physikalische Chemie*, Abt. A, Bd. 148, Heft 1/2). The essential part of the apparatus is a glass tube 4 mm. in diameter slightly bulbed at the lower end. Within this slides a glass rod, 2 mm. thick and 10 cm. long; the lower end of the rod has three slight projections. Also included is an iron tube surrounding the glass rod and allowing this rod to be moved up or down with the help of an external electro-magnet. By means of liquid air the inert gas is condensed as a frozen ring in the lower part of the outer tube. With the help of the magnet the lower jagged end of the rod is set into this frozen ring. The whole apparatus is then introduced into an aluminium block thermostat, and the tip of the rod is watched by means of its projection on a screen whilst the slowly rising temperature is determined on a platinum resistance thermometer. The results obtained for the melting points of krypton and xenon are $-157{\cdot}0° \pm 0{\cdot}5°$ C. and $-112{\cdot}0° \pm 0{\cdot}5°$ C. respectively. Since these results differ considerably from those of Ramsay and Travers, it seemed desirable to control the figures by time vapour pressure curves. A bend in the curves confirms the temperatures given. The normal boiling points were also determined by extrapolation. In a separate paper, "Adsorptionsversuche mit schweren Edelgasen" (*Zeitschrift für physikalische Chemie*, Abt. A. 148 Bd. 1/2 Heft), the same authors have described a method for the quantitative separation of argon, krypton, and xenon. The mixed gases can be adsorbed on carbon at $-190°$ C., and then as the temperature rises they can be 'desorbed' through separate successive ranges of temperature by means of a mercury pump.

New Science Buildings at Christ's Hospital, Horsham.

HIS Royal Highness the Prince of Wales, who is the president of Christ's Hospital, visited the school at Horsham, on Oct. 14, to open the new buildings (Fig. 1) which have recently been erected for the purpose of supplying increased facilities for the teaching of science and geography.

The Prince arrived by aeroplane about mid-day and, accompanied by the headmaster and the Bishop of Worcester, he entered the new quadrangle, where he addressed the assembled school. In the course of his speech, he thanked those who had subscribed to the building fund and stressed the importance of biological and geographical studies in furthering the welfare of the Empire.

"The new building," he said, "which adds so finely to the beauty and usefulness of this great and ancient school, is to be used mainly for the teaching of geography and of natural sciences, among which, I understand, biology will now be able to take its proper place beside chemistry and physics. Knowing as I do the need of scientific investigators to fill posts in outlying parts of the Empire, the teaching of geography and biology has for me a special appeal. They are both Imperial subjects, and they both make for the better understanding of mankind. To appreciate, through a study of biology, both the variety and the unity of all organic life is the surest path to sympathy and sound philosophy." The Prince then declared the building open and made a tour of inspection through it.

The new block of buildings is of red and white stone and forms the east side of a new quadrangle. It is very substantially built: the walls are double and the space between them filled with 'Hygean' rock—a material of bituminous nature—and the floors are of reinforced concrete.

On the ground floor are six large rooms. One is a chemical laboratory for the use of the more advanced students, leading out of which is a science library and reading-room. Two rooms are arranged for the teaching of practical mathematics, and one is a large biological laboratory. This is fitted with working benches and standing benches for aquaria, etc., and is intended for the more elementary work and nature study. It will be available for use out of school hours and will thus help to encourage the intelligent study of outdoor life, which has always been one of the aims of the school.

FIG. 1.—New science buildings, Christ's Hospital. West elevation and quadrangle.

On the upper floor are two large geography class-rooms. They are lofty and well lighted and have been excellently equipped under the direction of Mr. T. K. M. Booth, who is well known for his work as a teacher of physical geography. On this floor are also two other laboratories for more advanced biological work and a lecture room to accommodate about eighty boys. This is fitted with raised tiers of benches and is well equipped with up-to-date projection apparatus. Communicating with this by means of a hatch is a small preparation room.

Above one of the biological rooms is a flat roof, surrounded by a coping, where many outdoor experiments may be carried out.

The working benches in all the science rooms are of the knee-hole type, and each working space is supplied with gas, water, and both high and low tension electrical points. The constructional work has been carried out by Messrs. Henry Norris and Son, Ltd., of Hertford, under the direction of the architect, Mr. S. Tatchell, F.R.I.B.A.

Native Races of the British Empire.

THE first of the series of popular lectures under the auspices of the Royal Anthropological Institute in the coming winter took place at the Portland Hall of the Regent Street Polytechnic Annexe on Oct. 15, when Prof. John L. Myres, president of the Royal Anthropological Institute, delivered the inaugural lecture, on "Native Races of the Empire: Facts and Problems". He said that it is remarkable, and also natural, that the greater advances in the 'study of man' have occurred during the greater periods of exploration and exploitation. Contact and conflict with alien cultures sharpen men's observation of customs and beliefs, and provoke curiosity about the reasons for them. Political theories have been founded on travellers' tales about men in the 'state of Nature' presupposed by philosophers, and have differed like the customs so described. This has been the contribution of adventurers and administrators to anthropology. What has anthropology to offer in return by way of instruction, advice, or warning to those whose interests or duties involve intercourse with 'native races'?

At first sight, a survey of the native races of the Empire would seem to fall little short of a general survey of mankind, so widespread are the regions included. But the same reasons which explain the special courses taken by colonisation and conquest determined also which races and peoples the pioneers would encounter, the historical order in which they met them, and consequently the fund of previous experience with which each fresh 'native question' was handled. This in turn suggests a natural order in which to group studies of 'native races', according to their geographical backgrounds and economic foundations.

In North America, where intercourse between European settlers and aboriginals occurred first on a large

scale, it was mainly between hunters on both sides in the north, and only further south between hunting natives and immigrant farmers, involving transference of lands and displacement of natives by immigrants, eventually almost complete. Clash between the Plains Indians, already using the horse, and white cattle-ranchers, came later and was more severe; and in turn the discovery that grain could be grown on prairie restricted surviving redskins to a few limited reserves. In the mountain belt, displacement has been slower, as in the austerer north; and on the Pacific coast, fisheries and other local industries permit gradual incorporation of natives into the white community. All through North America, the absence of strong racial contrasts and the high quality of redskin intelligence has made absorption easy.

Contrast the course of events in Australia, where the physical difference was conspicuous, native adaptability was low, and the settlers' outlook, for various reasons, less favourable to tolerant or even humane intercourse. The dependence of Australian settlement on grazing animals emphasised the clash between pastoral and hunting populations; and the early discovery of precious metals introduced severe economic complications, unfavourable (as in South Africa) to aboriginal prosperity.

The natural poverty of aboriginal Australia contrasts alike with the natural wealth of New Zealand and of the Pacific island-world whence the Maori had come; and the higher intellectual endowment of the Polynesian helps to explain both the sturdy resistance of the Maori and the facility with which European intercourse has broken up the receptive culture of the other islanders. In Polynesia, and still more in Indonesia, tropical conditions (especially wealth of forest products) have on one hand precluded colonisation, and on the other led to various ways of utilising the forest-bred aboriginals as mere collectors of raw material, such as rubber or copra, under servile conditions which are disorganising their societies. Quite of a different kind are the problems which occur when the native population has domestic animals and is more or less pastoral and nomad, as in Arabia and Iraq, while the immigrants are agricultural and sedentary, or European needs favour agricultural elements against the pastoral. It makes little difference, moreover, to herdsmen, tenacious though they are of their own traditions, whether their grasslands have always been grazed, as in Arabia and Upper Mesopotamia, or were formerly the granary of great civilisations, as in Babylonia, Syria, Palestine, and Egypt. In northern Nigeria, the same clash of pastorals and cultivators appears in similar open country; and on the north-west frontier of India, too, the men of the plains are cultivators and the hillmen mainly pastoral, though not nomad like the Arabs and other Moslem pastorals.

As the only regions within the Empire or its mandated territories where purely pastoral communities are predominant lie where normal European colonisation is not practicable, contact with nomad peoples would be limited to marginal police work; were it not, with modern agricultural and engineering methods it is possible to farm large tracts of grassland, so that customary pastures are abridged, and nomads raid cultivated lands in reprisal.

In Palestine, for special reasons, political and sentimental, a country long abandoned to immigrants still mainly nomad is being reoccupied by sedentary farming communities, supplying the needs of an even larger tour-population, also immigrant, and imperfectly accustomed to traditional modes of life.

It is necessary to take account of the special problems of contact with pastoral peoples, as well as with hunting tribes and with the simpler cultivators, if we are to understand the peculiarly complicated situation all down eastern and southern Africa, from Sudan to the Kalahari Desert. Here, moreover, mainly because these tribes, so long as they kept to the plateaux, seldom wholly lost their cattle, and consequently kept their mobility, the population is unstable and tends to drift southward, gently or violently, with overlaps, conquests, and race mixture. Into this initial confusion European exploitation, based on the coasts, brings into the interior numerous cross-currents and such complication as former Arab slave-raiding, recent devastation of cattle and peoples by fly-borne and travel-borne diseases, the shift of native labour into gold-fields and diamond-fields, and the wastage of brains and resources in the so-called 'scramble for Africa' between Europeans.

Subsequent lectures will deal, on Nov. 12, with "Spirit Worshippers of the South Seas", by Mr. A. M. Hocart; on Dec. 10 with "Tribes of the Egyptian Sudan", by Lord Raglan; and after Christmas, with other native races, to be announced later.

Photosynthesis of Carbohydrates.*

As has already been described in previous papers, the photosynthesis of carbohydrates can be achieved by the irradiation of carbonic acid absorbed on a suitable surface in the form of a very fine powder. The material used in the earlier experiments was nickel carbonate, which, however, required previous activation by means of light and was only effective for about two hours.

Considerable advantage is gained by the use of ferric oxide as catalyst, the oxide, containing some thorium oxide as promoter, being deposited on kieselguhr which has previously been coated with aluminium hydroxide. The aluminated kieselguhr is evaporated to dryness with a solution of ferric nitrate, and the product is first ignited in a stream of dry air and afterwards heated at 410° in a vacuum in order to remove any adsorbed nitric oxide. These powders do not require any previous activation.

The activity of the powders in promoting photosynthesis varies in a remarkable way with the amount of thorium oxide present in the ferric oxide, sharp maxima being observed when the thorium oxide content is about 1·31 and 2·12 per cent with minima on either side of these amounts. The maximum yield of carbohydrates is about 0·13 gm. per hour with 100 grams of powder at 18°.

It has been found that photosynthetic activity is proportional to the magnitude of the electropositive charge assumed by the powders when in suspension in water saturated with carbon dioxide. This enables the activity of any powder to be rapidly determined. The most active powders give in the cataphoresis apparatus a velocity of 0·00041 cm. per second along a potential gradient of 1 volt per cm. Cataphoresis measurements made with activated nickel carbonate have shown that the material completely loses its activity in two hours when its suspension in conductivity water is exposed to light. The short-lived activity of this substance as a catalyst for the photosynthetic reaction is thus explained.

Cataphoresis measurements have rendered possible the determination of the rates of the poisoning of the

* Substance of a paper read by Prof. E. C. C. Baly, F.R.S., before Section B (Chemistry) of the British Association at Bristol on Sept. 8.

powders by the oxygen produced in the photosynthetic reaction and of the subsequent de-poisoning by carbonic acid. The ferric oxide powders in suspension in water saturated with carbonic dioxide maintain a constant cataphoretic velocity when kept in the dark. A suspension of a powder, with a stream of carbon dioxide passing through it, becomes less electropositively charged when exposed to light, the decrease in charge depending directly on the intensity of the light. When the intensity of the light exceeds a definite value the powder undergoes complete flocculation and is rapidly deposited on the bottom of the containing vessel. If the irradiation is then stopped, the powder is de-flocculated and the original maximum electropositive charge is restored, the poisoning and depoisoning being completely reversible. It follows from this that if the intensity of the light be not too great the photosynthetic production of carbohydrates becomes a continuous process.

It has been previously shown that the yield of carbohydrates is linearly proportional to the temperature between 5° and 31°, and that a very rapid decrease in yield takes place when the temperature exceeds 31°. It was suggested that the explanation of this sudden decrease in activity was due to the fact that 31° marks the limit of stability of the adsorption complex of carbonic acid. This suggested explanation has now been verified experimentally. Suspension of the ferric oxide powders in water saturated with carbon dioxide are completely stable in the dark at 31° and at lower temperatures. If the temperature is raised above 31° the suspension is completely flocculated and rapidly settles out.

Measurements have been made of the photosynthetic efficiency of the powders with light of different wavelengths, and it has been found that the efficiency increases from the blue to the red end of the spectrum, the maximum being obtained with light of about wavelength 700 $\mu\mu$. The analogy between the laboratory process and that in the living plant seems therefore to be complete, since the two are similar in the following respects:

(1) The reaction is a photochemical one on a surface.

(2) The energy of activation of the carbonic acid is supplied in two stages, part by the surface and part in the form of light.

(3) The photosynthetic efficiency decreases when the intensity of the light is too great, and is restored in the dark.

(4) The production of photosynthesised material is linearly proportional to the temperature up to a critical temperature, above which the production rapidly falls. In the laboratory this critical temperature is 31° and in the living plant it is 36°.

(5) The photosynthetic efficiency increases from the blue to the red end of the spectrum.

It may be recorded that, although the yields of carbohydrates obtained from carbonic acid have not yet been large enough for the purpose, a systematic analysis has been made of the sugars present in the syrup photosynthesised from an aqueous solution of formaldehyde. This syrup is very similar in its properties to that obtained from carbonic acid. The sugars were oxidised by means of bromine and the resulting acids were separated by fractional crystallisation of their salts with various alkaloids. There were thus obtained pure preparations of *d*-gluconic acid and *d*-erythronic acid, both of which were completely identified. The formation of these acids proves the photosynthesis of glucose and fructose. Evidence was also obtained of the formation of dibasic acids, suggesting the photosynthesis of carbohydrates with larger molecular weights than the hexoses.

Agricultural Field Experiments.*

A FOREWORD explains that the pamphlet referred to below is published primarily for the benefit of officers engaged in field experimentation in the Madras Presidency. It is divided into three parts; the first introductory, dealing with the general principles underlying the work and with experimental technique; the second with various methods of grouping plots so as to minimise the disturbing influence of soil heterogeneity; and the third with the statistical concepts which are utilised in the analysis and interpretation of results. There is a short bibliography and a separate booklet of mathematical tables.

The authors rightly stress the necessity for selecting a uniform piece of land for experimental purposes, and for ensuring that the plant shall be uniform also. Recent advances in field experimental technique, although they may reduce the effects of non-uniformity, do not lessen the desirability of choosing the best possible site for an experiment. A debatable point is raised when it is stated (p. 3) that "no experiment can provide accurate data that is not based on a simple enquiry". Care should certainly be taken to ensure that the questions asked are straightforward and that the answers are therefore unambiguous; but much information can be gained from a complex experiment which is sought in vain in a simple experiment. Thus two simple experiments, investigating the effect of varying quantities of nitrogen in one case and of phosphate in the other, will not give information, obtainable if the two experiments had been combined, as to the effect of nitrogen at different levels of phosphate and of phosphate at different levels of nitrogen. Where more than two factors are introduced into a single experiment it becomes possible, of course, to calculate interactions of higher order than the first. In this connexion R. A. Fisher has written: "No aphorism is more frequently repeated in connection with field trials, than that we must ask Nature few questions, or, ideally, one question at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire" ("The Arrangement of Field Experiments": *Jour. of Min. of Agric.*, 1925).

In the second part Beaven's half drill strip method is described, but without pointing out its two serious but remediable defects: that the continued use of one half of the drill for one variety, and of the other half for the variety with which it is to be compared, may introduce a constant difference the magnitude of which cannot be estimated; and that the regular alternation of strips of the two varieties does not permit of a valid estimate of experimental error. In this part the method of randomised blocks receives but scanty attention, and the Latin square method, which is by far the most efficient of all experimental arrangements, is not mentioned.

The third part indicates the procedure for calculating the standard deviation of the mean of a set of observations, and explains "Student's" method. A pamphlet published as recently as 1928 should have included an account of Fisher's "Analysis of Variance", that invaluable weapon of the field experimenter.

* "The Conduct of Field Experiments", by R. O. Iliffe and B. Viswa Nath. Bulletin No. 89 of the Department of Agriculture. (Madras: Government Press, Madras, 1928.) 1 rupee 4 annas.

Cyclones of the South Indian Ocean.

MR. R. A. WATSON, when director of the Royal Alfred Observatory, Mauritius, began a series of annual papers dealing with each cyclone season in that part of the South Indian Ocean lying near and to the east of Mauritius. They are published in the *Miscellaneous Publications* of the Royal Alfred Observatory. The second of the series, entitled "The Cyclone Season 1928–1929", shows that the season in question was a normal one in regard to the number of cyclones (8) that were noted. None of these storms caused damage in Mauritius, but Rodrigues suffered severely in January 1929.

The paper contains, in addition to the particulars of this one season, statistical information about the seasonal distribution and the movements of cyclones between the equator, lat. 30° S. and long. 50° and 70° E., based on 77 years' records beginning in 1848 that are not available elsewhere. This information extends and brings more up to date a part of the statistics that appeared in "Hurricanes and Tropical Revolving Storms", by Mrs. E. V. Newnham (*Geophysical Memoir*, No. 19), issued by the Meteorological Office, London, eight years ago. The manuscript records of the Observatory were used in addition to published information. Speaking of the seasonal variation in the number of cyclones recorded on each date, the author says: "The yearly variation is best represented by a slow rise throughout October and November, then a somewhat rapid rise to a maximum about Feb. 4, and a gradual fall to the end of May".

It may be noted that before the publication of the memoir referred to above, the best authority for the seasonal variation in the frequency of storms in the whole of the South Indian Ocean was Meldrum, who found from a consideration of 35 years' observations, also beginning in 1848, that more storms occurred in January than in February—71 as against 61 which implied an earlier date for the maximum than is now indicated. Mrs. Newnham's figures for the wider area accord well, however, with those found by Watson.

Watson also gives statistics in regard to the frequency with which all cyclones that crossed latitudes 10°, 15°, 20°, 25°, and 30° S. moved in the various directions: north, north-north-east, north-east, and so on. His remarks upon these have an important bearing upon the general question of the motion of tropical cyclones. He says, "The table is strongly suggestive of wind diagrams for various heights above the surface at Mauritius, the low latitudes corresponding to small heights and the higher latitudes to heights of 4 or 5 kilometres. . . . Given that the surface of separation between the easterly trades and the westerly 'anti-trades' slopes upwards from the surface about latitude 30° S. to reach very big heights about latitude 10° S., and that a cyclone is carried along by the prevailing current where condensation is taking place most vigorously, we should expect some such similarity." Before, however, this explanation can be accepted, it appears desirable to have direct evidence that the principal rain clouds show the very large variation in height in different latitudes that is implied. The suggestion opens up an interesting line of possible research.

University and Educational Intelligence.

CAMBRIDGE.—The professor of chemistry has, with the consent of the Vice-Chancellor, appointed S. E. Janson, of Gonville and Caius College, to be his assistant for five years as from July 1 last.

The Busk Studentship in aeronautics, founded in memory of E. T. Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1930–31 to R. H. Francis, of the University College of North Wales, Bangor.

N. F. Mott has been elected to an official corporate fellowship at Gonville and Caius College on his appointment as lecturer in mathematics. Mr. Mott was formerly a scholar of St. John's College, gained a first class in the Mathematical Tripos, Pt. I., and was a wrangler with distinction in Pt. II. in 1926. After working in Copenhagen, he was appointed lecturer in theoretical physics in the University of Manchester.

LONDON.—Notice is given that the Rogers prize for 1931, value £100, is offered for an essay on "Filtrable Viruses as a cause of Disease in Man". The competition is open to all persons whose names appear on the Medical Register of the United Kingdom. Copies of the regulations, including information regarding the date in April by which essays must be received, may be obtained on application to the Academic Registrar, University of London, South Kensington, S.W.7.

A SCHOLARSHIP has been founded at University College, Southampton, by friends of the late Dr. Alex Hill, in recognition of the distinguished services rendered by him to the College. The scholarship is of the value of £50 per annum, tenable for three years at the College, and will be awarded annually. The holder will be required to pay tuition fees. Dr. Alex Hill, who died on Feb. 27, 1929, became principal of University College, Southampton, in 1913, and steered the College through the difficult War and post-War years, until he resigned in 1920 to devote his energies to the rapidly developing work of the Universities Bureau of the British Empire. From 1920 until his death he was a vice-president of the College, so that he was actively connected with it for a continuous period of sixteen years.

THE following scholarships have been awarded by the Institution of Electrical Engineers for 1930:– *Ferranti Scholarship* (annual value £250, tenable for two years): E. Wilkinson (University of Liverpool); *Duddell Scholarship* (annual value £150, tenable for three years): T. R. Stretton (Cardiff Technical College); *David Hughes Scholarship* (value £100, tenable for one year): H. A. Wainwright (University of Sheffield); *Salomons Scholarship* (value £100, tenable for one year): E. Bell (Armstrong College, Newcastle-on-Tyne); *War Thanksgiving Education and Research Fund* (No. 1): grants of £50 each to F. J. Clark (East London College) and Miss W. Hackett (University of Birmingham); *Thorrowgood Scholarship* (annual value £25, tenable for two years): J. F. H. Tyler (Southern Railway Company).

THE Mond Nickel Company, Ltd., Imperial Chemical House, London, S.W.1, has arranged three exhibits showing aspects of the nickel industry, which are available, free of charge, to colleges, technical institutions, schools, etc., in connexion with conversaziones or to illustrate class or open lectures. Exhibit No. 1, illustrating "The Versatility of Nickel", was available last year. Exhibit No. 2 illustrates "The Extraction of Nickel by the Mond Process", and consists of flow sheet, photographs, samples of intermediate and fine products, letterpress, and booklets. Exhibit No. 3 illustrates "The Properties and Applications of Nickel and its Alloys", and consists of samples of products made in many different alloys, photographs, letterpress, and booklets. Lectures illustrated by travelling exhibits or lantern slides are also given by members of the firm's staff.

Historic Natural Events.

Oct. 26, 1916. Whirlwind in Essex.—A tornado travelled in a north-easterly direction across Essex near Writtle, passing through the centre of that village at 1.7 P.M. The track was only about 100 feet in breadth, and very sharply defined. Damage estimated at several thousand pounds was done to buildings in Writtle, but no lives were lost. An aneroid barometer was observed to fall an inch during the storm, and to recover in eight or ten minutes.

Oct. 27, 1913. South Wales Tornado. This disturbance was first observed in Devonshire shortly after 4 P.M., as a small but intensely black cloud from which fell torrential rain and hail of great quantity and size. It was accompanied by thunder and lightning, but the wind was not especially high. Travelling northwards, the storm crossed the Bristol Channel and appeared as a heavy thunderstorm at Aberthaw, but no material damage was recorded until it had penetrated 12 miles inland. From here onwards a great deal of damage was done along a sharply bounded track several hundred feet in width. Its passage lasted less than a minute, after which torrential rain fell. Trees were uprooted and buildings demolished; several pieces of slate were afterwards found buried to a depth of $1\frac{1}{2}$ inches across the grain of trees. After leaving Wales, the storm passed through Shropshire and Cheshire, reaching the latter at 8.30 P.M. The storm was noteworthy as the nearest approach to the true American tornado which has been scientifically investigated in England, its rotary motion being shown by trees lying in every direction, while others had their tops twisted off.

Oct. 28, 1891. Earthquake in Central Japan.—One of Japan's greatest earthquakes desolated the Mino-Owari plain near the centre of the Main Island. Over an area of 4286 square miles, the destruction of property was nearly complete, 197,530 buildings being ruined, while 7279 persons were killed. The earthquake was due to a sudden movement along a great fault, the scarp of which was traced across plain and mountain for 40 miles, and was believed to be nearly 70 miles in length. At the surface, the horizontal shift varied from 3 to 13 feet. The vertical displacement was usually less than 10 feet, but in one place reached nearly 20 feet. The after-shocks of this earthquake were unusually frequent. At Gifu, close to the fault-scarp, 1746 shocks were registered during the first thirty days and 3365 by the end of 1893.

Oct. 28, 1927. Breakdown of Electrical Transmission through Salt Spray.—On Oct. 28–29 a deep barometric depression crossed the British Isles, giving rise to a violent gale from south veering to west. At Southport the wind velocity reached 96 miles per hour in a gust and much damage was done. A remarkable feature of the gale was that in the Midlands electrical transmission along overhead power wires broke down from midday on Oct. 29 to early on Oct. 30. The cause of the trouble was afterwards found to be as follows: During the gale great quantities of spray were carried inland by the wind all along the west coast, and coated the insulators of the power lines in South Wales with a layer of salt water which practically short-circuited them. As the spray was carried inland, the water was evaporated owing to the dryness of the air, and by the time the air reached the Midlands the spray was reduced to salt crystals. These stuck on the insulators of the power lines but were too dry to destroy the insulation completely, until the air became damp again on Oct. 29, and they absorbed water. On Oct. 30 general rain washed the insulators clean again.

Oct. 29, 1867. The Hurricane of San Narciso.—This was one of the worst hurricanes on record in the West Indies. The storm passed across the Virgin Islands travelling towards the west-north-west, the centre reaching St. Thomas at 12.30 P.M., when the hurricane winds gave place to almost complete calm and darkness. More than six hundred persons were drowned at St. Thomas, mainly crews and passengers of vessels. On shore in St. Thomas and Tortola many deaths were caused by the falling of houses, which were almost all destroyed. Some houses were lifted bodily from their foundations and dropped some distance away. At Santa Cruz an American frigate was carried into the market place. This hurricane and the earthquake which accompanied it put an end to the almost completed negotiations for the purchase of the Danish West Indies by the United States. Continuing towards the west-north-west, the centre travelled diagonally across Porto Rico, where its effects were described in a work entitled "La Memorable Noche de San Narciso", by Don Vicente Fontan y Mera. In the various towns of the island 211 persons were killed, 741 injured, and an enormous amount of damage was done to houses and sugar mills. Owing to the torrential rains, there was much flooding.

Oct. 31, 1840. Rhone Floods.—On Oct. 27–30, from the Mediterranean to the Vosges, a general downpour of rain occurred, of unprecedented persistence and intensity. The Upper Rhone ravaged Lyons on Oct. 31; on Nov. 1 the Sâone surpassed all previous levels and all the torrents of the Cevennes were in violent flood. The Rhone had already risen more than 18 feet at Valence and more than 23 feet at Avignon, when a further terrific rainstorm burst over the valley from the evening of Nov. 1 to that of Nov. 3. In seven days, Oct. 27–Nov. 3, 9–10 in. of rain fell in the Rhone basin. The renewed floods fell like an avalanche on the already submerged valley; the Sâone rose 28 feet at Trévoux, inundated the lower parts of Lyons, and destroyed four bridges and several hundred houses. The Rhone at Avignon rose 27 feet above its normal level, and only the rupture of the dykes and consequent spread of the floods over an enormous tract of land prevented it from rising still higher. Near Tarascon the flood was nearly 20 miles across, and many bridges were washed away.

Nov. 1, 1755. Great Lisbon Earthquake.—This was one of the greatest of all recorded earthquakes. Coming without warning, the shock lasted six or more minutes, during which time about 60,000 persons were killed. The city of Lisbon was utterly ruined. Large numbers of persons had collected on a newly built stone pier, which sank suddenly with all upon it beneath the water. The epicentre lay about 100 miles west of Lisbon. The sea waves were of great height, about 50 ft. at Lisbon, 60 ft. at Cadiz, 15 ft. at Funchal, and 6–10 ft. along the southern coasts of England and Ireland. They swept across the Atlantic to the shores of Antigua, Barbados, and Martinique. An almost unique feature of this earthquake was the disturbance of lakes and rivers all over Europe and even in North America. In Loch Lomond (1220 miles from the epicentre), the water oscillated for $1\frac{1}{2}$ hours, at first to a height of 2 ft. 4 in. above the normal level. The Elbe at Hamburg (1400 miles), Lake Wener in Sweden (1750 miles), and the great lakes of Canada (nearly 4000 miles) were agitated.

Nov. 1, 1876. Backergunge Cyclone.—An intense cyclone travelled northward across the Bay of Bengal towards the delta of the Ganges, and a cyclone wave, ten to forty feet deep, struck the low-lying district of Backergunge in Bengal. In half an hour about 100,000 persons were drowned and all the crops were destroyed, and the disaster was followed by a famine and pestilence which cost a further 100,000 lives.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 15.—**Paul Helbronner**: The observation of a polar aurora. Observed Sept. 3, between parallels 65° 10′ and 64° 40′, on the occasion of the meeting of the International Congress of Geodesy and Geophysics at Stockholm.—**V. Romanovsky**: The discrete chains of Markoff.—**J. Rey Pastor**: A method of convergence by means.—**L. Bert** and **M. Raynaud**: A synthesis of propenyl benzene. The reaction between ω-chlorallyl benzene and sodium gave unexpected results, propenyl benzene, $C_6H_5.CH:CH.CH_3$, being the main product. The yield is sufficient to make this a good method of preparation of this hydrocarbon.—**Jean Piveteau**: The structural peculiarities of a new type of fossil fish from the Permo-Triassic formations of the north of Madagascar. This fossil has been previously described by Priem, and considered by him as belonging to the genus *Pristisomus*; the author does not agree with this view, and suggests the name of *Australosomus* as the name of a new genus.—**J. Vellard** and **Jarbas Penteado**: The action of ultra-violet rays on venoms. Experiments were made on venoms from *Lachesis atrox*, *L. jararaca*, *Crotalus terrificus*, *Naja tripudians*, and *Bufo marinus*. An account of the changes in physical and chemical properties is given. The physiological action was found to be considerably reduced by exposure to ultra-violet light. With large doses of venoms irradiated for 45 minutes, the authors have been able to protect guinea-pigs and goats against the action of a subsequent injection of fatal doses of fresh venom.

CAPE TOWN.

Royal Society of South Africa, Aug. 20.—**T. Stewart**: Steenbras rainfall. The yield of the catchment area for the wet months might be put at 6000 million gallons. This is the capacity of the reservoir which has recently been constructed. In 1922 observations for a period of seven years were available. These showed that the average amount of rainfall in the main valley for the period was 40·7 inches. The observations taken since, that is, over a period of fourteen years, give 39·3 inches for the main valley. This does not apply to the whole catchment.—**K. H. Barnard**: The Cape alder-flies (Megaloptera). Third report on the fauna of the mountains of the Cape Province. Five species are admitted, comprised in four genera. The egg, larva, and pupa of one species, and the larva and pupa of another, have been discovered.—**H. Zwarenstein**: A note on Bridge's genic balance theory of sex determination. The following modification is suggested: the female determining genes are located not only on chromosome X but also on chromosome IV. The male determining genes are in chromosomes II and III. Assigning arbitrary values to the efficiency of these two interacting components, a series of sex indices is derived.—**L. T. Hogben**: Spinal transection and the chromatic functions in *Xenopus Laevis*. Section of the optic nerves has the same effect as removal of the eyes. Section of the entire peripheral nerve supply of the leg has no effect on colour response. Both the black and white background response can be elicited in toads after section of the cord in front of the first pair of spinal nerves or at any lower level.—**Enid Hogben**: The total oxygen consumption of hypophysectomised toads. The ratio of dermal (Winkler method) to pulmonary (Haldane method) respiration has been determined, and the variation of total respiratory rate with temperature, body weight, and sex has been determined. Removal of the pituitary gland is accompanied by a profound diminution in the oxygen consumption.—**J. Hewitt**: Discoveries in a bushman cave at Tafelberg Hall.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 3, 1930).—**V. Ambarzumian** and **D. Ivanenko**: A note on the problem of the unified theory of the electromagnetic and the gravitational field from the point of view of the quantum mechanics.—**A. Mordvilko**: *Pemphigus bursarius* Tullgren (*pyriformis* Licht.) and its anolocyclic forms. The alate forms of *P. bursarius* migrate from the galls on poplars to roots of grasses, where they give rise to exules which have been described under different names. Galls of *P. bursarius* do not occur on poplars (*P. suaveolens* and *P. maximowiczii*) in eastern Siberia, though the root-forms are present; it is possible that *P. nigra* existed there in the preglacial times.—**D. Smirnov**: Systematics of *Diaptomus fischeri* Rylov and *Diaptomus acutulus* Brian. The two species are extremely close, but differ by a number of characters, which are enumerated and analysed.—**J. Medvedev**: The relation of a diastase to the substratum in a system of carboxylase and pyruvic acid.

Comptes rendus, No. 4, 1930.—**V. Ipatjev** and **A. Frost**: Chemical equilibrium between phosphine, phosphorus, and hydrogen.—**J. Kourbatov, N. Karzhavina,** and **N. Samoilo**: Description of a method for the preparation of a solution serving for the determination of ionium in the dispersed masses of Tuia-Mouiun.—**S. Smirnov**: (1) A new species of *Phyllopoda anostraca* from the Ussuri region. Description of *Pristicephalus longicornis* sp. n.—(2) A new species of the genus *Diaptomus* Westw. from the Amur region. A description of *D. ryloci* sp. n., closely allied to some North American species of the genus.—**V. Gromova**: Preliminary communication on the *Bos primigenius* Boj. in Russia. A series of thirteen skulls of *B. primigenius* was studied and great individual variability established; this throws some doubt on the validity of a number of species described by other authors, and only two of these may be retained, namely, *Bos trochoceros* Meyer of the glacial period and the postglacial *B. primigenius* Boj.—**G. Alderberg**: Preliminary synopsis of Russian and Mongolian wild boars. Only one species of *Sus* is recognised, with five subspecies, namely, *S. scrofa scrofa* L. (Germany), *S. s. attila* Thomas (Transylvania, Russia, Caucasus), *S. s. nigripes* Blanford (Turkestan, Tian-Shan), *S. s. raddeanus* sbsp. n. (N. Mongolia), and *S. s. continentalis* Nehring (Amur and Ussuri basins).

SYDNEY.

Royal Society of New South Wales, Aug. 6.—**A. R. Penfold, C. B. Radcliffe,** and **F. W. Short**: The essential oil of *Eucalyptus rariflora* (Bailey). The air-dried leaves yielded 2·5 per cent of oil, the principal constituents of which have so far been identified are the terpenes Δ-4 carene, *B.* phellandrene, *l*-a-pinene, *B.* pinene, cymene with cineol (about 10 per cent), sesquiterpenes (principally aromadendrene), sesquiterpene alcohols, with small quantities of the aromatic aldehydes (cuminal, phellandral, and cryptal), alkali soluble bodies (unidentified phenols) and dehydroangustione (*B.* diketone).

VIENNA.

Academy of Sciences, June 26.—**E. Beutel** and **A. Kutzelnigg**: The catalytic action of light on the disintegration of certain salts.—**W. J. Müller**: The theory

f passivity phenomena (12). The passage of a curent through anodes which are covered with an insolble surface layer. A formula is suggested based on ssumptions as to the division of the current between he surface-layer and its pores.—**J. Zellner** and **E. Zikmunda**: The chemistry of halophytes.—**J. Zellner** and **E. Zikmunda**: The chemistry of higher fungi (21). *Polyorus sulfureus* and *Lentinus squamosus*.—**N. Froschl, . Zellner** and **E. Zikmunda**: The comparative chemstry of plants, chemistry of barks (7). *Morus nigra* and *Alnus incana*.—**E. Gebauer-Fülnegg** and **H. Jarsch**: Condensation products from aryl-dithio-glycolic acids. —**E. Riess**: Organic sulphur-nitrogen linkage.—**H. Huber** and **K. Brunner**: The action of ferric chloride on the acyl esters of phenol.—**F. Perktold**: Para-azobenzol-sulphonic acid and paramononitro-para-azobenzol-sulphonic acid. **F. Raaz**: The space-unit of gehlenite. Pure synthetic material was prepared in he Kaiser Wilhelm Institute for silicate research at Berlin-Dahlem and submitted to X-ray analysis in Leipzig. The elementary unit is a tetragonal prism with two molecules of the compound $Ca_2Al_2SiO_7$.—**. Kisser** and **A. Sesser**: Biological researches on dwarf trees (1). The structural relations of the high moor forms of *Picea excelsa*. Trees fifty years old were only 60 cm. high and 2 cm. in diameter. The leaves show a diminution in the number of cells rather than in the size of cells.—**W. Laves**: Histological researches with buffered stain solutions on the post-mortem breakdown of the nuclear chromatin and of the plasma of liver cells.—**O. Taussky**: The metrics of groups. **E. Bersa**: Culture and nutrient physiology of the genus *Pilobolus*. The favourable and unfavourable nitrogen and carbon sources were determined. **A. Himmelbauer**: The crystalline form of cadmium antimonide. Form rhombic, formula CdSb. **H. Gerhart**: Alterations of crystalline form in double sulphates. Crystals were obtained from solutions containing additions deliberately introduced. Magnesium, cadmium, and manganese double salts cause deformations of copper, nickel and zinc double salts.—**L. Goebel**: Radioactive disintegration phenomena in the fluorite of Wölsendorf. Haloes are formed and these have been examined with he ultramicroscope. An explanation of the colours of fluor spar is offered in terms of the size of colloid particles of calcium.—**R. Steinmaurer**: Observations on the variations of the Hessian cosmic ultra-radiation on the Hohen Sonnblick (3100 metres) in July 1929. Registering apparatus was used, both in half-open and in a completely enclosed 7 cm. thick iron-clad electroscope. The measurements were arranged according to sidereal time. There was also a small barometric effect, and other unexplained irregularities.—**T. Pintner**: Little known and unknown tapeworms.—**A. Zinke** and **R. Wenger**: Perylene and its derivatives (29). The decomposition of perylene to benzanthron. —**A. Zinke** and **O. Benndorf**: Perylene (30).—**A. Pongratz**: Perylene (31).—**F. Halla** and **E. Mehl**: The space-lattice of natrolite. The unit contains eight molecules of $Na_2Al_2Si_3O_{10}$, $2H_2O$.—**A. Brukl**: The hetero-poly acids of germanium. Molybdenum and tungsten unite with germanium to form acids.—**K. Vanek**: Division properties of curves connected in detail.—Communications of the Radium Research Institute.—(No. 258) **B. Karlik**: The scintillation faculty of calcium tungstate.—(No. 259) **M. Blau**: Quantitative research on the photographic action of α- and H-particles.—(No. 260) **F. Urbach**: The breadth of bands and the dependence of emission bands on temperature in alkalihalide phosphorescence.—(No. 261) **F. Urbach**: The luminescence of alkali halides. Preace and visual observations (1).—(No. 262) **F. Urbach**: Luminescence of alkali halides (2).—**R. Holzapfel**: Chief results of radiation measurements on the Stolzalp in the period November, 1928 to October, 1929.—**O. Beran**: Conductivities and counter voltages in ion-conducting crystals.—**M. Beier**: Zoological expedition to the Ionian Islands and the Peloponnesus (13). *Hymenoptera parasitica* by C. Ferrière.—**L. Waagen**: The geological structure of the highlands between Frohnleiten, Übelbach and Deutsch-Feistritz in Styria.

Official Publications Received.

BRITISH.

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1930–1931. Pp. 96. (Edinburgh.)

Annual Report for the Year 1929 of the South African Institute for Medical Research, Johannesburg. Pp. 84+2 plates. (Johannesburg.)

Observations made at the Royal Observatory, Greenwich, in the Year 1928 in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii+A106+B1+C111+D62+E16+17. (London: H.M. Stationery Office.) 37s. 6d. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 43: The Raised Beaches of the East Coast of Ireland. By C. P. Martin. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Eleventh Annual Report of the Ministry of Health 1929–1930. (Cmd. 3667.) Pp. xiv+277. (London: H.M. Stationery Office.) 4s. 6d. net.

Interdepartmental Committee on Crabs and Lobsters. Report on Crabs: Being an Interim Report of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland to enquire into the Crab and Lobster Fisheries. Pp. 94. (London: H.M. Stationery Office.) 1s. 6d. net.

Aeronautical Research Committee. Report for the Year 1929–30. Pp. 82+5 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+108. (London: H.M. Stationery Office.) 2s. net.

Tanganyika Territory: Department of Tsetse Research. Co-ordination Report No. 3, 1st September 1929 to 30th September 1930. Pp. 15. (Dar es Salaam: Government Printer.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 17, No. 1, September. Pp. 275. (Plymouth.) 12s. 6d. net.

The Year's Photography, 1930–1931. Pp. 20+lii+88 plates. (London: Royal Photographic Society.) 2s. 6d. net.

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Paper 1, Extract from Bulletin No. 17: Some Periods in Australian Weather. By Dr. Edward Kitson. Pp. 33. (Melbourne: H. J. Green.)

First Annual Report of the Executive Council of the Imperial Agricultural Bureaux. Pp. 15. (London.)

Report for 1929 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool. Edited by Prof. James Johnstone and Dr. R. J. Daniel. (No. 38.) Pp. 109. (Liverpool.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, September. Pp. 567–662+xlii. (London.)

FOREIGN.

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 5, No. 6: Sveriges Vattenkrafttillgången, Sammanställning av resultaten i "Förteckning över Sveriges Vattenfall" för Norrlands älvar och Dalälven, jämte preliminär beräkning av Vattenkraften i hela landet. Av Ragnar Melin. Pp. 27+12 planscher. (Stockholm.) 5.00 kr.

Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1929. Rédigées par Bruno Rolf. Pp. iv+72. (Stockholm.)

Statens Meteorologisk-Hydrografiska Anstalt. Nr. 279: Climate of Sweden. By Axel Wallén. Pp. 65. (Stockholm.) 2.00 kr.

Estados Unidos Mexicanos: Secretaria de Agricultura y Fomento. Estudios de la Oficina Federal para la Defensa Agricola, Num. 3: El Arsenico, y sus derivados, como insecticidas. Por Pablo Hope y Hope y Manuel de la Lama. Pp. 63. (Tacubaya, D.F.: Secretaria de Agricultura y Fomento.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 265: A Method for the Extension of Balmer Series in Laboratory. By Toshio Takamine and Taro Suga. Pp. 117-122+plate 21. (Tōkyō: Iwanami Shoten.) 15 sen.

Science Reports of the Tokyo Bunrika Daigaku. Section A. No. 1: On the Vapour Pressure of Liquid. Part 1: On the Vapour Pressure, Heat of Vaporization and Chemical Constant of Pure Liquid Substance. By Keiichi Watanabe. Pp. 13. (Tokyo: Maruzen Co., Ltd.) 25 sen.

The Science Reports of the Tohoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 13, No. 3. Pp. 35-114+plates 11-40. (Tokyo and Sendai: Maruzen Co., Ltd.)

State of Arkansas: Arkansas Geological Survey. Bulletin 3: Geology of the Arkansas Paleozoic Area, with Especial Reference to Oil and Gas Possibilities. By Carey Croneis. Pp. xx+457+45 plates. (Little Rock, Ark.)

Technical Books of 1929: a Selection. Compiled by Donald Hendry. Twenty-second Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 92: On a Severe Infection of Dogs in Cairo simulating Rabies. Preliminary Note by Prof. Dr. Matteo Carpano. Translated from the Italian by E. Talarewitch. Pp. 10+2 plates. 5 P.T. Bulletin No. 96: Ratoon Cotton in relation to Insect Pests. By Ibrahim Bishara. Pp. ii+68+24 plates. 5 P.T. (Cairo: Government Press.)

CATALOGUE.

Collections and Apparatus required for the Study of Geology. Pp. 24. (London: Thomas Murby and Co.)

Diary of Societies.

FRIDAY, OCTOBER 24.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—M. A. H. Tincker: Growth Studies on Oats.—M. Jones: The Yielding Capacity of Oat Varieties under Different Conditions of Soils and Climate.—Dr. P. S. Hudson: The Differentiation of the Wheat Ear.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—J. McGovern: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Institute of Chemistry) (at Liverpool University), at 6.—Dr. P. Lewis-Dale: Chemistry in the Service of the Railway.

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill), at 6.45.—Dr. E. F. Armstrong: The Future of the Dyestuff Industry: have we Fought in Vain?

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at Manchester Literary and Philosophical Society, Manchester), at 7.—H. K. Bamber: The Effect of Road upon Rail Transport and its Influence on Locomotive Design (Presidential Address).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—J. L. Hodgson and others: Discussion on What are the Desirable Objectives of the Age of Power?

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—J. Frith and F. Buckingham: Stored Energy.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. P. Morris: Bitumen Emulsions, with Particular Reference to their Use on Indian Roads.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. Lomas: Pure Silk Manufacture.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. Major Greenwood: Public Health Education (Presidential Address).

INSTITUTION OF CHEMICAL ENGINEERS (Graduates' and Students' Section).—J. E. Duckham: Lubrication as applied to Chemical Engineering.

SATURDAY, OCTOBER 25.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—A. L. Ford: Machine Mining in Faulted Ground.—Dr. W. Hopkins: A Record of the Upper Carboniferous Non-Marine Lamellibranchs of Northumberland and Durham, and a Record of their Sequence. Papers open for further discussion:—The Pitman's Yearly Bond, by Prof. H. Louis; The Surveying of Bore-holes, by J. T. Whetton.

BRITISH PSYCHOLOGICAL SOCIETY (at Bedford College for Women), at 3.30.—Miss Madeline Kerr: Unseen Drama and Imagery, Experimental Observations.—Prof. T. H. Pear: Psychological Problems suggested by Radio-Drama.

MONDAY, OCTOBER 27.

CAMBRIDGE PHILOSOPHICAL SOCIETY (Annual General Meeting) (in Cavendish Laboratory), at 4.30.—H. C. Webster: The Capture of Electrons by α-particles.—Dr. N. A. de Bruyne and H. C. Webster: Note on the Use of the Thyratron with a Geiger Counter.—N. Feather: An Unsuccessful Attempt to Influence the Normal Decay of a Weak Source of Polonium.—Dr. F. L. Arnot: Note on the Angular Scattering of Electrons in Gases.—H. S. W. Massey: The Theory of the Scattering of X-rays by Molecular Hydrogen.—*Papers to be communicated by title only*:—Dr. G. Temple: The Matrix Mechanics of the Spinning Electron.—S. Verblunsky: (*a*) A Property of Continuous Arcs II; (*b*) Note on the Sum of an Oscillating Series II.—W. G. Welchman: The Number of Contact Primes of the Canonical Curve of Genus *p*.—R. Hargreaves: Wave Forms and a Special Problem.—Prof. L. J. Mordell: Note on Some Linear Diophantine Inequalities.—R. E. A. C. Paley and A. Zygmund: On some Series of Functions (2).—R. E. A. C. Paley: On the Strong Summability of Fourier Series.—H. R. Hasse: The Polarisability of the Helium Atom and the Lithium Ion.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Annual Meeting.

INSTITUTE OF ACTUARIES, at 5.—H. M. Trouncer: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—C. C. Paterson and others: Discussion on The Link between Sales, Manufacture, and Research.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Fuel Section) (at Hotel Metropole, Leeds), at 7.—Dr. W. H. Blackburn and Prof. J. W. Cobb: The Influence of Furnace Atmosphere upon the Scaling of Steel.—Dr. A. Key and Prof. J. W. Cobb: The Determination of the Reactivity of a Coke to Steam and CO_2.

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—C. Schelling: The Odontological Society in the Last Decade of the 19th Century.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.15.—Dr. W. J. Pinard: Perseveration as a Means of Testing Leadership.

TUESDAY, OCTOBER 28.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. J. A. Ryle, Prof. H. Moore, Dr. Helen Mackay, and others: Discussion on Research in Clinical Medicine.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas's Café, Swansea), at 6.15.—Dr. W. Rosenhain: Impurities in Copper.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Technical College, Derby), at 6.30.—H. H. Dyer: Some Applications of Electricity to Railway Signalling.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—H. G. Fraser: Chairman's Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Sir William Bragg: X-rays and the New Range of Vision (Hurter and Driffield Memorial Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.30.—A. L. Lunn: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—E. Seddon: Chairman's Address.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—Dr. W. H. Hatfield: Nitride Hardening.

WEDNESDAY, OCTOBER 29.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—M. Waters: Chairman's Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch, Graduate Section) (at Middlesbrough), at 7.30.—T. P. Richards: Chairman's Address.

THURSDAY, OCTOBER 30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Middlesbrough), at 7.30.—Addresses by J. McGovern and J. R. Dippie.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—F. H. Whysall: Chairman's Address.

CHEMICAL SOCIETY, at 8.—N. I. Fisher and F. M. Hamer: A General Method for the Preparation of Thiocyanine Dyes. Some Simple Thiocarbocyanines.—Dr. W. H. Mills and I. G. Nixon: Stereochemical Influences on Aromatic Substitution. Substitution Derivatives of 5-hydroxyhydrindene.—Prof. C. S. Gibson and J. D. A. Johnson: Syntheses with ββ'-dichlorodiethylether. Part II. Heterocyclic Compounds containing Two Different Atoms of the Oxygen Group in the Ring. 1:4-selenoxan.

FRIDAY, OCTOBER 31.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Corporation Electricity Showrooms, Swansea), at 6.—Sir A. Whitten Brown: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) at 6.15.—H. T. Young: Is the Engineer of To-day making the Best Use of his Opportunities in Electrical Development in this Country?

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Prof. W. A. Bone: High-Pressure Reactions (Lecture).

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—L. T. Westbury: The Two-stroke Engine.

GEOLOGISTS' ASSOCIATION (in Great Hall, University College), at 7.30.—Annual Conversazione.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science).—Prof. J. F. Thorpe: The Life and Work of W. H. Perkin, Jun.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Glasgow).—Dr. S. Miall and others: Discussion on the Journal of the Society.

MEDICAL SOCIETY OF LONDON.—Sir Almroth Wright and others: Discussion on The Prophylactic and Therapeutic Values of Vaccines.

PUBLIC LECTURES.

FRIDAY, OCTOBER 24.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. Penck: The Relations of Europe and Central Asia. (Succeeding Lecture on Oct. 27.)

SATURDAY, OCTOBER 25.

UNIVERSITY OF BRISTOL (in Henry Herbert Wills Physical Laboratory), at 11.15 A.M.—Prof. J. Franck: Relations between Spectroscopy and Chemistry (Henry Herbert Wills Memorial Lecture).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Stories told by Hairs and Fibres.

MONDAY, OCTOBER 27.

UNIVERSITY OF EDINBURGH (in Greek Class Room, Old Quadrangle, University, Edinburgh), at 8.—Capt. C. W. Hume: The Universities and Animal Welfare.

TUESDAY, OCTOBER 28.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Means of Communication and Transport.

WEDNESDAY, OCTOBER 29.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Lt.-Col. J. A. A. Pickard: The Prevention of Street Accidents.

UNIVERSITY OF LIVERPOOL (in Arts Theatre), at 8.—Prof. S. Brodetsky: Ancient Jewish Astronomy.

THURSDAY, OCTOBER 30.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—C. P. Blacker: Sterilisation of the Unfit.

UNIVERSITY OF DUBLIN, at 5.—Dr. F. S. Lavery: Trachoma, with Special Reference to its Sociological Aspect (Montgomery Lecture).

BRITISH MEDICAL ASSOCIATION (Hastings Hall, Tavistock Square), at 5.15.—Dr. G. Slot: Rheumatism in Childhood (Chadwick Lecture).

UNIVERSITY COLLEGE, LONDON, at 5.30.—Miss E. Jeffries Davis: Re-plannings of London, c. 1520–1920. (Succeeding Lectures on Nov. 6, 13, 20, and 27.)

SATURDAY, NOVEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Stuart Age.

CONGRESS.

NOVEMBER 1 AND 2.

INSTITUTE OF SOCIOLOGY (at Imperial Institute).—Lectures and Discussions on Sociological and Survey Topics.

SATURDAY, NOVEMBER 1, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Science and Broadcasting.

IT has been rather bitterly remarked that the most attractive feature of a wireless set is that there is no necessity to have one. Many people, indeed, hold that the violation of domestic privacy by the telephone, and more particularly by the wireless set, is a thing to be deplored; and this attitude is by no means confined to those unappreciative of the benefits science has lavished upon us. Dislike of broadcasting is frequently based upon the feeling that the public is far too prone to take its opinions and its entertainment ready-made—something to be bought and paid for as one would buy a box of cigarettes. There is good cause for this feeling. The popular Press, for example, is in many ways admirable; but it would be idle to deny that the enormous circulations of modern newspapers inevitably tend forcibly to mould and stereotype public opinion, while the very fact that they cater for the masses necessitates (or apparently necessitates) a comparatively low level of intellectual outlook. The mental indolence of much of the nation is accompanied by an emotional or æsthetic indolence in choice of amusement. Instead of amusing or entertaining themselves, many people prefer to pay to be amused, and generally select that form of amusement which involves the least effort on their own part. "I like to go to the cinema once a week," said Miss Pinnegar in "The Lost Girl". "It's instruction, you take it all in at a glance, all you need to know, and it lasts you for a week. You can get to know everything about people's actual lives from the cinema." Although cinema-goers are now much too sophisticated to imagine that the film bears any sort of relation to "people's actual lives", it yet remains true that "you take it all in at a glance", and if your amusement is solely of this soporific character, taste for intellectual pleasure cannot fail to atrophy.

Those who condemn broadcasting on such grounds as have been thus briefly indicated can surely have listened-in but seldom. Whatever may be said of certain foreign stations, the British Broadcasting Corporation has consistently and steadfastly striven at a much higher aim, and on the whole with a success that must have been as gratifying to its directors as beneficial to the nation at large. It cannot have been an easy matter to plan and to realise policies and programmes that have met with such widespread and well-merited approval, not merely from the general public but also from those best qualified to

pass a critical and considered judgment on moral, æsthetic, and cultural grounds. One of the chief difficulties lies in the varied types of listeners, many of whom are only too ready to find fault with any programme that does not coincide with their personal preferences. In a foreword to the list* of broadcast talks for September to December 1930, the Hon. Harold Nicolson describes, with his usual felicitous wit, the ideal qualities of a reasonable listener: he should be unselfish, modest, patient, and able to exercise judicious selection. "He may be a busy City magnate," says Mr. Nicolson, "and, as such, feel that his attitude towards 'Ways of Cooking Fish' is, to say the least, impersonal. But there are countless other people whose days are darkened by this problem, and for whom the voice of an instructor on the subject is the voice of a true friend." As to patience, Mr. Nicolson himself seems to have little of this virtue to exercise on the 'twiddler'—the man whose chief delight is to tune in one station after another simply for the satisfaction of having got them. While we can sympathise with Mr. Nicolson's irritation at "that impatient type of egoist", we confess to a weakness for wandering off to Langenberg, Milan, or preferably Toulouse (for the ever-flowing and inconceivably soothing voice of its announcer!) when the B.B.C. is prattling of League football results or 'Autumn ailments of the Wyandotte'.

Small grumbles often conceal a great satisfaction, and men of science must feel especially satisfied with the quality and quantity of scientific matter included in this autumn's programme. Sir James Jeans is giving six lectures on "The Stars in their Courses"; Lord Moynihan, Sir Humphry Rolleston, and others of equal eminence, are talking on the future of medicine; Dr. D. Jordan Lloyd is speaking on the possibilities of synthetic food-stuffs; and Mr. B. H. C. Matthews is dealing with the electricity in our bodies. These names and subjects by no means exhaust the scientific section of the programme, but they serve to indicate that the B.B.C. committee casts its net widely and well, and that the adult portion of our population may still, if it will, be initiated into some of the habits of scientific thought and become familiar with important aspects of scientific progress and discovery.

A study of the programme shows that the ground covered—and covered by authoritative exponents—is really very extensive, and we feel that all who are in a position to do so should make an effort to ensure that the listening public derives as much benefit as possible from the fare thus generously and intelligently spread before it. It would, for example, be attractive to arrange group discussions of such talks as those on Tuesdays at 7.25 ("A Study in Population" and "The Future of the Race") and 8 o'clock ("The Mind of a Child" and "The Stars in their Courses"); adult education societies, debating clubs, and young men and women's societies ought to welcome opportunities of this kind, particularly if someone trained in science, medicine, or psychology would take the chair and direct the discussion. Free interchange of thought and opinion upon subjects of immediate interest will always be welcomed by large numbers of people who, in the absence of such stimulus, would spend their evenings in less profitable and probably more lethargic ways. Those of us who have given semi-popular lectures on scientific topics to audiences in small provincial towns or villages will agree that the desire for knowledge, in the middle classes and better sort of working classes in particular, is refreshingly vigorous; one may, indeed, go so far as to call it pathetically vigorous, for at present it is far from likely to be adequately fulfilled. The B.B.C lectures, properly utilised, might do much to foster this love of knowledge and to train it upon the best lines. To bring about a widespread understanding of the nature of science, in a world that owes its continued existence to science but is nevertheless dangerously ignorant of that fact, would be an achievement full of the happiest prospects for the future of civilisation.

The possibilities of broadcast talks in connexion with school work ought also to receive more consideration than appears to be the case at present, though several educational associations have subcommittees to watch the matter. There are admittedly difficulties of time-table, and the school curriculum is already overcrowded, but it would surely be of great value to boys and girls if they could listen to such lectures as those on "Keeping Fit in Everyday Life". The cost of reliable receiving sets is now so small that expense can scarcely be regarded as a serious obstacle to the general use of wireless in schools; yet we think we are right in saying that a school which will cheerfully pay several guineas to a lecturer may often be found innocent of a loud speaker. The B.B.C. has shown itself so ready to comply with reasonable requests, and so enthusiastic for the cultural advancement of the nation, that we

* Broadcast Talks, September to December 1930. (London: British Broadcasting Corporation, Savoy Hill, W.C.2.) Gratis.

can be sure it would immediately respond to any approaches made to it by those responsible for the education of children. There would certainly be an immense stimulus to school science if, say once a week, one could tune in to a lecture on some scientific subject by an expert.

The present occasion is perhaps one on which a point of more general interest may be raised. Men of science, in spite of a popular but quite fallacious belief in the contrary, are keenly concerned over speech, language, and pronunciation, and view with alarm the growth of what one can only describe as a 'broadcast accent'. Uniformity of pronunciation over the whole country may or may not be desirable, and there may be technical difficulties in transmission; but we would respectfully inquire of the B.B.C. whether the familiar phrase 'forecast of to-day's weather' must necessarily be rendered 'fahcast of ta-dess wetha', and why the final *r* in 'tar' has been removed from its rightful place to form an unlovely appendage to 'law'. E. J. HOLMYARD.

Schiaparelli's Studies of Mars.

Le opere di G. V. Schiaparelli. Pubblicate per cura della Reale Specola di Brera. Tomo 1. Pp. x+515+19 tavole. 220 lire. Tomo 2. Pp. iv+486+30 tavole. 220 lire. (Milano: Ulrico Hoepli, 1930.)

WITH the appearance of these two stately volumes, we are witnessing the erection of yet another of those literary monuments which are raised from time to time by foreign countries to the memory of their great men of science. Tycho Brahe, Galileo, and Huygens have thus been commemorated during the last few years, while Kepler under discussion for a similar honour, and now Italy is once more adding to her laurels by undertaking the publication, in a superb edition, of the complete works of Giovanni Virginio Schiaparelli.

For some time past, a need had been felt for a eprint of certain of the works of Schiaparelli, more especially of those which by reason of their scarcity vere practically unobtainable by the student, so that when this matter was brought forward by Prof. rancesco Porro on the occasion of the fourteenth ongress of the Italian Society for the Advancement Science, held at Pavia in May 1925, it was unanimously decided to undertake the publication of he complete works of Italy's greatest astronomer in an edition which should have national importance nd should be modelled on the following lines:

(1) All Schiaparelli's works to be included.

(2) Writings dealing with one particular subject to be printed in immediate chronological sequence. Thus, the two first volumes now before us contain all that Schiaparelli has written about the planet Mars, while future ones will deal with his important work on the connexion between comets and meteors, his researches in ancient astronomy, and the many other scientific questions that engaged his attention.

(3) The new edition to be based on the author's own corrections and emendations, as existing in the copies of his works preserved at the Brera Observatory.

Schiaparelli's actual correspondence with scientific men, however, which was most voluminous and is now scattered throughout the pages of the world's scientific journals, will not be included in the proposed volumes, but may possibly follow later as a separate publication. That this is a wise decision on the part of the committee working on this new edition will be readily conceded when it is recalled that Schiaparelli's scientific labours are to be found in some 256 separate publications ranging over the whole domain of astronomy, both ancient and modern, not to speak of numerous papers trenching on the realms of literature and art, for he was a profound classical scholar whose versatility was without apparent limit.

Although our author's remarkable discovery so early as 1866 of the connexion between the orbits of comets and meteors—a discovery for which he was awarded the gold medal of the Royal Astronomical Society—as well as his noteworthy researches many years later on the rotation periods of Mercury and Venus, were fully equal to any of his other achievements in astronomy, introducing, as they did, wholly new and unexpected elements into our views concerning the heavenly bodies, it is unquestionably with his work on Mars that the world in general will always associate his name. Beginning his observations of the planet during the opposition of 1877, and continuing them until the opposition of 1897, Schiaparelli gave to the astronomical world the most complete description of the physical appearance of Mars that had ever been published, and it is these early studies in areography which have been chosen to form the contents of the two volumes recently issued.

Considering the great name Schiaparelli afterwards made for himself as an authority on Martian phenomena, it is interesting to read in the introduction to his first memoir on the planet's axis of rotation and topography (vol. 1, p. 11), presented to the Royal Academy of the Lincei in May 1878, that, in directing his attention to Mars during

the favourable opposition of 1877, it was by no means his intention to institute a course of regular observations of its surface, but rather to test the Merz 8½-inch refractor of the Brera Observatory, which had already proved itself so efficient in double star work, as to its suitability for planetary detail. The first results, he confesses, were anything but encouraging, for he had the misfortune to commence his observations during a difficult aspect of the planet, and it was some little time before he was able to recognise certain of the features which had been charted by Kaiser and Lockyer during the opposition of 1862. His ultimate success with these, however, as well as the general excellence of the images obtained, convinced him that, though of modest aperture, the Merz telescope was fully capable of doing good work on the planet, and, encouraged by fine weather, he decided to continue his observations, with the remarkable result which these volumes are now published to commemorate.

From the outset Schiaparelli had attacked the problem before him in a severely methodical manner, and, as this first memoir shows, the exhaustive discussion of the large number of micrometric measurements obtained enabled him to give an accurate determination of the Martian axis of rotation. This important result, coupled with the careful delineation—made on strictly geometrical principles—of the planet's physical features, formed the basis of the highly particularised maps which accompany his work, and of which he could truthfully claim (vol. 1, p. 12) that, in point of detail, they far excelled anything dealing with Martian phenomena published up to that time.

It was precisely the wealth of detail recorded, however, that moved Schiaparelli to the adoption of a brand-new nomenclature. At first he was inclined to use the topographical terminology invented by Proctor, though he soon abandoned the idea in favour of the names, now become doubly classic, taken from the geography of the ancients. Thorough classicist that he was, he tells us (vol. 1, p. 61) that as he stood working at the telescope he was reminded by the peculiar demarcation of the Martian topography of the celebrated 'diaphragm' of the Greek geographer and historian, Dicaearchus, whose Βίος τῆς Ἑλλάδος was familiar to him. The euphonious geographical terms used by the Greeks, he says, appeared at once to afford the best means of avoiding all danger of confusion with earlier Martian nomenclatures while offering an opportunity of describing fittingly the totally novel features he had observed on the planet. He modestly adds, however, that he has no desire to be taken too seriously in the matter and is willing to leave to posterity the choice of a more appropriate terminology.

The passages in these two volumes to which the reader will turn with pardonable curiosity will doubtless be those where Schiaparelli first introduces his famous canals and then describes their gemination. In the first volume he states his reasons for calling the streaks he saw *canali* (vol. 1 p. 167 *et seq.*), a word which properly signifies *channels*, but has been translated into both English and French as *canals*, thus connoting a certain degree of artificiality. He mentions the furrows and 'rills' familiar to lunar observers and then speaks of the channels of the Martian landscape, maintaining that as there are "solchi della Luna", so also may there be "canali di Marte". As regards the *gemination* of the latter, perhaps the most graphic general account of this much-debated phenomenon will be found in the long Germ n article originally contributed to *Himmel und Er* n 1889, and now reprinted as an introduction t the second volume (vol. 2, pp. 3-46). Our author repeats at somewhat greater length the vivi scription concerning the duplication of the which he had presented to the Royal Aca of the Lincei during the opposition of 1881–82, when, in anticipation of the general scept which he knew his statements must call he had hastened to add the declaration (v p. 386) that the observed duplicity could in no w be due to eye-strain, or any form of strabism causing diplopia monophthalmica, considering tha every precaution against ocular fatigue on his part had been duly observed.

Schiaparelli had already given such frequent proof of his careful, accurate, and conscientious work as an observer that these totally unexpected results of his were received with astonishment and incredulity. Though held to be based in some unexplained way upon actual changes, seasonal or other, taking place on the planet's surface, th appearances themselves were thought to belon to psychological optics rather than to astronomy, and a vague analogy was sought in the well known difficulties experienced by the microscopist when working with high powers on the resolution of diatomaceous frustules. Schiaparelli himself had carefully refrained from offering any sort of explanation of the singular phenomena observed. To do so, he said (vol. 1, p. 506), would be rash beyond compare—" sarebbe una temerità senza pari ! "

Whatever verdict posterity may find with regard to the interpretation placed upon these results,

there can be no doubt whatever as to the lasting value of Schiaparelli's work. In many ways he was the ideal observer, who studies not only the object observed, but also the exact circumstances, physiological as well as physical, attending the observation. He described his instruments with obvious pride, and, while not a little envious of the larger apertures possessed by other nations, he was well content to do his utmost with a smaller but first-class telescope aided by the limpid skies of Italy and his own untiring zeal. During the oppositions of 1877, 1879–1880, 1881–82, and 1884, the Merz 8½-inch refractor was used, but a start was made in May 1886 with the 18-inch instrument by the same makers, and during the opposition of 1888 this telescope was the one most generally employed. Practical observers will learn with interest that with the former instrument, which the greatest praise is given throughout, a magnification of 322 was most frequently adopted, while a memorandum was made of the fact that a tinted eye-cap of reddish-yellow glass was found to improve definition very materially (vol. 1, pp. 235 and 244).

Judging from these two noble volumes devoted to Schiaparelli's work on Mars, adorned with his portrait and many beautifully reproduced maps and drawings, and printed, moreover, on excellent paper bearing the great man's name watermarked on the lower margin of every page, we may already form some opinion as to the splendour of the literary monument Italy is thus raising to her greatest astronomer. Such an edition as this, as well as the others mentioned at the head of this notice, cannot fail to excite our highest admiration, tempered though it may be with some degree of envy that we in England have no similar edition of the works of Newton to set beside them.

W. ALFRED PARR.

Time and its History.

The Problem of Time: an Historical and Critical Study. By Prof. J. Alexander Gunn. Pp. 460. (London: George Allen and Unwin, Ltd., 1929.) 16s. net.

TIME, which is considered as a necessary element of history, nay, as the very substance of history itself, has now found its own historian. In his lucid and useful book on "The Problem of Time", Prof. Gunn guides us through the slippery paths and thorny places of the mono-dimensional field of time, where the pilgrim meets many extraordinary characters. From the conflicting views of the ever-changing Heraclitus and the immutable Parmenides, to the logical acrobatics of Zeno and the majestic disquisitions of Plato and Aristotle, down to the qualitative meditations of Plotinus, he lands in the medieval conceptions of time. He is shown how Augustine turns from metaphysics to psychology and substitutes discussions on memory and anticipation for past and future; and why Aquinas emphasises the Boetian doctrine of *aevum* as a mean between time and eternity. Then he discovers that the scientific revival of the Renaissance has raised both space and time from being accidental forms or minor entities to the rank of supreme or fundamental realities of the physical world. Here Galileo, Barrow, and Newton, who gave such an importance to time in the mathematical and scientific description of the world, tower over Descartes and Spinoza, who failed to appreciate the full value of time. But soon he assists in the gigantic onslaught against Newton's theory of absolute time perpetrated with psychological and metaphysical weapons by Locke, Berkeley, and Hume, and crowned by the mathematico-philosophical criticisms of Leibniz, who proposes as an alternative his relational theory of time.

Kant, of course, is given a prominent place. In trying to reconcile Newton with Leibniz and to avoid Hume's sceptical remarks, Kant leaves physics behind for transcendental æsthetics. So the pilgrim is shown why time is nothing by itself, but only a form of our intuition, nay, our very inner sense; and how Kant's treatment of time hurls him into his famous antinomies. But while he admires the relations between space and time or between time and phenomena, he is bluntly told that Kant's doctrine of time is highly unsatisfactory and contradictory—a statement soon confirmed by a fine piece of criticism of Kant's views about time. Yet that Kant's statement of problems remained the dominating feature of subsequent thought in western Europe, is shown by the wealth of criticism and alternative theories of his successors, from Hegel and Schopenhauer to Lotze and Cassirer. "The period of Kant and his successors shows a discussion of time as percept and as concept, and a struggle between the subjective and objective viewpoints in relation to time, with increasing stress on objectivity as a feature of time. This struggle has led to the conflict on the field of contemporary metaphysics, with Bergson, on the one hand, denying the existence of objective time and mischievously equating time and our subjective awareness of it, and on the other hand the physicists and the realists

asserting its objective existence, but the physicists limited merely to an interest in its measurement" (p. 340).

The whole position of time in the hurricane stirred up by the theory of relativity is then reviewed in the important chapter on "The Physicists and the Problem of Time-Measurement". Confining himself to his rôle of historian, Prof. Gunn proposes nothing new in his exposition, but his descriptive account of the fate of time tossed between the expert hands of Poincaré, Lorentz, Einstein, Eddington, Langevin, Bergson, Cassirer, Laue, and Schlick, is remarkably illuminating. Yet in his next chapter, on "Time in Contemporary Metaphysics", the philosophical exposition he gives of the doctrines of Whitehead, Russell, and McTaggart is not very satisfactory; while Alexander, Broad, Gentile, and Guyau are very adequately and ably treated. The difficulty about Prof. Whitehead is that his own terminology is not always clear, while the evolution of his views about some fundamental elements of his doctrine often leads to confusion.

Referring to the nature of time in his concluding chapter, Prof. Gunn sketches his own views about this problem, which he distinctly considers as a metaphysical problem. "Neither psychology nor physics attempts to grasp the problem of time in its full significance; the one is merely concerned with our subjective awareness of time and the other confines itself largely to considerations of measurement" (p. 371). According to Prof. Gunn, an inquiry about the nature of time is in effect an inquiry about reality itself; and the true metaphysician must not only regard reality objectively in a way which does not interest the psychologist, but also refuse to formulate a purely mathematical concept in which all qualitative and experiential factors are omitted as unreal. "The metaphysical concept of Time is one in relation to which both the mathematical and psychological concepts can be understood after their kind, but they cannot be equated with it. They separately present a false absolute, an abstraction valid within the respective sciences in which they arise, but misleading if in itself put forward as the sole description of reality. The metaphysician is concerned with the whole" (p. 396).

So Prof. Gunn reveals to us (p. 411) that "Time is an ever-changing present, a sequence of before-and-after objectively given", "a real feature within the Universe", not creating events but created them. He explains also that the concept of time cannot be legitimately divorced from perceptual experience, but that it is bound up with reality; while the whole or total reality is timeless.

A discussion of these provoking assertions would go beyond the compass of this article. But, on the whole, one fails to discover in them any new contribution to the almost exhaustive stock of theories suggested by the protean notion of time. The historical part of the work, however, suggests one or two comments.

Prof. Gunn seems to have misconceived the scholastic views about time, eternity, and eviternity (which should be the adequate term for *Aevum*). He says in a footnote (p. 21) that the scholastics consider real time as the time marked by the events of the heavens. Now, what the scholastics consider as 'real' time, in opposition to 'ideal' time, is the duration of the created objects, including man, it being understood that without an intellect to perceive this duration, no time as such could exist. Real time, therefore, is not confined for them to the motion of heavenly bodies; and further, Aquinas acknowledges in his commentary on "De Coelo" that our description of the universe could be different if we adopted other standards and methods. It is also incorrect to assert (p. 39) that Aquinas refuses his consent to the description of eternity as "interminabilis vitæ tota simul et perfecta possessio" given by Boetius, and which is laboriously explained in quest. X., art. 1, of the "Summa Theologica". As Aquinas begins his discussion by stating the objections to what he wishes to prove, Prof. Gunn has apparently read too hastily that part of the "Summa" which refers to time, taking the objection of Aquinas for his conclusions. As regards the doctrine of eviternity, the concept is ascribed to "incorporeal and heavenly bodies" in so far as they refer exclusively to the angels, whose duration has a beginning but no end, and which is a non-perfect *tota simul*, involving, however, a 'before-and-after'.

Turning to the part played by time in science, it is to be regretted that Prof. Gunn has overlooked the momentous influence of time on the development of mathematics. The timelessness of Greek mathematics, which offered no general method of describing natural phenomena; the genial speculations of Archimedes, who gave such a prominence to time in his devices—but whose name is not mentioned in Prof. Gunn's book; the mathematical discovery of time by the moderns, in their quest to give a more adequate description of Nature; the relations between the notion of

time and the method of tangents which led to the discovery of the calculus; the ontological implications of the mathematical distinction between absolute and relative time, are some of the fundamental problems which ought to have a place in a book about the history of time. Nevertheless, Prof. Gunn must be congratulated for having opened a most fascinating path to those who cannot escape the attraction of the philosophical jungle.

THOMAS GREENWOOD.

A Century of Geography.

The Record of the Royal Geographical Society, 1830–1930. By Dr. Hugh Robert Mill. Published at the Celebration of the Society's Centenary, October 1930. Pp. xvi+288+35 plates. (London: Royal Geographical Society; Edward Stanford, Ltd.; John Murray, 1930.) 10*s*.

IT was a happy choice to entrust the compilation of the record of the Royal Geographical Society's work to Dr. H. R. Mill, with his forty years' experience of the Society and many years' service on its staff. He acknowledges the valued assistance, throughout the work, of Mr. Douglas Freshfield, whose connexion with the Society runs to more than half a century. It cannot have been an easy task to know what to choose and what to omit in the record of the multifarious activities of a Society that was actively interested in practically all the journeys of exploration of its time. Dr. Mill has divided his record into periods of ten or more years, and in each period he has traced the changing fortunes of the Society, given some account of its presidents and other officials, and generally has had to rest content to gauge the work of the time by adding some account of the Society's medallists and the leaders of the expeditions which it has promoted or assisted.

The published journals, proceedings, and other works of the Society and the minute-books of the council have provided the main sources of information. There are many passages recounting heated controversies on lines of policy, told with impartiality and often with a touch of humour; and behind the story is a background of London changing its face and its habits through the years. For the later part of the century Dr. Mill has drawn on his own memories, which have enabled him to give vivid character sketches of many of the men conspicuous in the Society's history. This feature of the book will appeal to many. Some will remember H. W. Bates, the secretary from 1854 until 1892, the "shy and reticent entomologist" who developed powers of insight, judgment, tact, and organisation of a remarkable order. More will recall Sir Clements Markham, who dominated the Society for half a century, a strong but obstinate man, "never able to adjust his mind to scientific modes of thought", and full of narrow prejudices and dislikes, yet warm in friendship and zealous in furthering the interests of the Society. No name connected with the Society is remembered with more regard than that of Sir J. Scott Keltie, for many years librarian, secretary, and editor, a man of unfailing tact and invariable courtesy, and a friend as much to the humble aspirant as to the successful explorer.

Although the Society has always been concerned chiefly with exploration, and almost entirely so in its early days, the furtherance of geographical education was one of the aims of its founders. However, in 1833, three years after its foundation, its council disapproved of a request for "a small endowment" from the University of London for the foundation of a chair of geography to which the Society should have the nomination. In the long reign of Sir R. Murchison as president, from 1851 until 1870, the explorer was supreme in the interests of the Society. Murchison lionised explorers and taught London to do likewise. Thus one side of geography was popularised, but only at the cost of scientific approach. Not until the seventies of last century did other aspects of geography have warm advocates. Sir F. Galton and Mr. D. Freshfield championed a wider outlook. It was Galton who devised and carried through a scheme of school prizes awarded on examination. After sixteen years the scheme was abandoned through lack of interest on the part of schoolmasters. Mr. Freshfield persevered, and by his efforts Mr. J. S. Keltie was employed to report on geographical education in other countries. This report paved the way for the foundation of lectureships, to which the Society contributed generously, at Oxford and Cambridge. The movement at length spread to all the newer universities of England, and the universities of Scotland in time followed suit. Dr. Mill traces these developments, and he might have added that, in the provision of advanced instruction and the institution of honours schools in geography, several of the new universities anticipated Cambridge.

In his final chapter Dr. Mill takes a retrospect of the century in a review of various aspects of the Society's work. These aspects are: growth in number of fellows, finance, collections of books and maps (to which justice cannot be done in a few pages), map production by the Society, instruction

to travellers, and educational activities. An interesting historical chart shows the prosperity curve (total number of fellows) and the popularity curve (annual admissions) through the century, with the duration of each presidency and secretaryship shown. This is full of significance and repays careful study. Two chapters are added by Dr. A. R. Hinks on the Society's War work and a description of the new house which in its enlarged and completed form was opened by the Duke of York on Oct. 21. The volume is illustrated by plates, which include portraits of several of the presidents and other officials, various medals, and the different houses in which the Society has had its headquarters during the century. There is an admirably full index.

R. N. R. B.

Our Bookshelf.

Asia: an Economic and Regional Geography. By Dr. L. Dudley Stamp. Pp. xx + 616. (London: Methuen and Co., Ltd., 1929.) 27*s.* 6*d.* net.

IT is not only the War, with its reconstruction of States and redrawing of frontiers, nor the readjustment of economic relations consequent on these and on the changes which even the most stable countries underwent in their industries and powers of consumption, that make a new survey of the continents necessary and welcome. During the same short period, the study and, most of all, the teaching of geography have been remodelled; even the popular outlook on the world has become geographically orientated in a way which would amaze the pioneer teachers of the previous generation. A mass of recent publications is to hand, and needs fresh guidance if it is to be used as it deserves; and everyone has less time for acquiring exact information which daily becomes more indispensable. A fresh compendium of the geography of Asia, therefore, arouses hopes and challenges criticism.

It is characteristic of the newer geography that it bases its exposition on the reading of maps; and Dr. Dudley Stamp's uses of this 'geographical shorthand' to condense and clarify what he has to say are numerous and often ingenious. It is characteristic, also, that geography is regarded less as a statical presentation of what is, than as an interpretation of what has come to be. If it is not, and cannot strictly be, historical science, its method has at all events much that is akin to that of history. So the book rightly begins with an excellent account of the genesis of the continent, as a clue to its structure and physique; in which stress is laid on the provisional quality of much that is said, and alternative explanations are fairly stated. Geography, further, is an outdoor subject: and Dr. Stamp has travelled widely, in Burma, Malaya, China and Japan, Turkey, Syria and Palestine, and parts of Asiatic Russia. These journeys make possible many vivid touches of description, and a realism of outlook which permits easy handling of a very large mass of information. Occasionally colloquial and lecture-room phrases seem to waste space; but they certainly make the book readable in a way not common among text-books. Where an earlier writer has done justice to a topic, Dr. Stamp, very sensibly, does not hesitate to quote him. The references to literature are carefully selected, and the index is ample.

It is a good test of a book of this kind, that it improves by better acquaintance. A belated review is perhaps none the less useful, if it can certify that this test has been applied: and Dr. Stamp's "Asia" is certainly a very usable book.

Experience and Nature. By John Dewey. (Published on the Foundation established in Memory of Paul Carus.) Pp. ix + ix + 443. (London: George Allen and Unwin, Ltd., 1929.) 12*s.* 6*d.* net.

IN this brilliant and inspiring book, Prof. Dewey attempts to apply in philosophy the thought which is effective in dealing with any genuine question, from the elaborate problems of science to the practical deliberations of daily life. In his opinion, the break between the two realms is the cause of our modern intellectual perplexities and confusions. He is then led to attack the momentous problem of bridging the gap between the intellectual and moral heritage of civilisation, and the material presented to the speculative mind by science, industry, or even politics, by means of what he calls "the method of empirical naturalism".

This method accepts the point of view and conclusions of modern science, and acts like a winnowing fan on the innumerable presentations of experience. What remains after the chaff is blown to the winds is enough to inspire the mind with courage and vitality to create new ideals and values. Prof. Dewey's metaphysical construction is thus based on the conception of the instrumental nature of physical science. Yet he denies the necessity of dividing the objects of experience into a physical and an ideal world, by considering them as linked together by language and other social devices. For example, by regarding life as the link between physical nature and experience, he gives a solution of the mind-body problem which more orthodox philosophers might consider as simply ignoring the whole question. Again, art and values are taken as further proofs of the continuity between nature and experiences by being defined in a pragmatic rather than in an ontological fashion.

On the whole, Prof. Dewey's philosophy is to replace the traditional separation of nature and experience by the idea of continuity. Though refreshing and encouraging in its message, it fails, however, to satisfy our quest for a deeper knowledge of things and values. Prof. Dewey's continuity is immanent rather than transcendental in character so that, although he talks about philosophy all the time, he seems to leave its most critical problems outside the vividly decorated house where he pretends to perform a valid marriage between nature and experience.

The Principles of Photographic Pictorialism. By F. C. Tilney. Pp. x + 218 + 80 plates. (London: Chapman and Hall, Ltd., 1930.) 25*s.* net.

MR. TILNEY is both a painter and a photographer, but above all he is a critic whose writings on photographic subjects during the past twenty years or more have been the best informed and most understanding of any. Whilst this, his latest book, is not specially concerned with photography, in that it does not touch upon any photographic manipulations or processes, it is one that will be of the greatest assistance to all who aspire to make their use of the camera something more than an aimless snapshotting of holiday incidents. It is equally addressed to the student of art and to the lover of Nature, and to both it should bring gain in the intelligent appreciation of the pictorial aspect of their subjects.

After a brief survey of the efforts at picture making in the past and the lessons they convey to us, he goes on to consider the practical points involved in this business of pictorial presentation by photography, and finally deals with certain controversial matters on which he holds firm views that do not always coincide with those held by other photographers. Wisely he begins with a chapter of definitions of the terms used by art critics, in order that there may be no misunderstanding or ambiguity. Thence he goes on to treat of the subject, its choice and design, all the factors relating to composition, beauty of shape, tonal effect, the last a chapter of great value. In the main his observations are based upon landscape, but separate sections are devoted to figures, genre, the nude, portraiture, and still life. The final part deals with what he terms 'problems to some', under which are included halation, colour and panchromatism, perspective (on which he holds emphatic views regarding the difference between the vision of the eye and the lens), and control in printing. The illustrations, drawn from pictures by leading photographers of all times and lands, are in themselves a notable gallery of photographic art. J. DUDLEY JOHNSTON.

Allegemeine Moorgeologie: Einführung in das Gesamtgebiet der Moorkunde. Von Kurd v. Bülow. (Handbuch der Moorkunde, herausgegeben von K. v. Bülow, Band 1.) Pp. xi + 308 + 12 Tafeln. (Berlin: Gebrüder Borntraeger, 1929.) 30 gold marks.

INTEREST in peat has developed greatly in recent years, not only on the applied side of reclamation and utilisation but also on the more purely academic side. Much of the literature on the subject has, however, been inaccessible and diffuse. A "Handbuch der Moorkunde", to appear in ten volumes, will therefore be welcomed. The general editor is K. v. Bülow, of Leba, who has written the volume under review as an introduction, which will undoubtedly appeal to a wider audience than the more specialised volumes to follow. For this reason the treatment is didactic rather than critical, the nomenclature has been simplified, and references to original papers are relatively few.

After a descriptive chapter on the petrographic classification of moors, with many analyses of different kinds of peat, the author deals with modern theories of their origin and development and then proceeds to their stratigraphical morphology and geographical distribution. A preliminary attempt at a world peat map, based on the nomenclature of the Swedish worker, v. Post, shows the close relationships of the different kinds of moor to climatic factors. For Europe there is a fair agreement with the distribution of Meyer's *N.S.* quotient (rainfall divided by absolute saturation deficit). A discussion of Scandinavian work on the division of the Quaternary period by the study of peat profiles leads to an examination of the value of moors as indexes of climatic changes in post-glacial time. This part of the book will appeal to climatologists, geologists, and others.

Simple Research Problems in Chemistry: for Junior Students. By F. Sherwood Taylor. Pp. vii + 100. (London: William Heinemann, Ltd., 1929.) 4*s.*; Answers only, 1*s.* 6*d.*

THE author holds the view that the usual practical training of chemistry students is unsatisfactory, and that "there is a marked tendency for a student to obtain a first-class degree without finding out anything at all". He proposes, as a remedy, to introduce a proportion of research into the school and university courses, so as to train students to a more scientific point of view. The benefit which students get from any practical course is largely dependent on the teacher, and it is questionable whether an unorthodox course such as is here presented would lead to any better results in the hands of a poor teacher than any other. The experiments are good, and one use of the book which suggests itself is to provide exercises for practical examinations. For senior pupils in schools who have been through the usual practical courses it will also provide scope for further work, and all teachers will find Mr. Taylor's book useful and interesting, whatever view they may take of the suitability of the course for the average student. Some of the exercises are suitable for quite advanced students.

An Introduction to the Chemistry of Plant Products. By Dr. Paul Haas and Prof. T. G. Hill. Vol. 2: *Metabolic Processes.* Second edition. Pp. viii + 220. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THE second edition of this standard work has been largely rewritten and considerably amplified, particularly in the chapters dealing with those sections of plant metabolism which have been undergoing rapid expansion, such as respiration and growth. In the former case, the recent work of Meyerhof, Hill, and F. F. Blackman is combined into a unified scheme of considerable value. The rather brief section in the first edition dealing with nitrogen metabolism has also been enlarged by a detailed discussion of nitrate reduction. The authors have exercised a wise choice in their amplifications and the value of the book is greatly increased throughout.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Spectrographic Analysis of Animal Tissues.

IN NATURE of April 20, 1929 (**123**, p. 601), one of us (H. R.) described a method of spectrographic analysis of mineral and organic substances and pointed out the value of the method for biological purposes. Since then we have undertaken a survey of the animal kingdom with the purpose of detecting and analysing quantitatively those of the less common elements contained in protoplasm and its products which can be investigated by this method.

The animals, if small, are minced whole, or if sufficiently large are dissected and the separate organs minced. The material is then dried at 100° C., powdered in an agate mortar, and a weighed quantity (50 mgm.) taken and rolled in ashless filter paper. The roll is burnt in an oxy-coal gas flame in front of the slit of a quartz spectrograph, the image of the flame being focused on the slit by a quartz lens. The spectrum is recorded on a photographic plate. In the case of liquids, such as blood, 0·1 c.c. is pipetted on to a rolled filter paper, which is then burnt as described.

The method has been developed quantitatively. A standard solution has been prepared containing the various elements in known quantities. Four different volumes of this solution are burnt on filter paper and the resulting spectra photographed on each plate on which the tissue spectra are recorded. The intensity of a given line in a tissue spectrum can then be matched with the corresponding line on one of the standard spectra, and the quantity of the element concerned can consequently be deduced.

Spectrographic analysis has hitherto only been applied to animal tissues in a few isolated investigations. Yet the method is obviously of great value, for a wide survey of tissue contents can be made with a rapidity impossible with chemical methods. We have commenced our investigations with annelids (analysed whole), molluscs (separate organs studied), and a few members of other phyla. Already a number of important new facts have emerged. The most salient are the following.

Iron and copper were present in all of the 146 different spectrograms made. The wide distribution of iron in protoplasm is already known, and its functional importance has been emphasised by Keilin's work on cytochrome (*Proc. Roy. Soc.*, B, **98**, 312; 1925). Copper has previously been found in numerous animal tissues and it has at least two functions, namely, as a component of the hæmocyanin molecule, and as an essential factor in hæmoglobin synthesis (Waddell, *J. Biol. Ch.*, **84**, 115; 1929, and others). When whole animals were used for our work, it is possible that elements which appeared in the spectra were in the gut or on the skin, and, of course, in the case of molluscs, copper exists in hæmocyanin. Nevertheless, the invariable presence of iron and copper strongly suggests that these are universal constituents of protoplasm.

Manganese was found in all nineteen species of polychætes studied. It was widely distributed in the molluscs, being present, for example, in all organs of land gastropods. It was found in numerous organs of marine gastropods, but was absent from *Haliotis*. The quantity in an organ varied with locality. Manganese is known to stimulate growth of rodents (McHargue, *Am. J. Physiol.*, **77**, 245; 1926. Bertrand and Nakamura, *C. R. Ac. Sci.*, **186**, 1480; 1928). When our survey has extended further, indications may be given of other functions. Harrison and Garrett (*Proc. Roy. Soc.*, B, **99**, 241; 1926) induced melanism in Lepidoptera by manganese feeding. We do not find this element particularly associated with melanin. The spectrum of the ink sac of *Sepia* shows none, and while manganese is strong in the black body-wall of *Arion ater* (0·008 per cent of dry weight), there is even more in the colourless common genital duct.

Nickel and cobalt were present in certain tissues. Cobalt was less common than nickel, and was usually associated with a relatively high concentration of the latter. But the foot of *Haliotis* has a high nickel content (0·004 per cent) without cobalt, while the liver of *Archidoris tuberculata* contains cobalt (0·003 per cent) with no nickel. There is thus a selective absorption.

Lead and silver occur spasmodically but not infrequently. The strongest silver was in the liver and kidney of *Pinna pectinata*. Individuals and individual organs absorb these metals selectively, for unknown reasons. One human subject had silver in all organs, while two others had none. Lead was present in different organs in each of the three men. This suggests an absence of functional significance.

Cadmium was found in the livers of all the eleven individuals of *Pecten maximus* examined. They came from three different localities. This seems to be the first record of cadmium in an animal.

Lithium turned out to be very widespread in animal tissues. Rubidium is less common. Cæsium was not found. This is remarkable, since rubidium and cæsium both enter frog's muscle from a perfusion fluid (Mitchell, Wilson, and Stanton: *J. Gen. Physiol.*, **4**, 141; 1921), and cæsium is present in sea water.

Strontium was present in 17 out of 19 species of polychætes and in 51 out of 67 tissues of molluscs. Previously it was known only from the skeleton of a radiolarian and from marine shells. Barium, on the other hand, was absent.

Calcium fluoride was found in one tissue only, namely, the body wall of *Archidoris tuberculata*.

A detailed account of the work will be published shortly.

H. MUNRO FOX.
HUGH RAMAGE.

University of Birmingham, and
Ridgemont, Carrow Hill, Norwich,
Oct. 3.

Experiments on Binaural Sensations.

AT intervals during the past five years I have been attempting a survey of the various experiments which have been taken as evidence that binaural sensations with musical notes of low pitch are due to the appreciation of phase differences produced at the ears. The work grew out of some experiments with sound waves which are recorded in the *Proceedings of the Physical Society* for August 1927.

Repetition of the various experiments has driven me to the conclusion that, with the forms of apparatus used, there have been possibilities of intensity change and I do not think that these possible alterations have been sufficiently taken account of in the interpretation of some of the published results. It is very difficult to produce the binaural sensation of change of position of the sound 'image' under conditions where it can be shown that phase differences are set up without any accompanying alterations of intensity. Change

of intensity produced by common forms of apparatus are found, when actually measured, to be surprisingly large and may well be an important factor in producing the binaural effect.

The experiments with two valve oscillators, which have been interpreted as favouring the phase difference localisation theory, depend on the known fact that, when the frequency of one oscillator is adjusted by a tuning condenser over the range for which the sets are in unison, the phase difference of the electrical oscillations, and also of the telephone diaphragm movements, alters from 0 to π. Two telephones, energised one from each oscillator, are worn over the observer's ears and he adjusts the loudness of the sound in each ear by means of two shunts. With this arrangement the sensation of rotation can be obtained either when the two circuits are nearly but not quite in tune or when the tuning condenser has its adjustment altered within the unison range.

I have made measurements both of the amplitude of the oscillatory currents and of the amplitude of the telephone diaphragm movements under these conditions and both show changes. The variations depend on the degree of coupling between the circuits, and when the amplitude is increasing in one telephone it is decreasing in the other. Thus an intensity effect is present which will aid the sense of localisation of the sound. It is possible, moreover, to produce similar intensity variations under conditions where no phase differences are present at the ears. When this is done, the sensation produced seems very like the ordinary binaural rotation.

In experiments on binaural beats it is evident that, when this form of apparatus is used, great care must be taken to eliminate all possibility of these oscillatory current variations before any conclusions are drawn about the so-called 'subjective' beats.

When sound from one source is led by two paths of adjustable length to the two ears, again experiment shows that measurable variations of intensity may occur at the ears. It would seem therefore that, until such variations have been eliminated, this method does not give conclusive evidence in favour of phase difference as the main factor in binaural localisation.

Experiments with two tuning forks producing slow beats seem to be open to criticism along similar lines.

I think that the induced currents produced in a 'phasor' when it is used to give binaural effects must be tested also for possible intensity variations. May I ask someone who possesses such a phasor with which binaural effects have been observed, if he will allow me to borrow the instrument to make measurements of the induced currents? Experiments already made with an apparatus of this type have shown that it is not easy to introduce phase difference by moving one of the coils without producing, at the same time, changes in the magnitude of the currents.

It is hoped that full details of the experiments will be ready for publication in the next few months.

S. R. HUMBY.

The College, Winchester,
Oct. 6.

Observations on the Mechanism of Spore Formation.

DURING the investigation of a spore-bearing organism isolated from heated milk, certain morphological changes prior to sporulation were observed. The observations recorded were made upon fixed preparations stained by Moeller's spore-staining technique and by Giemsa's stain, and upon unfixed preparations stained by Nakanishi's method. The results were confirmed by dark ground examination of the living organisms.

Germination of spores takes place rapidly under suitable conditions and an actively-dividing vegetative phase ensues. In this phase the cells show dense protoplasmic contents which stain readily with the basic aniline dyes (Fig. 1, i). Later, the contents become less dense, and as the time for spore formation approaches, become distinctly granular. After thirty-six to forty-eight hours' incubation a characteristic stage may be observed in which an unstained area is lying towards one end of each cell, cutting off and isolating a definite terminal part of the cell contents (ii). This terminal portion is the potential spore and its position is fixed at this stage of the development. The remainder of the cell contents, meanwhile, have shown definite signs of contraction (iii) and finally condense to form a second body, which we have called the 'secondary granule' in order to distinguish it from the 'terminal or spore granule'. The appearance of the organism at this stage is quite characteristic (iv). It consists of a swollen, practically unstained envelope within which lie the two granules, deeply stained, one terminal in position, the other

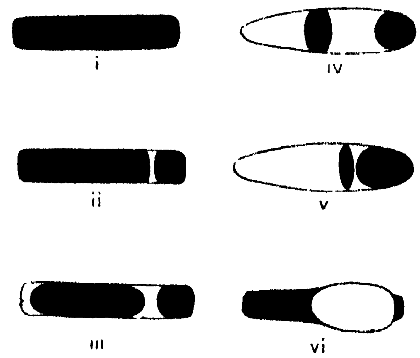


FIG. 1.

median or excentric. At a slightly later stage the position of the 'secondary granule' is seen to vary somewhat in different cells. In a definite proportion of cases, however, it is oval or lens-shaped and lies closely adjacent to the 'terminal granule' (v). Whether there is any actual contact between them has not yet been established, but it is of interest to note that it is in such cells that the first indication of a spore wall is visible, and that as soon as this wall begins to form, the staining and refractive properties of the 'spore granule' become those of a true spore. The fate of the 'secondary granule' is uncertain, but it would seem from careful observations that, having played some part in the development of the spore, it disperses throughout the body of the mother cell, which then resumes its ordinary staining capacity (vi).

A study of the literature, particularly the work of Schaudinn (1902), Guilliermond (1908), Swellengrebel (1913), Bessubetz (1913), and many others, shows that various nuclear processes have been previously recorded in connexion with spore formation. Whether any analogy exists between these findings and the present case is a point which can only be established by further and more detailed work, but there remains the strong suggestion that, as spore formation is preceded by the sequence of morphological changes recorded, some nuclear process may well be involved.

MARGARET I. CHRISTIAN.

The National Institute
for Research in Dairying,
Shinfield, nr. Reading,
Sept. 30.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Spectrographic Analysis of Animal Tissues.

IN NATURE of April 20, 1929 (**123**, p. 601), one of us (H. R.) described a method of spectrographic analysis of mineral and organic substances and pointed out the value of the method for biological purposes. Since then we have undertaken a survey of the animal kingdom with the purpose of detecting and analysing quantitatively those of the less common elements contained in protoplasm and its products which can be investigated by this method.

The animals, if small, are minced whole, or if sufficiently large are dissected and the separate organs minced. The material is then dried at 100° C., powdered in an agate mortar, and a weighed quantity (50 mgm.) taken and rolled in ashless filter paper. The roll is burnt in an oxy-coal gas flame in front of the slit of a quartz spectrograph, the image of the flame being focused on the slit by a quartz lens. The spectrum is recorded on a photographic plate. In the case of liquids, such as blood, 0·1 c.c. is pipetted on to a rolled filter paper, which is then burnt as described.

The method has been developed quantitatively. A standard solution has been prepared containing the various elements in known quantities. Four different volumes of this solution are burnt on filter paper and the resulting spectra photographed on each plate on which the tissue spectra are recorded. The intensity of a given line in a tissue spectrum can then be matched with the corresponding line on one of the standard spectra, and the quantity of the element concerned can consequently be deduced.

Spectrographic analysis has hitherto only been applied to animal tissues in a few isolated investigations. Yet the method is obviously of great value, for a wide survey of tissue contents can be made with a rapidity impossible with chemical methods. We have commenced our investigations with annelids (analysed whole), molluscs (separate organs studied), and a few members of other phyla. Already a number of important new facts have emerged. The most salient are the following.

Iron and copper were present in all of the 146 different spectrograms made. The wide distribution of iron in protoplasm is already known, and its functional importance has been emphasised by Keilin's work on cytochrome (*Proc. Roy. Soc.*, B, **98**, 312; 1925). Copper has previously been found in numerous animal tissues and it has at least two functions, namely, as a component of the hæmocyanin molecule, and as an essential factor in hæmoglobin synthesis (Waddell, *J. Biol. Ch.*, **84**, 115; 1929, and others). When whole animals were used for our work, it is possible that elements which appeared in the spectra were in the gut or on the skin, and, of course, in the case of molluscs, copper exists in hæmocyanin. Nevertheless, the invariable presence of iron and copper strongly suggests that these are universal constituents of protoplasm.

Manganese was found in all nineteen species of polychætes studied. It was widely distributed in the molluscs, being present, for example, in all organs of land gastropods. It was found in numerous organs of marine gastropods, but was absent from *Haliotis*. The quantity in an organ varied with locality. Manganese is known to stimulate growth of rodents (McHargue, *Am. J. Physiol.*, **77**, 245; 1926. Bertrand and Nakamura, *C. R. Ac. Sci.*, **186**, 1480; 1928). When our survey has extended further, indications may be given of other functions. Harrison and Garrett (*Proc. Roy. Soc.*, B, **99**, 241; 1926) induced melanism in Lepidoptera by manganese feeding. We do not find this element particularly associated with melanin. The spectrum of the ink sac of *Sepia* shows none, and while manganese is strong in the black body-wall of *Arion ater* (0·008 per cent of dry weight), there is even more in the colourless common genital duct.

Nickel and cobalt were present in certain tissues. Cobalt was less common than nickel, and was usually associated with a relatively high concentration of the latter. But the foot of *Haliotis* has a high nickel content (0·004 per cent) without cobalt, while the liver of *Archidoris tuberculata* contains cobalt (0·003 per cent) with no nickel. There is thus a selective absorption.

Lead and silver occur spasmodically but not infrequently. The strongest silver was in the liver and kidney of *Pinna pectinata*. Individuals and individual organs absorb these metals selectively, for unknown reasons. One human subject had silver in all organs, while two others had none. Lead was present in different organs in each of the three men. This suggests an absence of functional significance.

Cadmium was found in the livers of all the eleven individuals of *Pecten maximus* examined. They came from three different localities. This seems to be the first record of cadmium in an animal.

Lithium turned out to be very widespread in animal tissues. Rubidium is less common. Cæsium was not found. This is remarkable, since rubidium and cæsium both enter frog's muscle from a perfusion fluid (Mitchell, Wilson, and Stanton: *J. Gen. Physiol.*, **4**, 141; 1921), and cæsium is present in sea water.

Strontium was present in 17 out of 19 species of polychætes and in 51 out of 67 tissues of molluscs. Previously it was known only from the skeleton of radiolarian and from marine shells. Barium, on the other hand, was absent.

Calcium fluoride was found in one tissue only, namely, the body wall of *Archidoris tuberculata*.

A detailed account of the work will be published shortly.

H. MUNRO FOX.
HUGH RAMAGE.

University of Birmingham, and
Ridgemont, Carrow Hill, Norwich,
Oct. 3.

Experiments on Binaural Sensations.

AT intervals during the past five years I have been attempting a survey of the various experiments which have been taken as evidence that binaural sensations with musical notes of low pitch are due to the appreciation of phase differences produced at the ears. The work grew out of some experiments with sound waves which are recorded in the *Proceedings of the Physical Society* for August 1927.

Repetition of the various experiments has driven me to the conclusion that, with the forms of apparatus used, there have been possibilities of intensity changes and I do not think that these possible alterations have been sufficiently taken account of in the interpretation of some of the published results. It is very difficult to produce the binaural sensation of change of position of the sound 'image' under conditions where it can be shown that phase differences are set up without any accompanying alterations of intensity. Changes

of intensity produced by common forms of apparatus are found, when actually measured, to be surprisingly large and may well be an important factor in producing the binaural effect.

The experiments with two valve oscillators, which have been interpreted as favouring the phase difference localisation theory, depend on the known fact that, when the frequency of one oscillator is adjusted by a tuning condenser over the range for which the sets are in unison, the phase difference of the electrical oscillations, and also of the telephone diaphragm movements, alters from 0 to π. Two telephones, energised one from each oscillator, are worn over the observer's ears and he adjusts the loudness of the sound in each ear by means of two shunts. With this arrangement the sensation of rotation can be obtained either when the two circuits are nearly but not quite in tune or when the tuning condenser has its adjustment altered within the unison range.

I have made measurements both of the amplitude of the oscillatory currents and of the amplitude of the telephone diaphragm movements under these conditions and both show changes. The variations depend on the degree of coupling between the circuits, and when the amplitude is increasing in one telephone it is decreasing in the other. Thus an intensity effect is present which will aid the sense of localisation of the sound. It is possible, moreover, to produce similar intensity variations under conditions where no phase differences are present at the ears. When this is done, the sensation produced seems very like the ordinary binaural rotation.

In experiments on binaural beats it is evident that, when this form of apparatus is used, great care must be taken to eliminate all possibility of these oscillatory current variations before any conclusions are drawn about the so-called 'subjective' beats.

When sound from one source is led by two paths of adjustable length to the two ears, again experiment shows that measurable variations of intensity may occur at the ears. It would seem therefore that, until such variations have been eliminated, this method does not give conclusive evidence in favour of phase difference as the main factor in binaural localisation.

Experiments with two tuning forks producing slow beats seem to be open to criticism along similar lines.

I think that the induced currents produced in a 'phaser' when it is used to give binaural effects must be tested also for possible intensity variations. May I ask someone who possesses such a phaser with which binaural effects have been observed, if he will allow me to borrow the instrument to make measurements of the induced currents? Experiments already made with an apparatus of this type have shown that it is not easy to introduce phase difference by moving one of the coils without producing, at the same time, changes in the magnitude of the currents.

It is hoped that full details of the experiments will be ready for publication in the next few months.

S. R. HUMBY.

The College, Winchester,
Oct. 6.

Observations on the Mechanism of Spore Formation.

DURING the investigation of a spore-bearing organism isolated from heated milk, certain morphological changes prior to sporulation were observed. The observations recorded were made upon fixed preparations stained by Moeller's spore-staining technique and by Giemsa's stain, and upon unfixed preparations stained by Nakanishi's method. The results were confirmed by dark ground examination of the living organisms.

Germination of spores takes place rapidly under suitable conditions and an actively-dividing vegetative phase ensues. In this phase the cells show dense protoplasmic contents which stain readily with the basic aniline dyes (Fig. 1, i). Later, the contents become less dense, and as the time for spore formation approaches, become distinctly granular. After thirty-six to forty-eight hours' incubation a characteristic stage may be observed in which an unstained area is lying towards one end of each cell, cutting off and isolating a definite terminal part of the cell contents (ii). This terminal portion is the potential spore and its position is fixed at this stage of the development. The remainder of the cell contents, meanwhile, have shown definite signs of contraction (iii) and finally condense to form a second body, which we have called the 'secondary granule' in order to distinguish it from the 'terminal or spore granule'. The appearance of the organism at this stage is quite characteristic (iv). It consists of a swollen, practically unstained envelope within which lie the two granules, deeply stained, one terminal in position, the other

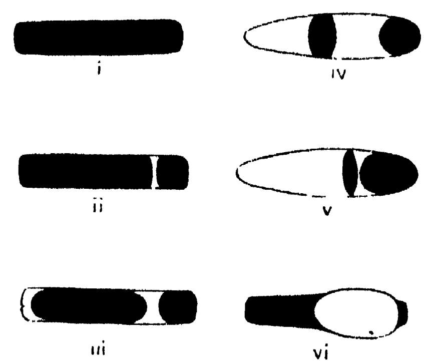


FIG. 1.

median or excentric. At a slightly later stage the position of the 'secondary granule' is seen to vary somewhat in different cells. In a definite proportion of cases, however, it is oval or lens-shaped and lies closely adjacent to the 'terminal granule' (v). Whether there is any actual contact between them has not yet been established, but it is of interest to note that it is in such cells that the first indication of a spore wall is visible, and that as soon as this wall begins to form, the staining and refractive properties of the 'spore granule' become those of a true spore. The fate of the 'secondary granule' is uncertain, but it would seem from careful observations that, having played some part in the development of the spore, it disperses throughout the body of the mother cell, which then resumes its ordinary staining capacity (vi).

A study of the literature, particularly the work of Schaudinn (1902), Guilliermond (1908), Swellengrebel (1913), Bessubetz (1913), and many others, shows that various nuclear processes have been previously recorded in connexion with spore formation. Whether any analogy exists between these findings and the present case is a point which can only be established by further and more detailed work, but there remains the strong suggestion that, as spore formation is preceded by the sequence of morphological changes recorded, some nuclear process may well be involved.

MARGARET I. CHRISTIAN.

The National Institute
for Research in Dairying,
Shinfield, nr. Reading,
Sept. 30.

Injury to Plaster due to Osmosis.

FROM time to time, it has been suggested that osmosis plays a part in the weathering of building materials. A note on a failure of plaster work for which osmotic action is directly responsible may therefore be of interest.

Brick walls are sometimes found to which lime plaster cannot be made to adhere permanently. Some time after the plaster is applied it commences to bulge and finally is pushed off the wall. Immediately behind the face of the brick is found a columnar crystalline growth which, in all cases so far examined, proves to be magnesium sulphate ($MgSO_4 7H_2O$) in a practically pure condition.

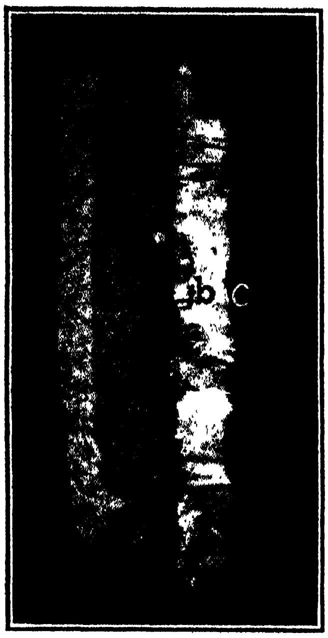


FIG. 1.—(*a*) Lime plaster; (*b*) magnesium sulphate; (*c*) brick

It now appears that, when lime plaster is applied to bricks containing a proportion of magnesium sulphate, a semi-permeable membrane is precipitated in the face of the bricks. As the plastered wall dries out, magnesium sulphate is drawn from the body of the bricks, concentrates behind the membrane, and then crystallises, forcing the plaster and a thin shell of brick away from the wall.

It has been found possible to precipitate membranes of magnesium hydroxide in the walls of porous pots. Using a half-saturated solution of magnesium sulphate, osmotic pressures so high as 100 cm. of water were developed in three days.

In Fig. 1 is shown the magnesium sulphate growth (*b*) between the plaster (*a*) and the main body of the brick (*c*). To the left of the layer of magnesium sulphate the thin layer of brick which supports the osmotic membrane may be seen.

F. L. BRADY.

Building Research Station,
Garston, Watford, Oct. 7.

The Zeeman Effect and the Absorption Coefficients of the Hyperfine Structure Components of the Mercury Resonance Line.

THE investigations of McNair (*Phys. Review*, **31**, 986; 1928) have shown the complicated behaviour of the Zeeman patterns of the mercury resonance line, 2537 A., in emission. Some observations made in absorption five years ago by Wood appear to be in contradiction with the results of McNair. To clear up this difficulty I have made a more systematic study of the Zeeman effect of the mercury resonance line in absorption for magnetic fields from zero to 8 kilogauss and have obtained the following results:

The parallel components in absorption behave similarly to those in emission, with the exception of moderate intensities of the magnetic field, 1-3 kg., when, besides the five components, the light of intermediate wave-lengths is also absorbed. The scheme of McNair does not quite suffice to explain the behaviour of the components perpendicular to the field, because the – 10·4 and + 21·5 mA. components (transmitted through the absorbing vapour in the magnetic field) show for certain intensities of field an anomalous behaviour, not understandable from the point of view of McNair. However, generally speaking, the results of my investigations can be reconciled with the results of McNair rather than with the eventual existence of a Paschen-Back effect, and they lead to fairly good interpretation of the curve giving the intensity of transmitted light as a function of the field intensity, which was obtained two years ago by Schein.

These investigations have further shown that, for certain intensities of the field, the vapour transmits: (α) only the outer short wave-length component, – 25·4 mA., or (β) one inner and one outer component, – 10·4 and + 21·5 mA., or (γ) two inner components, 0 and + 11·5 mA. The absorption coefficients of the radiation, which was monochromatised in this way, was estimated by means of the decrease of the intensity of the resonance radiation along the beam. The measurements were made for the temperatures 0° and 16½° C. and have given the results: β = 1·25 · γ – 1·60; which are in agreement with the estimates of intensity in emission lines made by Miss Schrammen. The estimated values of the absorption coefficients, which are less certain than the relative ones, computed in the ordinary way for the temperature 20° C. from the measurements made at 0° C., are: $\alpha = 3{\cdot}3$; $\beta = 4{\cdot}0$; $\gamma = 5{\cdot}1$ cm.$^{-1}$. The estimated value for all five components, $k_{20} = 4{\cdot}2$ cm.$^{-1}$, which differs only little from the average of the valu $\alpha + 2\beta + 2\gamma$ less than that obtained from the photoelectric measurements (Kunze, Kopferman and Tietze, Zemansky), probably because I was not able to extend my measurements close enough to the window through which the exciting light enters into the resonance vessel.

A full report of these investigations will appear in the *Bulletin de l'Académie polonaise* (Cracow).

S. MROZOWSKI.

Physical Laboratory of the Society
of Sciences and Letters,
Warsaw.

Two Modifications of Liquid Ethyl Ether.

THE changes of the dielectric constant of liquid ethyl ether with temperature studied by one of us (J. M.), and described in a recent communication in NATURE, suggest that at the temperature 105·4° C. the liquid undergoes some transformations analogous to that found for liquid helium by W. Keesom and M. Wolfke (*Comm. Leiden*, 190 *b*). To confirm this supposition

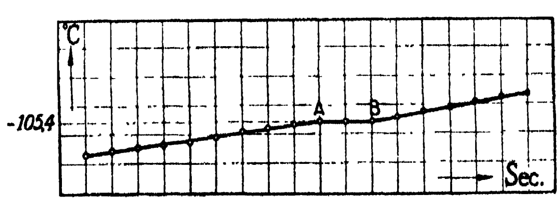


FIG. 1.

we have made a study of the change of temperature with time during the gradual heating of carefully purified ethyl ether.

Ethyl ether cooled to a temperature lower than – 105·4° C. was contained in a Dewar vessel provided with a nickel covered refrigerator cooled with liquid air. We have studied the change with time of gradually increasing temperature of the ether, which was

isolated from all external disturbances. The platinum resistance thermometer was used as a stirrer.

The accompanying graph (Fig. 1) representing these observations shows a distinct slowing down of the rate of change of temperature at $-105 \cdot 4^\circ$ C. (see the part A B of the curve). The transformation point is very clearly indicated in this heating curve. The parts of curve above and below the point $-105 \cdot 4^\circ$ C. are to a high degree of approximation straight lines, making different angles with the temperature axis, which shows that the specific heat of ethyl ether undergoes a change at $-105 \cdot 4^\circ$ C.

The transformation of liquid ether described above is the second observed case of such a phenomenon, the first one being the discovery of liquid helium I. and helium II. by W. Keesom and M. Wolfke (*Comm. Leiden*, 190 *b*).

M. WOLFKE.
J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw.
Sept. 30.

The Development of the Mesoderm in Gastropods.

IN 1891 Erlanger reported that in the freshwater snail *Paludina* the mesoderm was formed as a hollow pouch budded out from the primitive gut or archenteron. From a portion of this pouch, which may be regarded as the secondary body-cavity or cœlom, the pericardial sac was formed. Such a mode of the formation of the cœlom, though normal in Echinodermata and Chætognatha and also in *Amphioxus* and the Enteropneusta, was hitherto unknown in Mollusca, and Erlanger's results were received with a storm of scepticism. Later, Tönniges (1896) examined the development of *Paludina* and denied the validity of Erlanger's results, and asserted that the mesoderm arose as small cells budded from the ectoderm. The most recent worker on the subject (Dautert, 1929) has confirmed Tönniges's conclusions.

It seemed as if Erlanger had been utterly discredited. During this summer Mr. Fernando, a student working in my laboratory, re-examined *Paludina*. He found all the stages figured by Erlanger and completely confirmed his results. But he also found the stages figured by Dautert and Tönniges and showed that the differing results of these two workers were due to the old embryological error of missing out stages in development.

Fernando's results may serve as a warning against accepting negative results in zoology. Positive results are a definite addition to our knowledge: they may be misinterpreted and later workers may supply better interpretations, but negative results which suggest that positive results are entirely imaginary are almost always due to defective observation.

E. W. MACBRIDE.

Imperial College of Science,
London, S.W.7.

Vitamin A and Carotene.

RECENT work by Moore and others (see, for example, Moore, *Biochem. Jour.*, **24**, 692; 1930) has left little doubt that, in the rat, carotene can function as a precursor of vitamin A. Experiments which I have just carried out have indicated that the same holds true in the fowl also. White Leghorn chickens, six weeks old, were given a synthetic diet free from vitamin A to which irradiated ergosterol was added to supply vitamin D. Control birds receiving this diet succumbed in about six weeks, their livers giving negative tests for vitamin A either by the antimony chloride test or by the absorption spectrum. To other birds, after a preliminary period of vitamin A depletion, daily doses of carotene (1 mgm.) or cod liver oil concentrate (10 mgm.) were given, with the result that complete cures were effected and satisfactory growth restored. The livers of all these birds, receiving either carotene or concentrate, gave positive tests for vitamin A, the oils yielding an intense blue colour with antimony chloride and showing a strong absorption band in the region of 328 $\mu\mu$.

As well as indicating that the ability to transmute carotene into vitamin A may hold fairly generally throughout the animal kingdom, the experiments would seem to afford an explanation of the results of Palmer and Kempster (*Jour. Biol. Chem.*, **39**, 331; 1919), who found that while xanthophyll fed to fowl reared on a diet free from carotenoids quickly increased their pigmentation, carotene had no such effect. The transmutation of carotene into the colourless vitamin A would account for this very simply.

A full account of the experiments will be published elsewhere.

NORMAN S. CAPPER.

The Donald Currie Laboratories,
The Queen's University of Belfast.

Denaturation of Proteins by Urea.

THE important article by Sir Frederick G. Hopkins which appeared in NATURE on Aug. 30 and Sept. 6 records many valuable new observations on which he is to be congratulated. It has, indeed, only one defect, and, at his request, I write to make that good, namely, the absence of all reference to the observations made many years ago by myself and my delightful friend Dr. N. G. Chavasse, a man who was twice awarded the V.C., and whose loss is to me one of the major tragedies of the War. The fact that Sir Frederick knew nothing of these observations is, however, very intelligible, since the first paper (*Jour. of Physiol.*, **28**, pp. 23-26; 1902) appeared obscurely in the *Proceedings*, only, of the Society concerned, and the second (*Proc. Faraday Soc.*, March 1913; German translation in *Zeits. f. Kolloide*, **12**, pp. 250-252; 1913) was entitled "Graded Protein Sols".

Let me add that during the last two years Mr. J. Hatton has been working on this subject under my supervision, and that in 1929 we found, like Sir Frederick, that the rate of denaturation of approximately isoelectric egg-albumin by urea had a negative temperature coefficient. Other results of ours will now be found in the Proceedings of the Biochemical Society published in *Chemistry and Industry*, Oct. 10, 1930, p. 851. That account should be supplemented by the statement that, in the case of sheeps' wool, much, though apparently not all, of the substances the thiol or disulphide groups of which have become 'unmasked' passes into the urea solution.

W. RAMSDEN.

University of Liverpool,
Oct. 13.

Oviposition of *Hæmatopota pluvialis*, Linné.

DR. CAMERON's interesting account, in NATURE of Oct. 18, p. 601, of the oviposition habits of Tabanid flies, and especially of those of *Hæmatopota pluvialis*, L., suggests that the following observation may be worth recording. On Aug. 24, 1925, at Waidbruck (Ponte all' Isarco), Italian Tyrol, I observed a female of *Tabanus glaucopis*, Mg., laying her eggs on the leaves of the common plantain, *Plantago lanceolata*. The plant was growing in a dry hay-field, not in the immediate vicinity of water.

O. W. RICHARDS.

Imperial College Biological Field Station,
Slough, Bucks.

The Biological Significance of Conjugate Nuclei in *Coprinus lagopus* and other Hymenomycetes.*

By Prof. A. H. REGINALD BULLER, F.R.S.

CONJUGATE nuclei are two nuclei of opposite sex, associated with one another in a single cell, which divide sumultaneously in such a way as to give rise to two daughter pairs of conjugate nuclei. Stages in conjugate nuclear division in *Coprinus lagopus*, based on the work of Mlle. Bensaude, are shown in Fig. 7.

In animals conjugate nuclei are unknown and in plants their occurrence is limited to the Higher Fungi. They especially characterise the diploid mycelium and fruit-bodies of the Hymenomycetes (Mushrooms and Toadstools) and the diploid mycelium of the Rust Fungi and the Smut Fungi, all of which groups are included in the larger assemblage of the Basidiomycetes. Conjugate nuclei are also present in the ascogenous hyphæ of certain Ascomycetes.

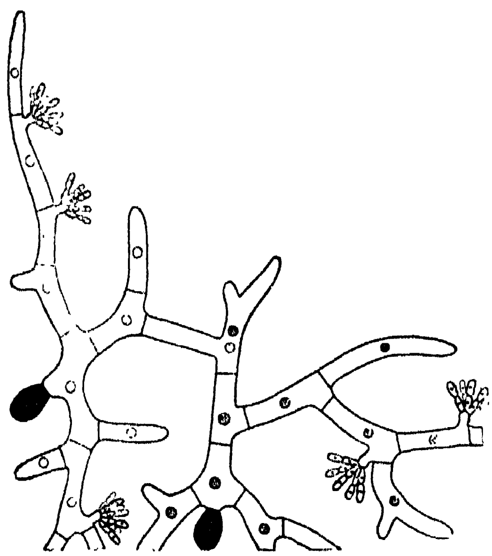


FIG. 1.—*Coprinus lagopus*. Diagram showing two *haploid* mycelia of opposite sex, (*AB*) on right (black nuclei), (*ab*) on left (white nuclei), each derived from a single basidiospore. Note the simple septa, the groups of oidia, and the isolated nuclei. The two mycelia have just effected a hyphal fusion and in the fusion cell an (*AB*) nucleus and an (*ab*) nucleus have become associated as a pair of conjugate nuclei. The diploid cell is able to diploidise all the other cells of both mycelia by a process illustrated in Fig. 6.

Coprinus lagopus is a small toadstool of common occurrence on horse dung in pastures. Its pilei shed numerous black basidiospores which are carried off by the wind, settle on grass, etc., are swallowed with herbage by horses, and germinate in freshly deposited dung-balls. In these dung-balls haploid mycelia of opposite sex mate with one another and form diploid mycelia. The diploid mycelia give rise to diploid fruit-bodies which produce and liberate haploid basidiospores. The life-cycle from spore to spore is carried through in 10-14 days.

As determined by Hanna,[1] Dorothy Newton,[2] and others, the monosporous mycelia (each derived from a single basidiospore) of *Coprinus lagopus* fall into four groups. If it be assumed that each mycelium bears one of each of two pairs of sex factors, *Aa* and *Bb*, then the four groups of mycelia and the four groups of spores from which they have been derived may be represented by the symbols (*AB*), (*ab*), (*Ab*), and (*aB*).

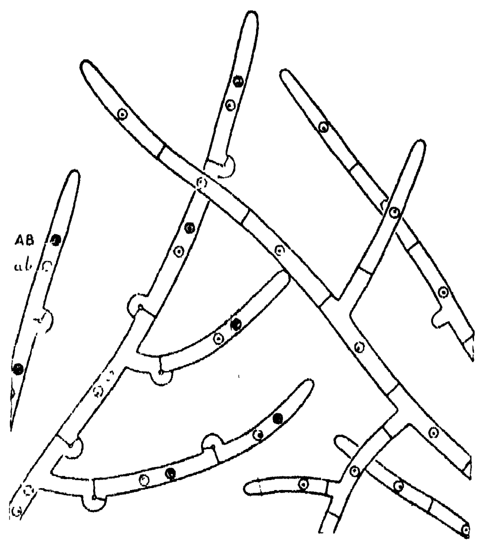


FIG. 2. *Coprinus lagopus*. A diploid mycelium (*AB*) + (*ab*) on the left, and a haploid mycelium (*ab*) on the right. In the diploid mycelium, note the pairs of conjugate nuclei of opposite sex [illegible] each cell and the clamp-connexion at each septum. A ce[illegible] hypha of the diploid mycelium is about to fuse [illegible] hyp[illegible] the haploid mycelium. The diploid mycelium, after the [illegible] was effected, would begin to diploidise the haploid mycelium.

Successful mating of the haploid mycelia of *Coprinus lagopus* with the production of a diploid mycelium (bearing clamp-connexions and containing a conjugate pair of nuclei in each cell) is normally possible only in the combinations (*AB*) × (*ab*) and (*Ab*) × (*aB*). These two kinds of combinations give rise to two kinds of diploid mycelia which may be represented by the symbols (*AB*) + (*ab*) and (*Ab*) + (*aB*) respectively.

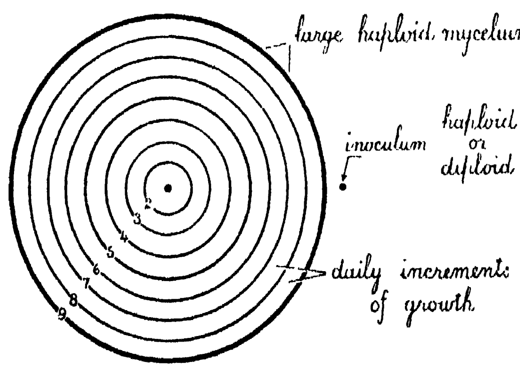


FIG. 3.—*Coprinus lagopus*. A large haploid mycelium which has been growing for 9 days on dung-agar. A tiny hyphal mass of another haploid mycelium of opposite sex or of a suitable diploid mycelium, called the *inoculum*, has just been set a little way from the periphery of the large haploid mycelium. Two-thirds the actual size.

Haploid mycelia (Fig. 1) are known by containing single isolated nuclei, by having simple septa devoid of clamp-connexions, by the wide-angled mode of branching of their leading hyphæ, and by bearing oidia. Diploid mycelia (Fig, 2,

* Substance of a paper communicated to a meeting of the Fifth International Botanical Congress at Cambridge, Aug. 19, 1930.

left) are known by their cells containing pairs of conjugate nuclei, by having a clamp-connexion at each septum, by the narrow-angled mode of branching of their leading hyphæ, and by not bearing oidia. Clamp-connexions, as shown by the cytological investigations of Mlle. Bensaude, Hans Kniep, and others, are the outward and visible sign that the adjacent cells are diploid in that these cells contain a pair of nuclei of opposite sex.

A large haploid mycelium (*AB*), which had been growing on a dung-agar plate for 9 days (cf. Fig. 3), was inoculated with a small hyphal mass of a haploid mycelium (*ab*). The two mycelia soon fused hyphally and mutually *diploidised* one another, that is, (*ab*) nuclei entered the mycelium (*AB*), divided and subdivided, and established pairs of conjugate nuclei (*AB*) + (*ab*) in every cell of the peripheral hyphæ of (*AB*), while (*AB*) nuclei entered the mycelium (*ab*), divided and subdivided, and established pairs of conjugate nuclei (*AB*) + (*ab*) in every cell of the peripheral hyphæ of (*ab*). This was indicated by the appearance of clamp-connexions. In the large haploid mycelium (*AB*), clamp-connexions appeared on the (*AB*) hyphæ on each side of the inoculum (*ab*) progressively (*see* crosses in Fig. 4): and the diploidisation† of the (*AB*) mycelium was effected in the course of three days. In 42 hours after the (*ab*) inoculum had been deposited and about 40 hours after the (*ab*) and (*AB*) mycelia had come into contact with one another, clamp-connexions had appeared at a distance of 6 cm. or 60 mm. from the inoculum. Therefore (*ab*) nuclei must have moved through the hyphæ of the (*AB*) mycelium at an average rate of at least 1·5 mm. per hour. The nuclei could not move in a straight line like that shown in Fig. 4, because the mycelium (*AB*) was a three-dimensional hyphal net-work. The (*ab*) nuclei must have taken a zigzag path and, therefore, their speed of movement doubtless exceeded 2 mm. per hour. As Lehfeldt's cytological work on *Typhula erythropus* has shown,[3] the septa of a haploid mycelium undergoing diploidisation break down and thus allow nuclei to pass along the hyphæ.

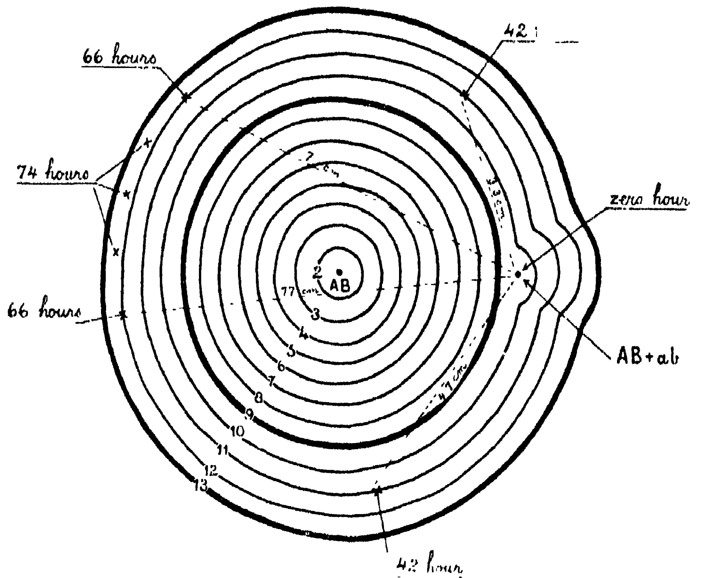


FIG. 5.—The diploidisation of a large haploid mycelium (*AB*) by a *diploid* mycelium (*AB*) + (*ab*). The (*AB*) mycelium was inoculated with a tiny hyphal mass of the (*AB*) + (*ab*) mycelium after 9 days of growth (periphery shown by heavier inner circle, No. 9) at the zero hour. The diploid mycelium diploidised the haploid mycelium in a little more than three days. The crosses show where clamp-connexions were observed at particular times. The (*ab*) nuclei must have travelled more than 7·7 cm. or 77 mm. through the (*AB*) hyphæ in about 64 hours, or more than 1·2 mm. per hour. Two-thirds the actual size.

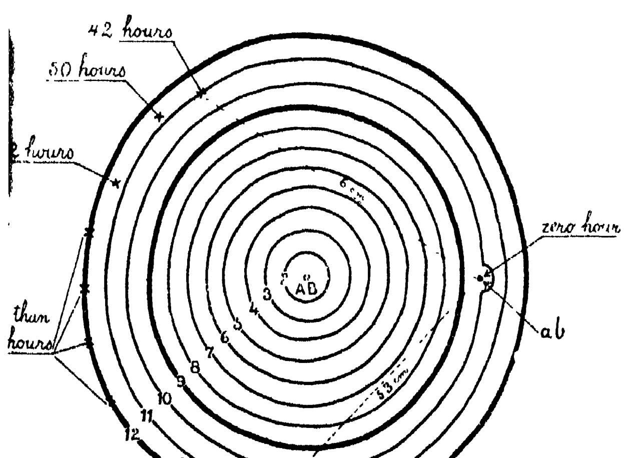


FIG. 4.—The diploidisation of a large haploid mycelium (*AB*) by another *haploid* mycelium (*ab*) of opposite sex. The circles 2-12, originally drawn in blue pencil on the under side of the Petri dish, show the boundary of the mycelium from the end of the second to the end of the twelfth day. The (*AB*) mycelium was inoculated with a tiny hyphal mass of an (*ab*) mycelium after 9 days of growth (periphery shown by heavier inner circle, No. 9) at the zero hour. The (*ab*) mycelium diploidised the (*AB*) mycelium in the course of three days. The crosses show where clamp-connexions were observed at particular times. The (*ab*) nuclei must have travelled more than 6 cm. or 60 mm. through the (*AB*) hyphæ in about 40 hours, or more than 1·5 mm. per hour. Two-thirds the actual size.

The radial rate of growth of the (*AB*) mycelium of Fig. 4 was 0·15 mm. per hour. Therefore the rate of movement of the (*ab*) nuclei along the hyphæ of the (*AB*) mycelium —upwards of 2·0 mm. per hour—was more than thirteen times the rate of elongation of the leading radial (*AB*) hyphæ.

Fig. 5 illustrates an experiment similar to that just described, except for the important fact that a *diploid* inoculum was employed instead of a haploid. The combination was a large haploid mycelium (*AB*) and a small diploid inoculum (*AB*) + (*ab*). Again the large haploid mycelium was progressively diploidised. In this case, doubtless, (*ab*) nuclei left the diploid inoculum, entered the (*AB*) mycelium, there divided and subdivided, and so provided mates

† The term *diploidisation* has been introduced here for the first time to designate the process by which a haploid cell is converted into a diploid cell or a haploid mycelium into a diploid mycelium by the formation of conjugate nuclei within the cell's or the mycelium's interior. A haploid mycelium of one sex may be said to *diploidise* a haploid mycelium of opposite sex.

to form conjugate pairs with all the (AB) nuclei in the peripheral hyphæ of the (AB) mycelium.

It has been found that a diploid mycelium $(AB)+(ab)$ can rapidly diploidise a haploid mycelium (AB) or a haploid mycelium (ab); and also that a

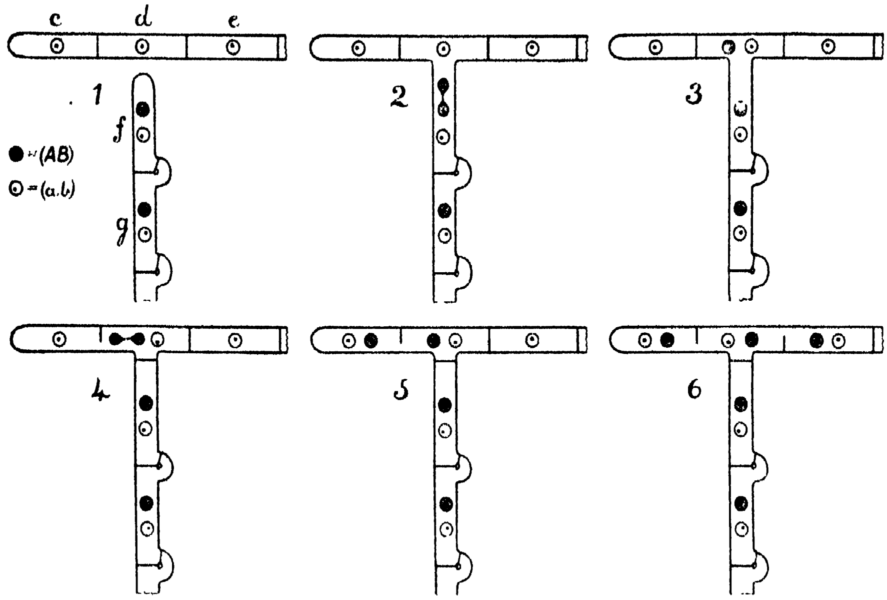


FIG. 6.—Diagram to show the diploidisation of a haploid mycelium (ab) by a *diploid* mycelium $(AB)+(ab)$. No. 1: the cell f of the diploid hypha fg is growing toward, and soon will meet and fuse with, the cell d of the haploid hypha cde. No. 2: fusion has taken place and the (AB) nucleus of f is dividing. No. 3: one of the daughter (AB) nuclei has passed into the cell d, thus diploidising it. No. 4: a wall now separates the cells d and f, and the (AB) nucleus in the cell d is dividing. No. 5: the wall between the cells c and d is partly broken down and one of the daughter (AB) nuclei has passed through it from d to c. No. 6: the (AB) nucleus of the cell d has again divided and sent one of its daughter (AB) nuclei into the cell c. Thus the diploid cell f diploidised the haploid cell d and the diploid cell d in its turn diploidised first the haploid cell c and then the haploid cell e.

diploid mycelium $(Ab)+(aB)$ can rapidly diploidise a haploid mycelium (Ab) or a haploid mycelium (aB).

The discovery that a diploid mycelium can diploidise an appropriate haploid mycelium is of considerable interest from two points of view: (1) It indicates that, in *Coprinus lagopus* and other similar fungi, the normal matings in dung-balls, wood, and other substrata in Nature are not merely the haploid matings $(AB)\times(ab)$ and $(Ab)\times(aB)$ but are also the haploid-diploid matings $(AB)\times(AB)+(ab)$, $(ab)\times(AB)+(ab)$, $(Ab)\times(Ab)+(aB)$, and $(aB)\times(Ab)+(aB)$; and (2) it also indicates that a diploid cell containing a pair of conjugate nuclei can diploidise a haploid cell containing a single nucleus, and thus gives us a clue to the biological significance of conjugate nuclei. This last point will now be discussed.

When, in a haploid-diploid combination, a diploid cell containing a pair of conjugate nuclei, say $(AB)+(ab)$, comes into contact with a haploid cell containing a single nucleus, say (ab), doubtless the (AB) nucleus—possibly in response to a stimulus received from the unpaired (ab) nucleus—*divides* and sends off one of the daughter nuclei into the haploid cell (Fig. 6, stages 2 and 3). Thus, in a very simple way, a diploid cell can diploidise a haploid cell. Doubtless, also, when a large haploid mycelium has been inoculated with a tiny hyphal haploid inoculum of opposite sex, the progressive diploidisation of the large haploid mycelium is due essentially to the fact that a diploid cell is able to diploidise neighbouring haploid cells in the manner just suggested (cf. Fig. 6, stages 3-6).

If, when a large haploid mycelium (AB) made a hyphal fusion with a small haploid inoculum of opposite sex (ab), an (ab) nucleus on passing into an (AB) cell immediately fused with the (AB) nucleus there present, an $(AaBb)$ nucleus would result and progressive diploidisation of the thousands of other (AB) cells the (AB) nuclei of which awaited partners would be impossible. However, since the (ab) nucleus is attracted by, but does not fuse with, the first (AB) nucleus it meets, it is possible for it to divide and send off a daughter (ab) nucleus into the next haploid (AB) cell and thus contribute to the diploidisation process.

The organisation of the nuclei in conjugate pairs $(n)+(n)$ instead of as isolated nuclei $(2n)$ i the diploid myceliu a fruit-body of *Coprin lagopus* and oth Hymenomycetes results, it is true, in delayi the fusion of nuclei of opposite sex until t

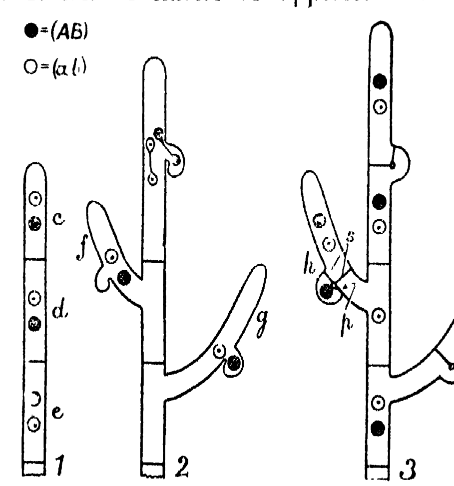


FIG. 7.—Diagram to show how a haploid hypha after it has just been diploidised develops further. No 1: a haploid hypha (ab) or (AB) which has just been converted into a diploid hypha $(AB)+(ab)$; a pair of conjugate nuclei are present in each cell. No. 2: the cells d and e have branched and the cell c has elongated; in f a hook has grown backwards; in g an (AB) nucleus has passed into the hook; in the terminal cell c, the two nuclei are dividing conjugately and the hook is growing toward the main hypha. No. 3: in the branch f the two daughter pairs of conjugate nuclei have separated from one another and two septa s have been formed, but the lower (AB) nucleus is momentarily a prisoner in the hook-cell h, from which it will escape as soon as the walls at p have broken down; in the branch g and the terminal cell c conjugate nuclear division and cell-division with the formation of a clamp-connexion is complete and each daughter cell contains a pair of conjugate nuclei (AB) and (ab).

basidia come into existence, but it has the great advantage that, in the diploid mycelium or in a diploid cell of a haploid mycelium under-

going diploidisation, each member of a pair of conjugate nuclei retains its identity, so that one member of a pair can divide independently of the other member of the pair whenever such a division is able to promote the diploidisation of another haploid mycelium or of an adjacent haploid cell.

The sexual process (fertilisation or conjugation) of animals and most plants is relatively simple in that two *unicellular* and *uninucleate* gametes fuse to form a unicellular and uninuclear zygote. On the other hand, in the Hymenomycetes the sexual process is more complicated, because it takes place between *multicellular* and *multinucleate* mycelia and results in *the diploidisation of all the growing cells of each mycelium.* It is the non-fusion of nuclei of opposite sex and the establishment of conjugate pairs of nuclei which makes this diploidisation possible.

The development of a haploid hypha (*ab*) or (*AB*), which has just become diploidised owing to the entry into it of nuclei derived from either a haploid mycelium of opposite sex or from a diploid mycelium (*AB*) + (*ab*), is shown in Fig. 7, where it will be seen that, as the cells grow in length or branch, conjugate nuclear division takes place, and that each conjugate nuclear division is accompanied by the formation of a clamp-connexion. When, in a dung-ball, a diploid mycelium of *Coprinus lagopus*, like that shown in Fig. 7, stage 3, meets a haploid mycelium (*AB*) or (*ab*) of the same species (*cf.* Fig. 2) the diploid and the haploid mycelia doubtless fuse hyphally and the diploid mycelium diploidises the haploid mycelium (*cf.* Fig. 6), thus increasing the chances that one or more vigorous diploid fruit-bodies developing all the possible sexual kinds of spores (*AB*), (*ab*), (*Ab*), and (*aB*) will be produced rather than one or more relatively feeble haploid fruit-bodies developing only one of the four possible sexual kinds of spores. There can be no doubt that, in *Coprinus lagopus* and in other similar Hymenomycetes, the diploidisation of haploid mycelia by appropriate diploid mycelia is a distinct aid to reproduction.[4]

In conclusion, the author desires to acknowledge a grant in aid of the work made by the Research Council of Canada and valuable assistance in making the experiments given by Miss Ruth Macrae.

[1] W. F. Hanna, "The Problem of Sex in *Coprinus lagopus*", *Annals of Botany*, vol. 39, pp. 431-457; 1925

[2] Dorothy Newton, "The Distribution of Spores of Diverse Sex on the Hymenium of *Coprinus lagopus*", *ibid.*, vol. 40, pp 891-917; 1926.

[3] W. Lehfeldt, "Über die Entstehung des Paarmycels bei heterothallischen Basidiomyceten", *Hedwigia*, Bd 64, pp. 30-51; 1922.

[4] A fuller discussion of conjugate nuclei has been prepared for vol. 4 of the author's "Researches on Fungi".

Recent Hydro-Electric Developments in Switzerland.

By Dr. BRYSSON CUNNINGHAM.

FROM the report for 1929 of the Swiss Service des Eaux, it is to be gathered that developments of hydro-electric energy have been prosecuted during recent years with unabated enterprise and zeal. There was merely a slight falling-off during 1929 in the productive capacity of the power stations, due essentially to the intense cold in the early part of the year and to depletion of the water supplies in the autumn. The returns show a total of 4178 million k.w.h. as compared with 4410 million k.w.h. and 4350 million k.w.h. in the two years immediately preceding. The adverse conditions necessitated recourse in a large measure to the supplies of water stored in the lakes, and the deficit was only made good towards the end of the year.

The most important installation put into operation during 1929 was the power station at Handeck, in connexion with the river Aar, an undertaking of the Forces Motrices de l'Oberhasli S.A., Innertkirchen. This has a present capacity of 60,000 horse power, with an ultimate possibility of 120,000 horse power. Among projects still in course of construction at the end of the year may be mentioned an installation on the Dixence in the Canton of Valais, of 175,000 horse power, and another of 50,000 horse power at Monte Piottino in the Canton of Ticino. An installation of 140,000 horse power at Ryburg-Schwörstadt on the Rhine will be partially Swiss.

It is computed that, on Jan. 1 last, the power stations in Switzerland, either in operation or in course of construction, aggregated a total capacity of about 2,700,000 horse power. Some of these stations are of considerable individual capacity, among them being those of Vernayaz (Canton Valais) for the Swiss Federal Railway, 108,000 horse power; Waggital (Zurich), 90,000 horse power; Löntsch (Glarus), 66,000 horse power; and Laufenburg (Rhine), 65,000 horse power.

A recent visit to the Engadine brought me into close proximity with a number of hydro-electric installations which have materialised during the past quarter of a century. The district is particularly rich in sites affording scope for power development and some of these have now been exploited almost to the full extent of their capacity. One of the most striking examples, which I had an opportunity of inspecting, is the undertaking of the Brusio Power Company, which has its headquarters at Poschiavo in the extreme south of the Canton of the Grisons and within a short distance of the Swiss-Italian frontier.

The series of stages by which the Brusio Power Company develops the hydraulic capacity of the southern slopes of the Bernina Range and the Poschiavo Valley commences at the summit level of the Bernina Pass, where there are two sheets of water forming a natural reservoir for impounding purposes at a level of 2200 metres above the sea. The two sheets of water, more or less frozen, of course, during a considerable part of the year, are Lago Bianco (White Lake) and Lago della Scala (the precise signification of which between 'staircase', 'scale', 'succession', and 'landing-place' is not easy to determine). The former is much the larger of the two, but they are so closely adjacent within a common depression as essentially to form

a single basin, which has been adapted so as to provide a supply of 15 million cubic metres of water for power purposes. To this end, the two lakes have been connected and by means of dams at each extremity of the basin the water level has been raised 5·5 metres, bringing the surface up to 2236·16 metres above sea level over an area of 1·36 square kilometres. Under normal working conditions, the water level can be lowered to 2226 metres, which is the state of affairs shown in the photographic view of the basin reproduced as Fig. 1. In order to augment still further the available resources, a set of three pumps has been installed for drawing water from the deeper portion of Lake Bianco, by means of which the level may be reduced to 2210·16 metres above the sea, the maximum difference in level between the fully impounded and the most depleted condition being thus increased to 26 metres.

FIG. 1.—The Bernina Lakes reservoir at the summit level of the Bernina Pass. View looking south. By courtesy of Die Kraftwerke Brusio.

The Bernina Lakes reservoir is fed by an average annual precipitation of 1500 mm. in the catchment basin and by summer seasonal meltings from the Cambrena glacier.

From the snow and ice of the Bernina ridges two main valleys descend towards the south and eventually merge into one another in the Poschiavo plain. One of these, the Val Pila, receives the natural overflow from the two lakes described above and also the discharge from the Palü glacier at the foot of Piz Palü on the ledge overlooking Cavaglia, where it gives rise to the torrent Cavagliasco; the other, the Val Lagoné, receives the flow of the upper Poschiavino, fed in turn by the streams from the Val di Campo. The Poschiavino, united with these tributaries at Robbia, passes through the valley of Poschiavo, having by this time attained an appreciable amplitude of flow, so far as Lake Poschiavo. This is an extensive natural basin lying at a level of 964 metres above the sea and having a superficies of 1·96 square kilometres. It is utilised to the extent of providing 14 million cubic metres of water for a power station below. For this purpose a retaining dam has been constructed across the bed of the Poschiavino at the point of exit from the lake and provided with an intake which is suitable for taking the discharge consequent upon lowering the lake level by 8½ metres. The lake is replenished in due course during the season of melting snow. After leaving the lake at Meschino, the Poschiavino descends 433 metres in a horizontal distance of 5 kilometres to the Swiss-Italian frontier at Campocologno. Beyond this station there is one further stage of development at the junction with the river Adda near Madonna di Tirano.

In all, the series of progressive developments consists of five power stations, situated in sequence at Palü, Cavaglia, Robbia, Campocologno, and Poschiavino. The first of these, which receives its supply direct from the Bernina Lakes and the Palü glacier, has

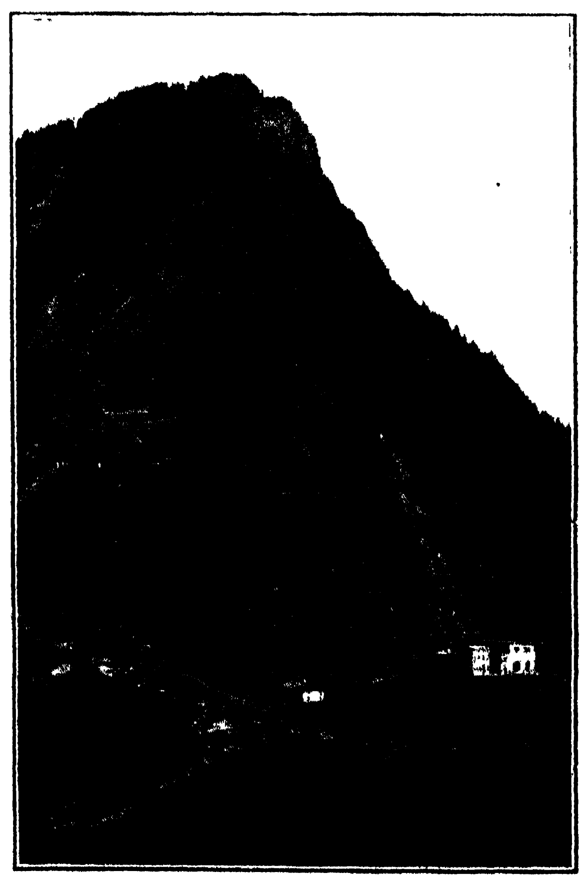


FIG. 2.—Power station at Robbia. By courtesy of Die Kraftwerke Brusio.

a capacity of 15,200 horse power; Cavaglia power station, at a height of 1709 metres above sea level, develops 10,000 horse power; Robbia (Fig. 2), at a height of 1082 metres, develops 16,000 horse power; Campocologno (Fig. 3), at the level of 531 metres, develops 45,000 horse power, making a total within Swiss territory of 86,000 horse power, to which is to be added the 14,000 horse power of the Poschiavino station, bringing the total up to 100,000 horse power.

Nor is this the full tale of possible exploitation. The storage capacity of the Bernina Lakes and of that at the foot of the Palü glacier are susceptible of further artificial developments. The waters of the upper reaches of the Poschiavino in the Val Lagoné and of its influents from the Val di Campo are capable of being brought into use, as well as those of the Cavagliasco, the Bernina, and the Palü.

The record as it stands at present, however, is a most interesting example of the detailed, step-by-step utilisation of the full resources of an Alpine watercourse from its source in the glaciers of the summit to its final absorption in the comparatively low-lying and slow-moving river in the valley below—a descent which amounts to nearly 6000 feet. The conditions, of course, cannot be paralleled in Great Britain, but they are of interest as indicating how vast resources of power in mountainous regions, which for lack of knowledge and need of incitement have been ignored or neglected in the past, are now being brought into effective service. The works in question have been executed during the period of a quarter of a century commencing in 1903, the first installation at Campocologno having materialised in 1906, and the stations at Palü and Cavaglia having been put into operation at the close of 1927. A tribute is due to the initiative and foresight of the progenitors of the undertaking, as well as to the skill and enterprise with which the various sections of the work have been designed and carried out. I must also take the opportunity of expressing my acknowledgments to the Brusio Power Company, and in particular to the director, Herr Rickenbach, for the facilities which were courteously afforded me for inspecting the whole series of stations and for the information and photographs which have been kindly supplied at my request.

The electric current which is generated at the respective stations is transmitted between them by three principal lines of alternating current, three-phase, 23,000 volts, 55,000 volts, and 140,000 volts. The joint supply is transmitted northwards for utilisation in Switzerland by the Bernina Railway, the Rhaetian Railway, and by various local centres in the Engadine and even so far as Zurich; southwards, it is exported into Italy, where it is linked up with the system of the Lombardy Company serving the province of that name.

Had time permitted, it would have been interesting to inspect the series of power stations belonging to the A. G. Bündner Kraftwerke and located in the valley of Prättigau in the Lower Engadine. These have been in operation since 1922–23 and comprise installations of 14,000 horse power at Küblis, of 10,000 horse power at Klosters, and of 7500 horse power at Schlappin. Ultimately, the aggregate of the capacities is to be increased to 55,000 horse power.

Also, alongside the track of the Rhaetian Railway from Bevers to Chur, there is a power station at Thusis at the entrance to the Via Mala Gorge which utilises the water of the Hinter Rhine and develops energy to the extent of 13,500 horse power, which is supplied for the use of the railway system. The Albula station not far distant, of 26,600 horse power, should also be mentioned: it supplies current to the municipality of Zurich, as also does the Heidsee station of 13,000 horse power. Other sites are in course of exploitation.

FIG. 3.—Power station at Campocologno. By courtesy of Die Kraftwerke Brusio.

Sufficient, however, has been enumerated to show that, even on a quite casual and very cursory survey, there is impressive evidence of notable activity in the realisation to the fullest possible extent of the wonderful hydraulic resources of the numerous mountain chains which form the predominant and characteristic feature of the country. That this development has been and is of the greatest economic benefit to the Swiss community cannot be doubted for a moment. Natural hydraulic power is an asset of the highest importance, self-replenishing, and, unlike coal deposits, not subject to exhaustion.

Impressive and inspiring as is the solemn

grandeur of the crests and pinnacles of massive rock and ice which tower to the heavens in stately solitude, great mountain ranges have a further claim to distinction in an age of pressing utilitarian needs. The Alpine panorama with its multitudinous snowfields, glaciers, torrents, lakes, and rivers is no less wonderful as an example of how Nature contrives to compensate a country for its economic deficiencies in one respect by benefits of equivalent value, though of another kind.

Obituary.

DR. LEWIS EVANS.

IN the Lewis Evans Collection of Historic Scientific Instruments is a small jointed rule of ivory, inset with a compass needle, and engraved as a portable sundial. It was a special favourite of Dr. Lewis Evans, whose death occurred on Sept. 25 last, because it bears the inscription, "Registered 1853", which by a happy chance was the year of his birth, on Feb. 15. Twenty years later Francis Galton might well have included the Evans family among those English men of science whose hereditary influences and education he described at the Royal Institution, for at least four generations have achieved scientific distinction. The Rev. Lewis Evans, vicar of Froxfield, 1788–1827, was an accomplished mechanician and astronomer, who ground his own specula, recorded observations, and continued to 1864 the calculations on Ferguson's Astronomical Instrument and Rotula, published in 1817. He had been educated at Merton College, Oxford, was instructor in mathematics at the Royal Academy at Woolwich, and became a fellow of the Royal Society in 1823. He was in the habit of communicating mathematical notes to the *Reading Mercury* under the *nom de plume* of 'Felix Ford' (anagram of Froxfield), some of which are preserved with his lecture MSS. in the Lewis Evans collection. One of his sons, Thomas Simpson Evans, LL.D., became an assistant at Greenwich and, later, mathematical instructor at Woolwich. His grandson, Sir John Evans, K.C.B., for many years treasurer of the Royal Society, attained to special eminence as an antiquary, a branch of study which has been materially extended by both his sons—Arthur, who has also the scientific blue-ribbon of F.R.S., and Lewis, the subject of this notice, who died on Sept. 25. On the distaff side, two ancestors had also achieved similar distinction, namely, John Dickinson, F.R.S., F.S.A., and George Dionysius Ehret, F.R.S., the inimitable flower painter, who was born at Erfurt in 1708, and died at Chelsea in 1770.

Owing to the great demands made upon his time and energy by the needs of a great manufacturing business, Lewis Evans was more than forty years of age before he published his first paper, "On Pocket Sundials", a modest article illustrated by neatly executed cuts of the author's own drawing. This was followed by a fuller contribution upon the same subject to Mrs. Alfred Gatty's standard "Book of Sundials", 1900. His knowledge was largely based upon his own rapidly expanding collection of scientific instruments, in which a perfect Roman portable dial of about A.D. 300 was then one of the greatest treasures. In 1901 there appeared in *Archæologia* the account of another of his discoveries—the original dial of gilt brass made for Cardinal Wolsey by Nicholas Kratzer, who at the time was "reading Astronomy in the University by the command of King Henry VIII. and soon after made by Cardinal Wolsey his Mathematical Reader when he first settled his lecture there". Kratzer was made a fellow of Corpus by Richard Fox in A.D. 1517.

From this time on, many writers at home and abroad drew upon the experience of Dr. Evans, notably Dr. Joseph Drecker of Dorsten, and with the dispersal of other collections his own collection grew. It was many years before he could obtain an astrolabe, but "nothing succeeds like success", and the first he acquired was soon followed by some three score others, the most important of which he figured and described in "Some European and Oriental Astrolabes", in the *Archæological Journal* in 1911. In 1922 he offered the whole of his unique collection of dials and early scientific books and instruments to the University of Oxford: It is by far the most important collection of the kind that has ever been given to a university, and owing to peculiar circumstances, the present gift is a lasting memorial to the noble-minded generosity of the donor: for, like the Mensing collection, it might quite easily have been sold for a fortune to America, and thus have been lost to Europe. Incidentally it has served as a nucleus around which other benefactors, including many Oxford colleges, have deposited instruments and objects of value for illustrating the progress of scientific studies and research in the University. In the past five years the space needed for the proper exhibition of the collection has doubled in area, and apparatus of the very greatest importance has had to be refused, on the ground that the best exhibition space available in the Old Ashmolean Building is still being occupied by the staff and books of the English Dictionary, although that work was completed many months ago.

As was recently pointed out in NATURE in a letter signed by the president of the Institute of Physics and others, scientific instruments, often the landmarks of invention, are lost so long as they are hidden and not in the charge of someone who appreciates their scientific value. No one realised this more vividly than did Dr. Lewis Evans himself. Although an ardent admirer of art and craftsmanship, he felt that to place unique instruments of science among art objects in a gallery of art, as is the case in the British Museum and at South Kensington in London, or at the Ashmolean Museum in Oxford, or to group scientific apparatus among books and to catalogue it as 'manuscripts', as is now the practice in the Bodleian Library, is both derogatory to science and destructive to the proper study of its history. He therefore determined that

his collection should either 'go to the hammer', or else be shown as a scientific collection with all the advantages of exhibition that art collections usually enjoy. By the greatest good fortune, a part of the most historic building connected with the early history of science in Britain, the Old Ashmolean, was available, and this being approved by Dr. Evans, was allocated by the University to his collection. The Goldsmiths' Company voted £1000 for initial expenses, and is now offering £500 more if and when a greatly needed extension of exhibition space is forthcoming either in the Old Chemical Laboratory or in the original meeting-room of the Oxford Scientific Society of 1683. A benefactor to complete the good work which Dr. Lewis Evans has so generously begun is urgently needed, for the losses of most important instruments are great and are continuing. R. T. G.

THE RIGHT HON. EDWARD ALLEN, BARON BROTHERTON OF WAKEFIELD.

THE career of a great industrial leader is not one which demands from him a platform exposition of his aims, policy, and programme as a condition of success, but perhaps all the more on that account any self-revealing utterances from such a man have a peculiar interest and special value. With Lord Brotherton, who died on Oct. 21 at the age of seventy-four years, it so happened that, in the last few months of his long and strenuous life, circumstances combined to break the barriers of constitutional reserve and led him to speak to sympathetic listeners of his experiences and aspirations.

Three occasions, different in character, come to the mind of the present writer. The first of these was the laying of the foundation-stone of the Brotherton Library at the University of Leeds. Lord Brotherton there spoke in firm voice and measured sentences of carefully prepared wording to an audience of the University and its friends. It was a dignified expression of what was in his mind in making this generous monetary gift, which should enable the University to erect a noble building for the housing of its library, and in adding thereto not only the fine collection of books which it had been his pride to bring together in his own home, but also an endowment to secure their care and maintain their usefulness.

On the same evening Lord Brotherton was the guest of the University at a dinner, and there, speaking with feeling and in simple, direct, and unprepared language, it was evident that he had the greatest possible wish to escape from his habitual reserve, and to get into closer human contact with the members of the Senate and others whose academic life and outlook were necessarily so different in some respects from his own. The sincerity and unconventionality of this speech were remarkably impressive.

On the third occasion, a little later, Lord Brotherton was in the midst of his fellow-members of the Society of Chemical Industry, who had marked their appreciation of his high standing and achievements as a master of their calling by conferring upon him the Messel medal and inviting him to deliver the Messel lecture at the annual meeting of the Society in Birmingham. He expressed at once his intention of dealing with what he knew best, and told the story of his own connexion with industrial chemistry. He told how he left Owens College to engage, in the first place, in the manufacture of ammonium sulphate, and showed how he was able to extend his operations in various directions, mainly by organisation, insight into the opportunities presented by the introduction of new chemical processes, and the determination to place his resources boldly at the back of any venture which had won his confidence. So came into being and good fortune the firm which bore his name, and so later arose his connexion with the Cassel Cyanide Company, of which he became chairman in succession to Sir George Beilby.

These three occasions of self-explanation came close in time to the termination of a career marked in equal measure by outstanding achievement and the exercise of a large-minded generosity.

J. W. COBB.

DR. E. H. WILSON.

THE death of Dr. Ernest Henry Wilson on Oct. 15, as the result of a motoring accident, will be lamented in botanical and horticultural circles, not only in Britain and America, but also throughout the world, for Wilson's activities were truly international. The news to hand from the Arnold Arboretum states that Mr. and Mrs. Wilson were returning from a visit to their daughter and her husband, Mr. and Mrs. G. L. Slate, at Geneva, New York State, when their car skidded on the greasy surface while travelling on the Boston Road, Worcester, Mass., crashing through a fence and down a 40-feet embankment. Mrs. Wilson was killed outright, and Dr. Wilson died soon after admission to hospital.

Wilson was born at Chipping Campden, Gloucestershire, on Feb. 15, 1876. He entered the Birmingham Botanic Gardens as a student in 1892 and moved to Kew in January 1897. In the lecture room and in the practical work of the Gardens it is evident that Wilson soon attracted attention, as he obtained first place in several of the lecture courses, and was awarded the Hooker Prize of the Mutual Improvement Society for an essay on Coniferæ. Wilson's next move was to the Royal College of Science, South Kensington, where he obtained a studentship with a view to becoming a teacher in botany.

At this time, the late Dr. Augustine Henry was sending home specimens—a few seeds, and letters descriptive of the floral wealth of Hupeh, China. Messrs. Veitch, of Chelsea, decided to send out a collector, and asked the then Director of Kew, Sir William Thiselton-Dyer, to recommend a suit-

able man. Wilson was chosen, and made his first journey between 1899 and 1902. This proved so successful that a second journey was made during 1903-5. Two further trips followed in 1907-9 and 1910-11, these journeys being on behalf of Harvard University and a few subscribers. The results of his labours are recorded in "Plantæ Wilsonianæ", which contains descriptions of 3356 species and varieties. Of these, nearly nine hundred were new, including several new genera. In 1914 and 1917 Wilson made two journeys to Japan. He was appointed Assistant-Director of the Arnold Arboretum in 1919. The next year he set out on a two years' tour through Australia, New Zealand, India, and Central and South Africa. On the death of Prof. C. S. Sargent in 1927, Wilson was appointed Keeper of the Arnold Arboretum.

An untiring worker, Dr. Wilson found time to write nearly a dozen books on his plant collections and studies. The best known of these are: "A Naturalist in Western China", 1913; "Cherries of Japan", 1916; "Conifers and Taxads of Japan", 1916; "Lilies of Eastern Asia", 1925; and "Aristocrats of the Garden", 1926. His work received recognition from numerous learned societies, including the Victoria medal of the Royal Horticultural Society in 1912, the Geoffrey St. Hilaire gold medal, the George Robert White medal, the Veitch memorial medal, and the Rhododendron Society's cup. He was a fellow of the American Academy of Arts and Sciences, an honorary M.A. of Harvard University, and in June last Trinity College, Hartford, Conn., conferred on him the degree of D.Sc.

As a plant collector, botanist, horticulturist, and author, Dr. Wilson possessed great knowledge of his subjects. He was also himself a very likeable man, which makes his loss the greater. A. O.

PROF. FLORIAN CAJORI.

WE much regret to record the death, which occurred on Aug. 14, of Prof. Florian Cajori, professor of the history of mathematics in the University of California. An appreciation of his work by Prof. David Eugene Smith appears in *Science* of Sept. 19, to which we are indebted for the following particulars. Florian Cajori was born in Switzerland on Feb. 28, 1859, and went to the United States when he was sixteen years of age. Between 1889 and 1918 he was at Colorado College, first as professor of physics, later as professor of mathematics, and finally as dean of the Department of Engineering. Throughout this period he paid particular attention to the history of his subjects. In 1918 he went to the University of California as professor of the history of mathematics. Cajori was the author of several works on the history of the physical sciences and mathematics, and at the time of his death was engaged on an edition of Newton's "Principia". His most important work was "The History of Mathematical Notations" (2 vols., 1928, 1929); while his "History of the Logarithmic Slide Rule" (1909) is still one of the most authoritative treatises on the subject.

WE regret to announce the following deaths:

M. Paul Appell, president in 1914 of the Paris Academy of Sciences, and more recently Rector of the University of Paris, who was distinguished for his mathematical work, on Oct. 23, aged seventy-five years.

Dr. W. R. Eckardt, director of the Meteorological Observatory at Essen, and author of "Grundzüge einer Physioklimatologie der Festländer", aged fifty-one years.

Dr. W. M. W. Haffkine, C.I.E., formerly bacteriologist with the Government of India, distinguished for his research work on plague and cholera, on Oct 26, aged seventy years.

News and Views.

No one more appropriate than Mr. H. G. Wells could have been found to introduce Prof. L. T. Hogben to his audience on Thursday, Oct. 23, when he read himself in as professor of social biology at the London School of Economics. Mr. Wells hailed the new experiment in bringing biology and economics together as the portent of a complete change of direction and method for the social and economic sciences, and spoke of it as a most exciting event. He did not spare the traditional treatment of the dismal science, which, dealing with human things, was, he said, entirely inhuman. While pretending to be a science, it began with hypotheses and definitions in the mediæval manner, and maintained to the present time the flavour of scholasticism. It would not have been Mr. Wells if he had not clearly been rejoicing in the belief that the new chair would be revolutionary: with the rapid advances in the knowledge of the biology of man made in the last quarter of a century, the new body of knowledge which can be brought to bear on sociology and economics will bring them within the region of pure scientific treatment. He defined the scope of Prof. Hogben's work as the treatment of one special case of the science of ecology, the science of the balance and welfare of species the study of the fluctuations of the human species under the fluctuating pressure of circumstances. Mr. Wells paid the London School of Economics the compliment of finding the establishment of research into this new byway of science only what one would expect of it, and he described the new professor as a most hopeful and desirable adventurer.

PROF. HOGBEN'S address, a synopsis of which appears elsewhere in this issue, did nothing to damp the liveliness of Mr. Wells's hopes and anticipations. It was a brilliant example of the exposition of a difficult scientific thesis in terms of smooth prose enriched by a wealth of humour and literary allusion. Prof. Hogben is not overwhelmed by the scope or the difficulty of the adventure on which he has embarked. Although Mr. Wells suggested that he was about to cut the first furrow in an almost virgin soil, it is plain enough that the territory has already been surveyed, and that it will not be a random

direction that this furrow will take. Nevertheless, Prof. Hogben sounded warning notes. He pointed out that the outlook which evolutionary biology brings to the study of human society is neither a philosophy of social reform nor a philosophy of social reaction but a philosophy of social discovery. Above all, he drove home the need for discipline, restraint, and detachment in the discussion of the genetical foundations of racial and occupational stratifications in human society. To force the issues into the political arena at the present stage of inquiry would be to render these virtues impossible to exercise. In conclusion, Prof. Hogben, changing the metaphor, begged that an astronomical estimate should be taken of the time required for the seed now being sown to germinate. Accepting the conclusions of Sir James Jeans, the School of Economics has five million million years of life in which to cherish and tend it. Prof. Hogben indicated that he confidently relied upon the School, with its tradition of free inquiry, to extend the necessary care and sympathy in its early, tender stages.

Sir David Prain's Alexander Pedler Lecture, delivered in the University of Liverpool on Oct. 22, under the auspices of the British Science Guild and the University, explored the troublesome problem of the academic attitude towards applied science. The term science discipline, which was Huxley's description of the methods of obtaining natural knowledge contrasted with technical exercise in the employment of natural knowledge, opened the door for a review of Huxley's ideas concerning the place of science in the universities, side by side with an historical account of the changing mutual relationships of the arts and the sciences since the fourteenth century. Sir David Prain had no difficulty in showing that in Huxley's mind the purpose of science discipline was twofold: to furnish those who wished to serve the community scientifically with the kind of natural knowledge that would prepare them for technical training, as well as to render all scholars in any ideal university competent to appreciate the scientific help afforded the community by those specially trained to give it. To orientate the first of these purposes falsely, while wholly ignoring the second, is to accentuate the antithesis held to exist between 'pure' and 'applied' science, and leads to the neglect by those entrusted with university organisation of the 'patient study' of the special features of science discipline for culture and science discipline for training that Huxley clearly envisaged. The idea that an advance in natural knowledge, however slight, is of greater consequence than any application of natural knowledge, however important, arises from an unreal distinction between 'pure' and 'applied' science. Teachers of natural history in the eighteenth century used system, and teachers of philosophy in the sixteenth century used controversy, as ends in themselves, with well-known consequences. Twentieth century teachers of science, said Sir David Prain, have to guard themselves against a like misuse of discovery.

Huxley's views concerning the place of science in universities were comprehensive. Science implanted in the misnamed 'Arts' faculty was to lead men to an understanding of all the methods of obtaining knowledge. Acquisition was incidental, but inevitable and extensive. The science faculties were to be intensive, supplementary to arts, and preparatory to training, but nevertheless cultural as a matter of necessity. It is a curious reflection on the antagonisms that praise of the useful engenders that art (in the unequivocal singular) has survived similar trials. Surely no artist now ever worries his head about 'art for art's sake', not because he has comprehended this once provocative assertion or disposed of it, but because it has ceased to stand for anything real. A quarter of a century later, science for science's sake still has power to wound. Science for the sake of its supreme intellectual interest is not something that leads to the contrasting of "second-rate advancement with first-rate application". Active and powerful minds are not usually undiscriminating. They imply, as a rule, powerful motives. Science for the sake of its impressive material consequences is none the less science. Another reflection concerning the place rather than the matter of Sir David Prain's stimulating address, is that the University of Liverpool is now the only 'scientific body' in Liverpool that could invite an Alexander Pedler lecturer in accordance with the conditions of the foundation. The courtesy of the University is warmly appreciated by those concerned in arranging the lecture; but it may be remarked, for the encouragement of creative culture in Liverpool, that the learned societies that still flourish in some Scottish and provincial centres have not only a great and honourable past but also a respectable present and a worthy future. Reference books give the Royal Institution of Liverpool a theatre, a library, a lecture-room, a museum, a room for the use of scientific instruments, and even a laboratory. The functions that these amenities suggest should be restored to it.

The centenary celebrations of the Royal Geographical Society began on Oct. 21, when the Duke of York, representing the King, who is the Society's patron, formally opened the new lecture theatre and the library and other buildings which have been added to the Society's house at Lowther Lodge, Kensington Gore. In declaring the building open, the Duke of York mentioned that the Society is the third of the great geographical societies of the world to celebrate its centenary, having been preceded only by the Société de Géographie de Paris in 1921 and the Gesellschaft für Erdkunde of Berlin in 1928. The new lecture hall has seating accommodation for at least 860 and its acoustics are admirable. A wide ambulatory connects the old building with the new, and its circuit gives ample space for movement and conversation after evening meetings. The library and map collections now have considerably increased space. Addresses of congratulation were presented by delegates representing many geographical societies throughout the world and kindred societies in Great Britain. Several of the visiting delegates were made honorary members of the Society.

On the evening of the opening day of the celebrations, addresses on the history of the Royal Geograph-

ical Society were delivered by Sir Charles Close (president), Dr. H. R. Mill, Mr. D. Freshfield, Sir Francis Younghusband, and the Marquess of Zetland. On the following day there began a series of papers on the habitable globe. Dr. A. Penck refuted the theory that within historic times there has been any considerable or progressive change of climate in Central Asia, and Prof. J. W. Gregory outlined the evidence against any change of climate in Palestine within the same period. Mr. L. B. S. Leakey, in speaking of East Africa, stated that the suitability of conditions in that country for permanent white settlement have yet to be proved, but he believes that they are probably favourable. This series of papers was continued on the next day by Prof. A. M. Carr-Saunders and others, and several short papers on striking episodes in recent explorations were given by various travellers. Other events in the celebrations included a reception of delegates and fellows in the Society's house on Oct. 22 and a centenary dinner on Oct. 23, at which the Prince of Wales presided.

THE centenary of the birth of John Whitaker Hulke, eminent as a surgeon and a geologist, occurs on Nov. 6. In his day he was president of the Geological Society of London (1882-84) and president of the Royal College of Surgeons (1893-95) an unusual association of scientific activities. Born at Deal, the son of a medical practitioner in the town, he was educated in Germany and at King's College School. He rendered medical service in the Crimean War, becoming afterwards surgeon to Middlesex Hospital, where, apart from geology, most of his life's work was accomplished. In 1859 his well-known essay, "Diseases of the Retina", was awarded the Jacksonian prize of his college. It was followed by a treatise on the ophthalmoscope, an instrument in use in Germany but at the time unfamiliar amongst English practitioners. He edited (with J. Burdon Sanderson) the collected papers of Sir William Bowman. Hulke was elected into the fellowship of the Royal Society in 1867, his claim being based exclusively on researches relating to the anatomy and physiology of the retina in man and the lower animals, particularly the reptiles. His knowledge of comparative anatomy, and especially of osteology, enabled him rapidly to grasp the meaning of structures presented by the remains of fossil vertebrates. It is said that he found relaxation from professional anxieties by working with his own facile chisel on the freeing of fossils from their matrices. Hulke was a faithful servant of the Geological Society, occupying not only the presidential chair, but also filling the posts of secretary and foreign secretary. He died in London, on Feb. 19, 1895.

THE Freshwater Biological Association, the principal object of which is to secure the establishment of a freshwater research station to investigate the numerous outstanding problems of freshwater biology, has secured the support of the leading scientific societies and of a large proportion of the bodies interested in water pollution, freshwater fisheries, and the like. The conference convened by the Council of the Association at Fishmongers' Hall on Feb. 21 last (see NATURE, Feb. 15, p. 241) afforded striking evidence of the interest displayed, and showed that there was a real and widely felt need for such a station. Promises of financial support in the form of annual grants have been received from many sources, but they are conditional upon the actual founding of the station as a research centre. The Council is therefore making an appeal for contributions towards a fund for the establishment and initial equipment of the station, and several hundred pounds have already been subscribed. To make a satisfactory beginning a sum of between three and four thousand pounds is, however, required. The Council is appealing especially to those interested in freshwater, such as public bodies responsible for water supply, medical officers of health, water and sanitary engineers, fishermen, and naturalists, who should realise the importance of the projected station in relation to the conservation and development of freshwaters and their amenities on an economic and scientific basis. Contributions should be sent to the treasurer of the Association, Mr. D. J. Scourfield, 6 Chadwick Road, Leytonstone. The chairman of the Council of the Association is Prof. F. E. Fritsch, and Mr. F. Balfour-Browne, Winscombe Court, Winscombe, Somerset, is acting secretary.

IN an address to the Liverpool Centre of the Institution of Electrical Engineers, delivered on Oct. 20, Mr. A. J. Pratt gave interesting statistics illustrating the very rapid growth of telephony. The first actual talking instrument was constructed in 1875, and on Mar. 7, 1876, the famous Bell patent was issued. In 1929 the Bell System of the American Telephone and Telegraph Co. controlled ninety million lines, with a total of about sixty-five million calls a day. If we count companies in the United States, we find that the Bell Telephone Co. is only one in ten thousand. Some of these companies, however, are very small. A universal linkage of all the telephones in the world by the aid of radio transmission is in process of realisation. It is impossible to separate the local exchange from the long-distance telephone system, as each is mutually dependent on the other. In Great Britain an immense programme of building and exchange plant reconstruction has been worked out since the War. There are now nearly 5000 exchanges, more than 300 of which are automatic. When the business man, following the American custom, needs a telephone not only in his office but also in his sitting-room and bedroom, the present rate of growth of telephony will rival that of radio broadcasting in Britain, which in the short space of seven years has attracted more than three million licensed listeners. Post Office officials consider it very desirable that the telephone habit be cultivated. It is suggested that this can be done by a wider application of the use of the internal extension telephone.

THE presidential address delivered at Newcastle on Oct. 24 by Mr. J. McGovern to the North-East Coast Institution of Engineers and Shipbuilders was devoted to a brief review of modern shipbuilding. Referring to the position of the north-east coast of Britain in the shipbuilding and engineering industry, Mr. McGovern

said that in 1929, 750,000 tons of ships were launched in the district, while the machinery completed had an aggregate of 682,000 horse power. Great Britain is now building 45 per cent of the world's tonnage, as compared with 57 per cent in pre-War years. Recent progress in naval architecture is one of steady research rather that of epoch-making development; but it cannot yet be claimed that experimental technique has reached a stage where we can be wholly satisfied with the results obtainable. The correlation of model tests with actual service results is rendered difficult by the insufficient precision with which powers obtained at sea can be measured. The chief uncertainties arising from attempts to correlate model and ship appear to lie in the assessment of a frictional value for the ship's hull surface, the effect of ship propeller roughness, the probability of some 'scale' effect in extending model results to the ship's actual size, and the comparison between screw performances in the open and in the varying flow obtaining at the stern of varying forms of vessels. Discussing the question of oil engines and steam engines, Mr. McGovern said that the investigations now proceeding may result in giving a new lease of life to steam as a prime mover. There would appear to be considerable economies obtainable by the use of high-pressure superheated steam plants, while the results already achieved in the ships of the Canadian Pacific Steamship Company are unequalled by other prime movers. In other directions, research is also being applied to the determination of strains and the subject of vibration in ships.

SIR ROBERT ROBERTSON, the Government Chemist, reporting on the work of the Government Laboratory for the year ending Mar. 31, 1930, gives a detailed survey of the many activities, interests, and responsibilities of his department. A comparison with last year's report shows that there has been a substantial increase in the number of samples examined, now well above the half-million mark, the rate of increase also having risen considerably. The chemical staff has increased from eighty to eighty-two; the long list of 'other activities' of the members of the staff again demonstrates the important part taken by the Laboratory in the promotion and application of chemical science. References to the absence of any standard for the percentage of fat in cream and to the absence of regulations relating to the marking of skimmed or partially skimmed milk cheese are repeated, and the presence of 2·5 per cent of proof spirit in samples of 'non-alcoholic' beverages is again reported. The number of samples of sea water examined for the Admiralty, the Ministry of Agriculture and Fisheries, and the Fishery Board for Scotland shows a substantial increase; this work is, of course, of noteworthy value in oceanography, since systematic determinations of salinity contribute to our knowledge concerning the drift of water between seas of differing saline contents. Further study has also been made of the diurnal variation in the quantity of dissolved oxygen in rivers; this variation is traceable in some rivers throughout the year. Atmospheric pollution also has been a subject of experimental investigation; a standard apparatus and method for determining the acidity of the air are now being tested at several stations. It appears that free sulphuric acid is present in a proportion which does not exceed a small fraction of the total sulphurous acidity, and that neutral sulphates are also present in small quantities.

UNDER the Food and Drugs (Adulteration) Act, 1928, the Government Laboratory was called upon to report to the Justices on nineteen samples, with the result that in four cases the results were in disagreement with those put forward by the prosecution. All four cases were concerned with milk or butter. Two samples of tinned vegetables examined for the Ministry of Health contained copper, whilst four contained hydrogen peroxide. Six samples of lead pipe carrying a municipal water supply were found to contain deposits of two kinds, one consisting mainly of basic lead sulphate and the other of basic lead carbonate. Deficiencies in condensed milk were found, but most of the adverse reports were concerned with the labelling. All consignments of tea which are imported into Great Britain are subjected to examination, officers of Customs and Excise being trained, for the purpose of preliminary examination, in the Laboratory. Of about thirty thousand samples, 256 contained foreign substances and 217 were unfit for human consumption. Of 1546 samples of beer, 32 contained arsenic in slight excess of the limit laid down by the Royal Commission on Arsenical Poisoning, but in no case (of 85 examined) was saccharin detected. A sample of soap alleged to be made wholly from waste potatoes consisted of ordinary soap loaded with sodium carbonate and starch; whilst two samples of meat meal were adulterated with potato and with mineral matter respectively. As the result of further examination of lime sulphur insecticides, it has been possible to work out the relationships between the various suggested criteria of strength of these products. During the year more than 200 milligrams of high-grade radium salt have been recovered from decayed luminous paint.

THE sphere of work of the League of Nations' Committee on Intellectual Co-operation has recently formed the subject of a general inquiry by a committee specially constituted for the purpose at Geneva. In the light of this committee's report, a number of proposals have been submitted to and approved by the Assembly of the League with the object of defining a programme and improving work in this field. Among the changes thus brought about is the constitution of committees of experts which will replace the formerly existing sub-committees of the League's International Committee on Intellectual Co-operation. An inquiry is to be initiated forthwith into the intellectual life of our time with special reference to methods of education at all stages in the different countries. The attention of governments is being directed to the utility of the work done by the bureaux responsible in the different countries for international interchanges of publications, with the suggestion that they should "be placed in a position to act as liaison between learned societies for exchanges of their publications and should

accordingly be provided with the necessary funds". The work of the International Educational Cinematographic Institute, including the publication in five languages of the *International Review of Educational Cinematography*, is highly appreciated by the Assembly of the League; and governments are being asked to give their sympathetic consideration to the draft convention, prepared and circulated by the Institute, for the abolition of customs barriers which interfere with the distribution of educational films, and generally to lend their aid and support to the Institute.

MANY generous donors have contributed to make the collection of birds in the Hull Municipal Museum fairly representative of the avifauna of the British Isles. The addition of many specimens and the rearranging of the birds of prey, the waders, and the game birds have made necessary the publication of a new "Guide to the Birds" by Mr. T. Sheppard. In it the collection is catalogued, with records of localities, a short comment on the status of each species, and two dozen illustrations of typical examples of the style of mounting adopted. Perhaps it is desirable from the public point of view to keep the nomenclature as simple as possible, and doubtless on this account no racial forms are indicated. But for the study of bird migration or for scientific identification, more than the Linnean binomial is required—and, indeed, the simple method may be misleading. For example, it is obvious that the specimens of golden plover (case 209), described as generally distributed throughout the British Islands, do not belong to the British race at all. The Guide contains many interesting Yorkshire records, and it is unfortunate that the cases should sometimes contain incongruous species (crested tit and abnormal skylark) and sometimes associate British with foreign species which have no British claims (red grouse and willow grouse).

AMONG the recent acquisitions of the British Museum (Natural History) are the following: The Trustees of the Rowland Ward Bequest have presented a fine mounted female specimen of a black howling monkey (*Alouatta niger*). The female is not, as the name of the species implies, black in colour, but a mixture of grey and yellow. A plaster cast of the bust of a young gorilla (John Daniel I.) and a cast of the entire left foot and ankle have been presented by Mr. F. O. Barlow and will shortly be placed on exhibition in the Upper Mammal Gallery. The Government of Greenland recently presented to the Museum a Greenland narwhal. The specimen, which is a male, 10 feet 3 inches in length, with a tusk 14½ inches long, was sent from Greenland packed in salt and arrived at the Museum in excellent condition. A plaster cast of the animal has been prepared and will be exhibited when the new Whale Room, now under construction, has been completed. Among the recent acquisitions in the Department of Geology are three interesting fossils—a fish and two palms—from the Middle Eocene beds of Bolca, near Verona. The fish is a fine example of a rare extinct genus, *Urosphen*, related to the living flute-mouths. The palms, which are both on slabs about six feet in length, are almost complete specimens of small fan-palms. The Department of Botany has received a collection of 101 seaweeds from Sir J. Ross's voyage of the *Erebus* and *Terror* to the Antarctic (1839–43), presented by Miss Jessie Lefroy. The Department already has the flowering plants of the expedition, to which Dr. (afterwards Sir) J. D. Hooker was naturalist. Many cryptogams were received from 1845 to 1854, and a further set was bequeathed, together with his Arctic collection, by Dr. R. M'Cormick, surgeon to the expedition, in 1890. The collection now added is valuable in extending the series and has an additional interest in that it was originally presented to Lady Franklin.

SIR ROBERT HADFIELD recently delivered an address, on the occasion of a luncheon of the Oil Industries Club, in which, after giving a general survey of the importance of the steel industry, that of gold being taken as a standard of comparison, he discussed the question of steels for use in the oil industry. For the purpose of rock drills no alloy steel has proved to be superior to plain carbon steel in cutting quality. The carbon is usually in the neighbourhood of 0·75 per cent, but when special care is taken to keep down the proportions of sulphur and phosphorus, the carbon may be raised to 0·85 per cent. Carbon steels are, however, deficient in toughness, so that small quantities of an alloying element, such as 0·2 per cent of vanadium or 0·6 per cent of chromium, may be added with advantage. Great care in heat treatment is essential, as surface imperfections give rise to fatigue cracks. For the fish-tail bits used in rotary drilling, and for core barrel cutter heads, excellent results have been obtained with an intermediate manganese steel, comparatively low in carbon, but containing 1·5-1·75 per cent of manganese. Such steel, when quenched, has a Brinell hardness of 550-575, and exhibits great toughness. The oil industry has also made demands on the steel-maker for heat-resisting steels in connexion with operations at high temperatures.

AN illustrated description of the construction of the large reinforced concrete tube for vehicular traffic which has been laid in the bottom of the estuary which separates the cities of Oakland and Alameda, on the shores of the Bay of San Francisco, is given in *Engineering* for Sept. 26 and Oct. 10. Owing to the geological formation, the driving of a tunnel beneath the estuary was impracticable and the unusual plan had been adopted of building a great part of the tube in lengths in a dry-dock and then sinking them into position after they had been floated. The total length of the structure is 4336 ft., and this includes 12 tubular sections each 203 ft. long, which were built in the dock. These sections have an external diameter of 37 ft. and are 2 ft. 6 in. thick, the concrete being heavily reinforced both circumferentially and longitudinally. Internally, the tube is divided into three sections by a ceiling and a roadway, the space above the ceiling being used as an exhaust duct and that under the roadway as a fresh-air duct. As completed each section weighed about 5000 tons, and as some of the sections were slightly curved, great care had to be

taken with their alignment. All the sections were, however, successfully sunk into position and then neighbouring sections were joined together by circumferential belts of Tremie concrete. The entrance portals are of a striking character and in them are housed the ventilation plants. The tube has a capacity of 4224 vehicles per hour when they are proceeding at 20 miles per hour; while the ventilation is such that it allows for but 4 parts of carbon monoxide in 10,000 parts of air. This remarkable engineering structure is called the Geo. A. Posey tube, after its designer.

THE second Henry Herbert Wills Memorial Lecture in physics was delivered in the H. H. Wills Physical Laboratory, Bristol, on Saturday, Oct. 25, by Prof. J. Franck, of Göttingen. The title of the lecture was "The Relation between Spectroscopy and Chemistry". Prof. Franck outlined a number of methods of determining the heats of dissociation of molecules from their molecular spectra, and showed how it is possible by spectroscopic methods to classify various types of chemical binding. He also indicated methods of deducing another thermochemical constant, namely, the heat of activation, and gave a qualitative physical picture of the function of a catalyst in promoting homogeneous chemical reactions. The lecture was well attended, and the audience included a number of visitors from other universities.

THE second of a series of exhibitions, at the galleries of the Royal Photographic Society, to illustrate the application of photography to the various branches of science, art, and industry, is to be devoted to "Photography in Astronomy". The striking results which have been secured by the combination of the photographic plate and the spectroscope will be well exemplified, and photographs of star fields, nebulæ, and other objects, many of which have been revealed by photography, will be on view. There will also be illustrations of instruments, telescopes, cameras, used in the different branches of astronomical research. The exhibition will be open daily at the Society's house, 35 Russell Square, London, W.C.1, on Nov. 3–29 (Sundays excepted), from 10 A.M. to 5 P.M. There will be no charge for admission. Lectures will be given during the exhibition—by Prof. F. J. M. Stratton, on Nov. 3, on "Solar Eclipse Photography"; by Prof. Herbert Dingle, on Nov. 17, on "Spectrum Photography"; and by Mr. J. H. Reynolds, on Nov. 24, on the slides and films in the exhibition.

DR. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, has been awarded the Daniel Giraud Elliot Medal for 1929 by the U.S. National Academy of Sciences for his recent monograph on Titanotheres.

THE sixth annual Norman Lockyer Lecture of the British Science Guild will be given by Sir William Pope in the Goldsmiths' Hall, Foster Lane, E.C. (by permission of the Goldsmiths' Company), on Thursday Nov. 13, at 4.30 P.M. The subject of the lecture will be "Science and Modern Industry". Sir Samuel Hoare, president of the Guild, will take the chair. There will be no charge for admission to the lecture, tickets for which can be obtained from the British Science Guild, 6 John Street, Adelphi, London, W.C.2.

HIS GRACE THE ARCHBISHOP OF YORK will deliver an address on "The Relations between Philosophy and Religion", at University College, Gower Street, W.C.1, on Tuesday, Nov. 18, at 8.15 P.M. The chair will be taken by Sir Oliver Lodge. Tickets for this meeting, which is one of a series arranged by the British Institute of Philosophical Studies, can be obtained, without charge, from the Director of Studies, University Hall, 14 Gordon Square, London, W.C.1.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Oct. 27, the following Council was elected: *President*, Sir E. A. Sharpey-Schafer; *Vice-Presidents*, Prof. J. Graham Kerr, Prof. W. Wright Smith, Prof. F. G. Baily, Prof. T. J. Jehu, Prof. J. H. Ashworth, Dr. A. Logan Turner; *General Secretary*, Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*, Prof. C. G. Darwin and Prof. James Ritchie; *Treasurer*, Dr. James Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *Councillors*, Dr. J. B. Clark, Prof. F. A. E. Crew, Prof. J. Montagu F. Drummond, Mr. D. A. Stevenson, Prof. H. W. Turnbull, Sir James Walker, Dr. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houstoun, the Hon. Lord Sands, Mr. Murray Macgregor, and Dr. A. Crichton Mitchell.

AT the Imperial Botanical Conference held on Aug. 15 at the Imperial College of Science and Technology, South Kensington, the following resolution was carried unanimously: "That an Imperial Botanical Conference take place in England in 1935, shortly before the International Botanical Congress which is to be held in that year in Holland." The following interim committee was appointed: The Director of Kew (convener); the Keeper of Botany, Natural History Museum; the professors of botany at Oxford and Cambridge; a professor of botany of the University of London (to be nominated by the chairman of the Board of Studies of the University); one representative of the Colonial Office, and one representative of the Dominion Office. It was further resolved that this Committee summon a meeting of British botanists in the near future for the purpose of appointing an executive committee for the said Conference.

THE first number of a new journal called the *Students' Quarterly Journal* has been published by the Institution of Electrical Engineers. Its object is to record the work done by the students' sections of this Institution and to publish short papers by them dealing with technical subjects of general interest. This number is notable, as it gives an abstract of a most interesting lecture on the ship-to-shore radiophone service by Sir Thomas Purves, Engineer-in-Chief to the Post Office.

WE have received Vol. 8 (1929) of the *Transactions* of the Institution of Chemical Engineers, which contains several papers of considerable interest. These

deal with the reactivity of coke, fatigue in metals, acid-resisting steel plant (in which precise directions for oxy-acetylene welding are given), the recovery of benzole from coal gas by adsorption, the absorption of nitrous gases, the fractional adsorption of gases, the industrial applications of active carbon, the evaporation of water in open pans, etc. The volume is fully illustrated and contains numerous tables, and is a production of very high standard.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An assistant director of the Research Laboratory of Queen Charlotte's Maternity Hospital—The Secretary, Queen Charlotte's Maternity Hospital, Marylebone Road, N.W.1 (Nov. 3). A graduate assistant in the Junior Technical School of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (Nov. 5). An assistant lecturer in physics in the University of Sheffield—The Registrar, University, Sheffield (Nov. 8). A woman inspector for work in connexion with the agricultural education (including rural domestic economy) of girls and women—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov. 10). An assistant lecturer in education in the University of Leeds—The Registrar, University, Leeds (Nov. 10). A student assistant in the Department of Economics at the Harper Adams Agricultural College—The Advisory Economist, Harper Adams Agricultural College, Newport, Salop (Nov. 10). Two scientific assistants and two technical assistants at the Radio Research Station, Slough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Nov. 11). Inspectors of plants and produce in the Agricultural Department of the Gold Coast—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Nov. 17). A plant physiologist in the Department of Agriculture and Horticulture of the University of Bristol, Long Ashton—The Secretary, University, Bristol (Nov. 17). A lecturer in zoology at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Dec. 1). An inspector for Scotland under the Alkali, etc., Works Acts, and inspector under the Rivers Pollution Prevention Act—The Secretary, Department of Health for Scotland, 125 George Street, Edinburgh.

Our Astronomical Column.

Total Solar Eclipse of Oct. 21. The only available station in the eclipse of Oct. 21 was the tiny island of Niuafo'ou, about midway between Samoa and Fiji. It has the drawbacks that landing is difficult and that the island is subject to volcanic disturbances, a considerable eruption having occurred last year. However, as the sun was high, and totality lasted more than 1½ minutes, it was felt that the opportunity should not be missed, and expeditions proceeded to the island from the Dominion Observatory, New Zealand, and from the United States. The former was in charge of Dr. Adams, the Dominion Astronomer; the following particulars, which he transmitted by wireless, are quoted from the *Times* of Oct. 23:—"There were no clouds and the sky was fair during the eclipse. The photographs taken were satisfactory. There was a faint corona with two long streamers, there were six medium prominences, and Bailey's beads were seen. The whole of the proposed programme was carried out."

Particulars about the American party were announced in a *Daily Science Bulletin* (Oct. 9) issued by Science Service, Washington, D.C. It was sponsored by the U.S. Naval Observatory, and was in charge of Dr. S. A. Mitchell, director of the Leander McCormick Observatory; it was his eighth expedition to a total eclipse; the only failure among the eight was the English eclipse of 1927. At the recent eclipse (1930) he proposed to study the flash spectrum. The largest instrument brought from America was a coronagraph of 63 feet focal length, operated by Dr. Ross W. Marriott, of the Sproul Observatory, and Dr. Weld Arnold. This was to be used both for coronal photographs and for obtaining star positions for the measurement of the Einstein deflection of light. No details of the results obtained by the American party are yet to hand.

The next total solar eclipse is that of Aug. 31, 1932, total near Montreal and in the north-east corner of the United States. It is likely to be observed by a great number of astronomers, as the meeting of the International Astronomical Union is to be held in the United States just after the eclipse.

Reproduction of an Old Crayon Drawing of the Moon.—There is in the Radcliffe Observatory at Oxford a large crayon drawing of the moon, made in 1795 by John Russell, R.A., on a scale of nearly five feet to the moon's diameter. Photographic reproductions of this have appeared in the *Monthly Notices* of the Royal Astronomical Society and elsewhere. It is reproduced in colours in the *Illustrated London News* for Oct. 18 on a scale about one-sixth of the original. Mr. Russell took extreme care to make his picture accurate, and his pencil studies of details of the lunar surface occupied him for ten years. Several of these are also reproduced. In one of them he has given rein to his imagination; there is a well-known *Tête de Femme* at one extremity of the Bay of Rainbows, but the picture makes the likeness to a female figure much stronger than the reality. A modern picture-map of the moon in colours, by M. Lucien Rudaux, is given for comparison; this shows the disc fully illuminated, whereas Russell preferred to portray the gibbous phase, the terminator being near Kepler; he wished to have some shadows visible, to assist in showing the surface in relief.

Discoverer of Pluto.—Mr. Clyde Tombaugh's name has become well known through his discovery of Pluto at the Lowell Observatory last January. The *Scientific American* for October has an article by him. Until 1929 his principal employment was farm work, but his interest in astronomy dates from 1926, when he made his first telescope, an 8-inch reflector; he made quite a good 9-inch reflector in 1928; however, he ceased to be an amateur soon afterwards, for early in 1929 he was given a post at the Lowell Observatory. When the 13-inch Lawrence Lowell telescope arrived, it was placed in his charge to search for the planet the existence of which the late Prof. P. Lowell had foretold. Lowell had expected that it would be as bright as mag. 13; actually Pluto was of mag. 15. Its detection shows the thorough nature of Mr. Tombaugh's search.

Research Items.

The Aryans.—In the October issue of *Scientia* Prof. Pizzagalli publishes a review of recent discoveries in philology in relation to the question of the origin of the Indo-Europeans. In the study of linguistic prehistory the dominant and pivotal view now is that of ethnic substrata—the view that the Aryans, not one people, but a number of tribes speaking different dialects of common origin, advanced, not over an empty country, but among peoples of considerable number and of a certain degree of civilisation. Further, that these did not vanish before the invaders, but survived as a subject population which imposed much of its culture and language on the conquerors. M. Auban has endeavoured to show that Sumerian is an Indo-European language, but, apart from other arguments, this involves acceptance of the view that Indo-European has passed from agglutinative to flexional—a transition of which language affords no evidence. The Indo-European character of the Hittite language has a firmer foundation, as traces of Indo-European are more numerous. As regards a Dravidian origin, Slater holds that it was a species of lingua franca diffused by the commercial relations of the peoples of Europe, Asia, and Africa. This depends upon the view that holds to the Mediterranean origin of the Dravidians, an integral part of a dispersion extending from Ceylon on one side to the Basques on the other. These theories tend to place the centre of dispersal in Asia Minor and Mesopotamia, to reduce the Indo-European element in Indo-European culture, and to assume an agglutinative phase before the flexional which is represented by the Dravidian, Sumerian, and Hittite languages, whereas in reality, these languages and cultures at some stage of their history came under the strong influence of the Aryans in their rôle of conquerors. The Aryans' origin must be looked for somewhere within the range of distribution from the Baltic to the Persian Gulf, probably Iran.

Pedigrees of Retinitis Pigmentosa.—Two pedigrees of retinitis pigmentosa have been investigated by Dr. Usher and published in the *Annals of Eugenics* (April 1930). The pedigree of the first family had not been recorded previously; the second is presented in collaboration with Dr. Shennan, and is an extension of an earlier record by Hine. The former covers six generations, and includes some 243 members; it is of considerable value as an addition to the authentic family histories of this condition, and is a detailed record showing that although the symptoms of night blindness varied slightly in degree, they were remarkably constant in being exhibited very early in life, and that the afflicted members in spite of their defective vision lived to an advanced old age. The second pedigree presents certain unusual features, of which perhaps the most interesting is the late age of onset of the condition; it also appeared that early, and presumably congenital, deafness might be an alternative anomaly of the central nervous system among members of the family concerned. It might be anticipated that different individuals would exhibit variations in the intensity and age incidence of a hereditary condition even in one branch of a family, but it would appear that in this instance both modifying factors are determined by the constitution of the germplasm, and that the latter is quite evenly distributed among the several members of a stock. The first family record is characterised by early onset, which permitted the ultimate development of total blindness; the second is significantly different, in that defective vision was a manifestation of later years, and that blindness was seldom complete. It would therefore seem certain that heredity can not only determine the occurrence of a defect but also regulate with precision the actual rate of its development in the individual.

Lead-poisoning of Water-fowl.—In 1921 thousands of water-fowl died in Louisiana from a mysterious disease which was finally diagnosed as lead-poisoning due to the swallowing of spent shot in areas much frequented by sportsmen. During the past two winters a recurrence of mortality from this cause has been notified (*California Fish and Game*, vol. 16, p. 257, 1930). It is associated with particularly low water levels in the coastal region, which permit shallow-feeding ducks, such as mallard and pintail, to puddle in mud-bottoms which have been plentifully sprayed with scattered pellets by shore-shooters. Post-mortem examination of 18 birds showed the presence in every one of pellets of lead, varying in number from 1 to 24, and in each case post-mortem aspects of lead-poisoning were revealed. The pellets might easily be overlooked in a superficial examination, for frequently they were worn down to mere discs of small size. Death is caused by the assimilation of the comparatively thin outer surface worn from all the shot, and since the toxic action of lead is slow and the bird may retain its power of flight for two or three days after having consumed a lethal dose of shot, cases in which an apparently healthy bird is found carrying a considerable number of shot are explained. Unfortunately, there is still deposited, not only in the shallow waters of Louisiana, but also in those of many other States, lead shot which will continue to kill water-fowl for many years to come, and there is no possibility of employing remedial measures.

Temperature and the Breeding of Marine Animals.—Mr. Sven Runnström in *Bergens Museums Arbók* for 1929 (No. 10) ("Weitere Studien über die Temperaturanpassung der Fortpflanzung und Entwicklung mariner Tiere") continues his valuable studies on the influence of temperature on the reproduction and development of certain marine animals. His previous work on the subject was published in the *Arbók* in 1927, where it is shown that the first developmental stages are much more sensitive to changes of temperature than the later larval stages and the adult. The breeding temperatures arrived at experimentally agree well with those in natural conditions. The present research has to do with Mediterranean-boreal forms and was conducted both at Bergen and at marine stations on the Mediterranean, certain ascidians and echinoderms besides *Mytilus edulis*, the common mussel, being studied. The Mediterranean-boreal forms in the boreal region (the southern limit of which is the English Channel) are nearly all summer breeders, whilst those in the Mediterranean usually breed in the winter and spring, sometimes all the year round. The species studied live under conditions of very varied temperature, ranging from 3° to 27·5°. Except in *Mytilus edulis* the ten species investigated in the boreal region show a normal development from 8° to 23° and typical Mediterranean-boreal forms in the Mediterranean show the same temperature limits. Separate races occur in the two regions, breeding at different times. *Mytilus edulis* breeds in Bergen typically in spring at 4°–16°. In the Mediterranean the form *galloprovincialis* breeds in summer at a temperature of 8°–23°.

New Zealand Mollusca.—The *Transactions and Proceedings of the New Zealand Institute*, vol. 60 (quarterly issue), part 4, Dec. 1929, issued March 1930,

contains two interesting papers dealing with the Mollusca. In the first, Mr. C. E. R. Bucknill ("Further Microscopical Details of New Zealand Loricata") investigates the nerve terminals of various chitons and goes minutely into the structure of ocelli, megalæsthetes and micræsthetes. It is shown that although many of the megalæsthetes are destined to become eyes, a large number in certain forms remain permanently as megalæsthetes, the function of which is to secrete a glutinous substance or merely to excrete moisture, and are protrusible, the micræsthetes having chiefly a tactile function. These last are universally distributed and very simple in structure, outnumbering all other nerve terminals by fifteen to one on an average. In the second paper, "New Species of New Zealand Mollusca from Shallow-water Dredgings, part 1", Mr. A. W. P. Powell describes thirteen new species and founds two new genera *Benthocardiella*, in the family Condylocardiidae, and *Altispecula*, in the family Cerithiidae—the latter founded on a handsome South Australian deep-water shell with strong axial ribs.

Virus Disease of Plants.—A new method of attack has been used by the workers on virus diseases at the Rothamsted Experimental Station. They have realised that the virus should be studied in the environment in which it is most active, namely, the living host, and Dr. J. Caldwell has recently published results of the first part of his work on the "Physiology of Virus Diseases in Plants" (*Annals of Applied Biology*, vol. 17, pp. 429-443). He has studied the passage of the virus of yellow mosaic in the tomato plant, finding that the movement was inhibited by the treatment of part of the stem with chloroform and was also effectively controlled by steaming an area on the stem. There was no localisation of the virus on one side of the stem as might be expected from movement through vascular tissue after a one-sided inoculation, nor did the virus behave as did red ink or particulate substances, both of which passed across the open xylem vessels of the steamed area. It was concluded that the movement takes place in the living ground tissue of the plant.

Slime Fungi in Soil.—C. Thom and K. B. Raper direct attention to the constancy with which amœboid forms of the Myxomycetæ or slime fungi can be obtained from samples of soil and from the decaying vegetation on the surface of the soil, in a paper in the *Journal of the Washington Academy of Science* (vol. 20, No. 15, Sept. 19, 1930). They suggest that the group of organisms may have been rather neglected in studying the soil population, and that the amœbæ of the soil, which have received very considerable attention from soil workers of the last generation, may usually include a strong representation of this group, especially when the soil temperature is not too high (not above 18° C.). The plasmodia and motile amœbæ observed were generally obtained on mannite agar on which suitable samples of the soil or vegetable detritus had been placed; when sporangia were obtained the genus *Didymium* was usually identified.

Suffolk Mosses.—Thirty years have passed since the Rev. E. N. Bloomfield compiled his list of Suffolk mosses; a recent paper by Mr. A. Mayfield ("The Hepatics, Mosses, and Lichens of Suffolk", *Jour. Ipswich and Dist. Nat. Hist. Soc.*, vol. 1, pt. 2, July 1930, pp. 89-140) brings that list up-to-date. While it may be true that the county has been so well worked for mosses and hepatics that few additions will be made in the future, Mr. Mayfield's intensive study of his own parish, in addition to more extended field work, has yielded such excellent results as to indicate the need for the close study of other small areas in order to determine the distribution of what now appear to be rare species in the county.

Saxifrage Crosses.—A cross between *Saxifraga rosacea* ♀ and *S. granulata* ♂ (Marsden-Jones and Turrill, *Jour. Genetics*, vol. 23, No. 1) has given results of unusual interest. These species belong to different sections of the genus. The *rosacea* was obtained from western Ireland, and the *granulata* from Coulston, Wilts. *S. rosacea* is evergreen, while *granulata* forms bulbils. There are also differences in the shape of sepals, petals, and fruit. The F_1, numbering twenty-six plants, was uniform except for one plant with a tendency to form tubular flowers and poor stamens, and this generation more nearly resembled the male parent in most features. The F_2 and F_3, numbering several hundred plants, also showed great uniformity except for the occurrence of lobed or staminoid petals in certain plants. The absence of segregation led to the conclusion that this hybrid form, which is named *S. potternensis*, was tetraploid. This surmise was confirmed by R. O. Whyte, who publishes an account of the cytology in the same issue of the *Journal of Genetics*. The count of 16 as haploid chromosome number in both parent species is confirmed, while the F_2 hybrids have 32-36. Study of the meiosis in F_2 plants indicates that the doubling takes place through a suspended heterotypic or 'semi-heterotypic' division. Investigation of the ovule, petal, and anther deficiency in flowers of this Saxifrage, as well as in several other genera, leads to the view that such deficiencies are a result of the competition for nutriment between anthers and ovules when they attempt to develop simultaneously instead of, as usual, successively. This is regarded as the state of affairs in, for example, the flowers of *Ranunculus acris*, which are deficient of anthers. If the nutrition level falls below that necessary for the optimum metabolism rate for anthers and ovules in the developing flower, then one of the developmental phases may be affected, producing anther or ovule deficiency or petal deficiency with abnormal floral types.

Orogenic History of Alaska.—The geological history of Alaska involves that of no fewer than five highland areas that are considered to be more or less independent of one another in their mode and time of origin. These are: (*a*) the southern coastal ranges; (*b*) the Alaska range and its continuation into the Alaska peninsula; (*c*) the central highlands of the Yukon-Porcupine area and Seward peninsula; (*d*) the Kuskokwim highland of south-west Alaska; and (*e*) the Brooks range of the north. In the *Amer. Jour. Sci.* for August 1930, J. B. Mertie, jun., summarises the fund of structural and stratigraphical data which is now available, with the view of elucidating the problem of orogeny in each of the above five terrains. For the southern coastal ranges the history may be summarised as follows. *Lower Jurassic:* submergence accompanied by great outpourings of basic lavas, with partial uplift towards the end followed by re-submergence. *Middle and Upper Jurassic:* continued submergence accompanied by granite intrusions. *End of Jurassic:* epeirogenic uplift followed by a period of erosion. *Late Lower or early Upper Cretaceous:* partial submergence, probably with injection of granitic rocks. *Early Eocene:* uplift followed by the formation of coal measures which, later, were deformed. *Pliocene:* regional uplift and mountain building with outflows of basic lavas. *Quaternary:* Continued uplift. Detailed histories on similar lines are given for the other four areas.

Friction on an Aerofoil.—In the October number of the *Proceedings of the Royal Society*, A. Fage and V. M. Falkner describe a determination of the friction on the surface of a Joukowski aerofoil. Three methods were used: in the first, the velocity in the air at a few thousandths of an inch from the surface was found by the aid of very small surface tubes, and the friction calculated from the velocity gradient; in the second, the frictional drag was calculated from the difference between the total drag, estimated from the total-head losses in the wake, and the drag due to the normal pressures on the surface; and in the third, the friction was derived from considerations of the momentum and pressure changes in the boundary layer. The values obtained were concordant to a few per cent. The distribution of friction over the surface was such that it had a maximum intensity at a short distance from the nose, and a second and larger maximum just beyond the first, the relative positions of which on the upper and lower surfaces varied with the incidence. The first maximum was ascribed to laminar flow, and the second to turbulent flow in the boundary layer.

Absorption of Light by Xenon.—The absorption spectra of liquids and solids exhibit wide continuous bands which must be related in some way, which is at present not clear, to the properties of the atoms and molecules of the materials. An investigation of absorption by xenon, which might be expected to give simple results from its inert nature, is described by Prof. J. C. McLennan and Mr. R. Turnbull in the October issue of the *Proceedings of the Royal Society*. The fullest results have been obtained with the gas. The longer of the two resonance wave-lengths for this ($^1S_0$ - $^3P_1$) is in the middle of the Schumann region at 1469 A., and at a pressure of a few millimetres of mercury line-absorption takes place there. As the pressure is increased, a band develops with strong asymmetry towards longer wave-lengths, and at fifty atmospheres extends between 1584 A. and 1428 A. The behaviour of xenon is thus similar to that of mercury, with which an asymmetrical development of a band takes place round the singlet-triplet line at 2537 A. in similar circumstances. The important question of whether symmetrical broadening occurs about the $^1S_0$ - $^1P_1$ xenon line at 1293 A., as it does with the analogous mercury line at 1850 A., according to the evidence available, is left open. A less complete description is also given of the absorption by the condensed phases of xenon, from which it appears, *inter alia*, that liquid xenon has a temperature of maximum optical density between - 10° C. and - 110° C.

Theory of Pulling a Synchronous Motor into Step.—In connexion with the problems of the parallel running of alternators and the pulling into step of synchronous motors, the main difficulty in finding mathematical solutions lies in solving the differential equations which express the motion. Lord Kelvin and Prof. James Thomson, so far back as 1876, described an integrating machine for solving differential equations with variable coefficients. Modern electrical and mechanical devices have now made possible the construction of a practical integraph of this type. Dr. Bush and others at the Massachusetts Institute of Technology have perfected such an instrument, which gives the solution in about a minute's time. In the *Journal of the Institution of Electrical Engineers* for September, H. E. Edgerton and F. Z. Zak discuss the problem of what happens when a synchronous motor is pulled into step. The results are put in a simple form, convenient for practical use. The relationships between the values of the field current, the motor torque, and the slip, which determine whether a given load having a definite flywheel effect can be brought into synchronism or not, are found. Numerical examples are given which prove the practical value of the equations they give.

Germanium Monoxide.—Although indications of the existence of the compound GeO were obtained by Winkler in 1886, no systematic investigation of the substance has been made. In the September number of the *Journal of the American Chemical Society*, Dennis and Hulse describe the preparation of this oxide, and of the corresponding sulphide, GeS, also described by Winkler. The anhydrous oxide is jet-black and crystalline, stable in air and towards acids and alkalis. Hydrogen chloride and chlorine attack it when heated, forming germanium chloroform, $GeHCl_3$, and $GeCl_4$ and GeO_2, respectively. No evidence of the formation of $GeOCl_2$ was obtained. The sulphide was obtained as a red amorphous powder and in black crystals.

Molecular Weight of Lactalbumin.—Besides casein, the chief protein constituent of cows' milk is lactalbumin, which occurs to the extent of about 10 per cent of the casein. Investigations have shown that the behaviour of casein is very complicated, and it was of interest to see whether the marked instability of casein is also found in the lactalbumin and is a characteristic of milk proteins. In the September number of the *Journal of the American Chemical Society*, Sjogren and Svedberg describe experiments with the ultra-centrifuge which show that lactalbumin is not homogeneous with regard to molecular weight, and thus resembles casein. Experiments on the direct ultra-centrifugal analysis of milk are also described. The values for the molecular weight of lactalbumin varied between 12,000 and 25,000, and it is regarded as probable that lactalbumin is not present in milk but is formed during the process of 'purification', especially by the action of concentrated ammonium sulphate, being produced from a material of molecular weight not exceeding 1000.

The Fractionation of Gliadin.—When wheat flour is kneaded with water, the starch is removed and a protein, gluten, remains. This was separated by Einhoff in 1805 into a portion (gliadin) soluble in alcohol of moderate concentration and a portion (glutenin) which is insoluble. Although much careful work on gliadin has been undertaken, it is not certain whether it is a single protein (as Osborne and his co-workers believed) or not. In vol. 18, part 2 (1930), of the *Comptes rendus* of the Carlsberg Laboratory, a long and detailed account of this problem is given by Haugaard and Johnson. Their experiments, although they have not given a final solution of the problem, lead them to assume that gliadin constitutes what Sörensen calls a coprecipitation system, that is, an association of substances combined in a mutually reversible manner in some way so that the system as regards osmotic respects behaves as a single substance, yet in which an exchange is possible between the components when changes in the state and composition of the solution (temperature, salt content, hydrogen ion activity, etc.) give rise to it. If such a component exchange is given the opportunity of forming a sparingly soluble or insoluble coprecipitation system under the new conditions, it will naturally form and precipitate out. The method of fractionation of gliadin used did not permit of the preparation of the constituents of the coprecipitation system in the pure state, but it was simple and did not appear to affect the fractions in any way.

Aspects of Carbohydrate Metabolism.

I. BLOOD AND URINE 'SUGAR'.

THE form in which carbohydrate circulates in the body is glucose: it is frequently of clinical importance to determine the amount of this substance in the blood, but estimation of blood-sugar may not be synonymous with determination of blood-glucose. Different methods of estimation give somewhat different results, but this is of little importance clinically, provided the same method is always used. It is, however, of some interest to inquire into the causes of these discrepancies and a certain amount of work has been recently devoted to this subject. After fermentation with yeast, blood still gives a residual reduction with oxidising agents, which is obviously not due to glucose: according to I. M. Rabinowitch (*Biochem. Jour.*, vol. 22, p. 753; 1928) the amount of the non-fermentable reducing substances present in normal or diabetic human blood is about 0·025 per cent expressed as glucose. It is very constant in the same individual, is not affected by insulin or by the administration of glucose by mouth, and is the same in venous as in arterial blood: in all these respects it shows a marked contrast with glucose.

F. K. Herbert, M. C. Bourne, and J. Groen have investigated the nature of the non-glucose reducing substances in human blood (*ibid.* vol. 23, p. 339; 1929; vol. 24, pp. 291 and 299; 1930). In the first paper the distribution of reducing substances between plasma and corpuscles was determined by several different blood-sugar methods. By those of MacLean, Hagedorn and Jensen, and Benedict, there appeared to be more sugar in the plasma than in the corpuscles; by those of Folin and Wu and Shaffer and Hartmann (as modified by Somogyi) the distribution was approximately equal; whilst when the Hagedorn-Jensen method was carried out on the Folin-Wu blood filtrate, there appeared to be slightly more in the corpuscles than in the plasma. Blood filtrates prepared by the tungstic acid method from whole blood or corpuscles reduced the Folin-Wu copper reagent in the cold, but not those from plasma; nor was such a reaction given by filtrates prepared by the use of colloidal ferric hydroxide or zinc hydroxide.

It appears, therefore, that the corpuscles contain non-glucose reducing substances which are precipitated by iron and zinc hydroxides but not by tungstic acid: they are not fermentable with yeast. The most important of these is probably glutathione, since uric acid, creatine, creatinine, and ergothioneine are present in too small concentrations to affect the estimation of blood-glucose. In the second paper of the series it was shown that when pure glutathione was estimated in the presence of 0·1 per cent of glucose, it produced a reduction of 56 per cent of that given by a corresponding amount of the latter when the Hagedorn-Jensen method was used, of 39 per cent with the Shaffer-Hartmann method, and of 20 per cent with that of Folin and Wu: it failed to affect Benedict's reagent. It was also shown that a zinc hydroxide filtrate, provided the precipitation had been carried out at a slightly alkaline reaction, contained none, whilst all the glutathione present passed into a tungstic acid filtrate. The third paper applies these results to blood, and a description is given of a new method of precipitating the proteins: the corpuscles are kept intact by using sodium sulphate as diluent instead of water, the precipitation being carried out by means of tungstic acid. The four methods of blood-sugar estimation agreed when compared on zinc hydroxide or the modified tungstic acid filtrates; on the original tungstic acid filtrates higher values (except with Benedict's method) were obtained and the methods disagreed. The discrepancies could all be explained by the known reducing powers of glutathione in the presence of the reagent used. The amount of this substance in the blood is about 0·05 per cent, a higher figure than that given by Rabinowitch.

J. M. Gulland and R. A. Peters (*ibid.* vol. 24, p. 91; 1930) have investigated the nature of the reducing substances in pigeons' blood. The Hagedorn-Jensen method was used: relatively high values for blood-sugar were obtained, but it was found that even after the injection of insulin, or after the blood had been exposed to anaerobic glycolysis, a residual reduction of 0·07 per cent was still observed. Deduction of this figure from the 'blood-sugar' value indicated that the true glucose of the blood was not very much higher than that of mammals. The residual reducing substances were almost confined to the corpuscles: about half of them reduced the ferricyanide in the cold, suggesting the presence of sulphydryl groups. It was found that, by this method, the reducing power—in terms of glucose (100)—of uric acid was 53, of glutathione 17, and of ergothioneine 56; by the ordinary Hagedorn-Jensen method glutathione was found to be equivalent to 45 of glucose (agreeing with Herbert *et al.*). From these estimations, and others carried out on tungstic, trichloroacetic, and zinc filtrates, it was concluded that the non-glucose reducing substances in pigeons' blood are ergothioneine, uric acid, creatinine, creatine, and one or more unidentified compounds, possibly a purine-carbohydrate or a phosphoric ester.

E. N. Allott (*ibid.*, vol. 22, p. 773; 1928) has shown that the rates of utilisation of α, β, and $\alpha\beta$ glucose when injected into the veins of rabbits are the same. O. J. Nielsen (*ibid.*, vol. 22, p. 1490; 1928), by estimates of the blood-sugar at intervals of 1–5 min., has shown that it is not, in man, subject to violent fluctuations, remaining fairly constant or falling or rising steadily according to the conditions at the moment: the observations were carried out after fasting and after the ingestion of food or glucose on both normal and diabetic subjects.

Two other papers on carbohydrates may be referred to briefly here. C. Rimington (*ibid.*, vol. 23, p. 430; 1929) succeeded in isolating a carbohydrate derivative from alcohol-denatured serum proteins, by hydrolysis with baryta, treatment with lead acetate, and precipitation with ammonia: the lead ammonia precipitate was dissolved in weak acid, the lead removed, and the filtrate treated with mercuric chloride solution: after removal of metals the solution was concentrated and the carbohydrate precipitated with methyl alcohol and ether. The yield was 2 per cent. On analysis it was found to contain 4·1 per cent nitrogen, and molecular weight determinations indicated that it was a disaccharide, having the empirical formula $C_{12}H_{23}O_{10}N$; further investigation showed that it was a disaccharide of glucosamine and mannose. Both albumin and globulin yielded the same derivative, and it was also obtained after tryptic digestion of serum protein. It is considered probable that the mannose is attached to the nitrogen atom of the glucosamine. From the amount present the minimum molecular weight of the albumin or globulin must be of the order of 17,000, a figure which agrees with estimations made by other methods. It is possible that this carbohydrate plays some part in the immunological reactions of the plasma proteins.

H. Sobotka and M. Reiner (*ibid.*, vol. 24, p. 394; 1930) have investigated the configuration of certain sugars by means of the differences in their reducing powers for the ferricyanide reagent of Hagedorn and Jensen. Their results lead to the conclusion that in aldo- and keto-hexoses the configuration between the third and fourth carbon atom is the determining factor: in aldopentoses the configurations between these two atoms and the second and third share the influence on the reducing power. The *trans* arrangement of OH is more active than the *cis*.

The question of the nature of the reducing substances in urine, especially in human beings, has always aroused interest. It is generally held that small amounts of glucose are normally excreted; during lactation, lactose may appear, whilst the excretion of a pentose is a rare abnormality. J. Patterson (*ibid.*, vol. 20, p. 651; 1926) considers, however, that the carbohydrate in normal urine is not glucose, since it is not fermented by baker's yeast and forms a phenylosazone of different crystalline form and properties from those of glucosazone, although its analysis suggests that it is a hexosazone. Hydrolysis of urine usually sets free a fermentable reducing sugar. A. Hassan, however, considers that glucose is present in normal urine, although accompanied by another sugar which forms a different osazone (*ibid.*, vol. 22, p. 1332; 1928). Both authors agree that interfering substances must be removed before attempting to form an osazone; Patterson employs the mercuric nitrate reagent and Hassan charcoal. The latter author also found that the number of urines giving typical glucosazone crystals as well as mixed crystals, instead of the latter only, was increased following a meal but not following the administration of glucose alone.

Social Biology.*

DARWIN'S "Descent of Man" was a challenge to the complacent dualism which had permitted utilitarian science and humanistic philosophy to pursue an independent course from the days of the schoolmen to the middle of the nineteenth century. To-day it is evident that the social sciences can no longer progress within the framework of a philosophical tradition brought into being by the conditions of the city State and nurtured from Abelard to Kant in servile association with the requirements of apologetics. Economic science has already severed its moorings to moral philosophy. There is a growing disposition among other branches of social science to do the same. To-day the application of scientific method to the study of human society is philosophically guaranteed by the generally accepted conclusion that millionaires and metaphysicians, statesmen and seventh-day adventists are products of the same secular agencies as have fashioned the rest of the brute creation. The far-reaching implications of the change in outlook which Darwin's doctrine has brought about are becoming more apparent in our time, because biologists are now undertaking the analysis of the characteristics of conscious behaviour in animals and the behaviourist school of psychologists is applying the new methods to man himself.

Man is an animal as the ant is an animal. The biologist as a biologist confines his attention to those characteristics which ants and antiquarians have in common. The sociologist confines his inquiries to certain characteristics which distinguish men and women from ants and all other animals. Their respective fields of investigation overlap in the attempt to define what characteristics of human society are determined by those characteristics which men share with all other animals and what characteristics of human society are referable to characteristics which distinguish man as one species of animal from all other species of animals.

We must be prepared to recognise that issues which made the first claim on the attention of men like Huxley, Galton, and Spencer are no longer topical. The misguided opposition of the Churches compelled biologists of Darwin's generation to concentrate on emphasising the characteristics which we share with other animals. Social biology has now to undertake the task of defining in biologically significant terms the characteristics which distinguish man as one species of animal from all other species of animals. The work of physiologists like Sherrington and Pavlov is opening the way to a biological interpretation of those peculiarities which are most diagnostic of the human species. A well balanced view of the rôle which inheritance and social tradition respectively play in determining differences which distinguish different social groups will only be possible when the biological study of behaviour and the methods of the geneticist can be brought into working harmony.

The great danger lies in undue haste to establish conclusions which may be made the basis of legislation. The genetic basis of occupational and racial stratification in human societies is a problem which calls for discipline, detachment, and restraint. Nothing could make the exercise of these wholesome virtues more difficult than to bring issues which are still problematical to scientific workers before the forum of political controversy. Much research directed to elucidate genetic variations in human communities has been vitiated by a failure to envisage the complexity of the problem. A genuine scientific analysis of genetic variation in human society must be sustained by the recognition that human society is a unique biological phenomenon, inasmuch as the family is a unit for the cumulative communication of old and new environmental stimuli as well as a group delimited by genetic affinity. The pre-eminent need of the moment is investigation rather than propaganda. The first task of the social biologist is not to advocate the sterilisation of the unfit but to undertake the sterilisation of the instruments of research before operating on the body politic.

In our own generation the population problem embraces a variety of issues in which the sociologist and the biologist have a common interest. A clear appreciation of the biological issues necessitates the prosecution of research into the physiology of reproduction, the genetic basis of human behaviour, and the incidence of changes in fertility. The analysis of this intricate problem will not be facilitated by an unduly alarmist attitude. The sceptical inquirer may approach the differential fertility of the social classes which has accompanied the decline in the birth-rate as a conundrum rather than a catastrophe. We have inadequate scientific evidence to justify the belief that extensive genetic differences do distinguish the social classes. If we had such knowledge it would be necessary to ascertain how such differences are transmitted before justifying the belief that a temporary disparity in fertility will necessarily produce

* Substance of an inaugural lecture delivered by Prof. Lancelot Hogben at the London School of Economics and Political Science on Oct. 23.

significant social consequences. The German and Swedish data suggest that contraceptive practice is rapidly spreading to all sections of the community, so that differential fertility may be a problem which will solve itself without legislative interference. On the other hand, if this transpires to be the case, it is possible that European communities will be faced with a rapid decline in general population, which will create a new constellation of social problems for legislative treatment. The decline in the birth-rate brings us face to face with the fact that human society is entering upon what Mr. J. B. S. Haldane has called the era of biological invention, and the institution of a chair of social biology is an implicit recognition of the impending change. The rapid progress now being made in physiology makes it unlikely that in the near future human society will be in a position to regulate the reproductive process to an extent and in ways hitherto unimagined and unimaginable.

In many directions it will be necessary for the social biologist to co-operate with pure sociology in ascertaining the significant factors which operate in determining the growth of human populations. On the other hand, social biology cannot develop fruitfully if it isolates itself from the methods of experimental inquiry. By the very complexity of the genetic problem social biology is committed to create a framework of biological research and teaching in which a new type of social psychology can develop. For the same reason it is entrusted with the experimental analysis of aspects of the physiology of reproduction too long neglected by medical science.

Periodicity of Locust Invasions.*

WHILE the technical methods of controlling locusts are well developed and very effective, a successful organisation of anti-locust campaigns meets with many difficulties. The main difficulty lies in the fact that locusts are not a permanent pest, but may be absent from a country one year, and appear in enormous swarms in the next. For example, the Desert locust, a species alluded to in the Bible, invaded the whole of north and east Africa, Persia, India, Iraq, Palestine, and Turkey in 1914-16 and then nothing was heard about it for more than ten years. In 1926-27 a new outbreak started, and by 1929-30 Africa from Tanganyika to the Mediterranean, and south-west Asia so far north as Transcaucasia and Turkestan, were overrun by devastating swarms.

Such sudden outbreaks involving whole countries find some of them not fully prepared to meet the danger, and during the recent invasion extraordinary efforts were required to save the crops. An effective organisation of an anti-locust campaign cannot be improvised at a moment's notice, while it is clearly impossible to keep the organisation in readiness during long intervals between invasions.

The key to the solution of the locust problem is therefore to find out the laws governing periodic outbreaks of locusts. Recent work in this direction in Russia, South Africa, Sudan, and elsewhere proves that the periodicity of locust outbreaks is intimately connected with the fact that all known species of locusts occur in two forms or phases. These forms differ from each other in a number of structural and colour characters, but more particularly in the habits. During the intervals between outbreaks locusts are represented by the solitary phase, which is a harmless grasshopper without definite social habits. When the outbreak begins, the solitary phase is transformed into the gregarious one: the individuals of this phase form dense swarms and undertake long migrations. Experimental work on phases has shown that the solitary phase can be turned into the gregarious one, if the locusts are kept in a crowded condition; conversely, one can obtain the solitary phase by breeding gregarious individuals under isolated conditions.

Periodic outbreaks of locusts depend, then, on the cyclic transformation of these insects from one phase into another, and back again. The actual factors causing and favouring the transformation are still insufficiently known, but it is clear that the problem of the successful control of locusts cannot be solved until these factors are thoroughly investigated.

A special Committee has been appointed recently by the Government to consider the locust problem, and it was decided to organise exhaustive investigations into the question of periodic outbreaks and their causes. It is hoped that the actual work will begin shortly, and this concentrated scientific attack on locusts should produce results of great practical value in the shape of means of foreseeing and preventing locust invasions, which would mean an enormous saving in crops, human energy, and money for a large number of countries affected by the plague.

* Substance of a paper read by Dr. B. P. Uvarov before Section D (Zoology) of the British Association at Bristol on Sept. 9.

Research in the Electrical Industry.

MR. C. C. PATERSON, president of the Institution of Electrical Engineers, gave his inaugural address on Oct. 23. His subject was research, and he illustrated it with many brilliant and novel experiments. It rivalled the address on 'pressure rises' given by the late W. Duddell in 1913, when many interesting experiments were shown. He pointed out that whichever way we look in the domain of electrical engineering, whether in lighting or heating, in electro-chemistry or electro-medicine, in radio-telephony, in photo-electricity, or in heavy engineering, there are new advances every day, and dramatic discoveries and achievements rapidly succeed one another. As each discovery from the researches of physicists, metallurgists, and chemists comes to the engineer, he tries to assimilate it and turn it to practical use. There is a serious risk, however, of treating the old problems—often only half understood—as if they are already solved. Engineers are too often content with the knowledge of the art as they find it, and allow new extensions of the industry to be built on an insecure foundation of half-truths and empiricism. The old subjects need research as much as the new, and the most difficult problems are often those which the last generation has thrown aside in its hurry to grasp and exploit the next new thing. Mr. Paterson advocated research on many of the old-established usages in the industry. In his opinion, this would open up many new avenues of advance.

Mr. Paterson said that the distinction between pure and applied research is only one of ultimate

object. The ideal which inspires every one working in research is the substitution of knowledge for empiricism, and this finds as true an expression in industry as in those research institutions where the labours are furthest removed from practical utility. The measure of purity of research is determined by the spirit of the worker. He who uses his research talents in order that he may gain the prestige of priority in discovery is no more exalted than he who seeks to understand enigmas which are preventing a product from becoming useful to mankind. The desire to explain the mysteries of the world is the impulse of the researcher; it is the way in which the knowledge is used that purifies or debases. Empiricism has an essential place in almost every industrial process, because schedules and specifications can only be based on theory and principles so far as these are known, and the rest has to be rule of thumb. In addition, the schedules must be such that people who operate them need only follow them blindly and empirically. As an example, Mr. Paterson mentioned the controversy about the permissible voltage variations at a consumer's terminals: he pointed out that the effect of increasing the permissible variations would be to neutralise much of the good work done by manufacturers. He suggested that there should be a joint examination, by the supply industry and the manufacturers, of the problem.

Speaking of the problem of electric heating, Mr. Paterson considered it is largely a metallurgical one. The alloys used for the resistance wires are generally of nickel and chromium. These alloys are suitable because the oxide layer formed on their surfaces when heated in air is highly protective. Once a certain thickness has formed, further oxidation of the underlying metal proceeds very slowly. The suitability of an alloy is determined by the protective and adherent properties of the oxide rather than by the properties of the alloy itself. So far as progress in electric lighting is concerned, the luminous efficiency of the modern tungsten filament gas-filled lamp is not likely to be greatly exceeded. The actual efficiency is about 18 lumens per watt, where 12·57 (4π) lumens are emitted by a uniform point source of one candle power. Theoretically, 670 lumens per watt could be obtained by transforming power directly into light of maximum visibility. The light obtained, however, would be monochromatic. It would be quite unsuitable for general illumination, as it would be of a yellowish-green hue. Mr. Paterson showed a gaseous discharge tube, first tried in the United States and developed by Prof. Pirani, of Berlin, which operates at ordinary voltages and gives an efficiency up to 50 lumens per watt. He showed that if we use two of these tubes, one filled with sodium and the other with neon gas, the combination gives a light akin to candle-light. If we add a mercury vapour tube we get a fair approximation to daylight. There is room for progress to be made in this direction.

African Ethnology and Archæology.

SEVERAL communications from field workers in Kenya, Rhodesia, and South Africa were made to Section H (Anthropology) of the British Association at the recent Bristol meeting. Mr. L. S. B. Leakey gave a detailed account of the system of land tenure among the Kikuyu. One great cause of misunderstanding between the incoming white races and the natives is the different way in which each looks at the ownership of land; and it was felt that such studies as that made by Mr. Leakey, who speaks Kikuyu and has worked with Kikuyu people for many years, should help to bridge this gulf.

Mr. Leakey also gave an illustrated account of the pottery found with stone age cultures in Kenya. A striking feature is the discovery of pottery *in situ* in the lower part of the Upper Aurignacian deposits, at a depth of 28 feet from the original modern floor surface, and beneath a big series of undisturbed strata. Associated with the pottery were tools of a Mousterian type, an industry belonging in Kenya to the second division of the Gamblian pluvial just after its maximum. In view of the absence of pottery finds in Europe in association with Palæolithic cultures, the discovery opens again the question as to whether pottery may yet be found in other regions associated with Aurignacian implements; the evidence at present is entirely negative.

Mr. Leslie Armstrong, in a paper on "The Age of Man in Africa as demonstrated at the Victoria Falls", referred to a letter from Col. Fielden which was published in NATURE of Nov. 23, 1905, p. 77, directing attention to the "stone implements . . . present in profusion, both in the river gravels on the highest margins of the Zambesi valley and also spread broadcast, along with rolled gravel, on the basalt platforms of the ancient river channel below the Victoria Falls". Later, Mr. G. W. Lamplugh and Mr. Henry Balfour published papers on these implements. In 1929 Mr. Armstrong and Mr. Neville Jones of Buluwayo, as part of the work of the Rhodesian Archæological Expedition, investigated the occurrence and the zones of distribution, and were able to suggest the relation of the various types of artefacts to successive stages in the cutting back of the gorge.

The sequence of types was found to be precisely the same as in Europe. The earliest are pre-Chellean and occur in a more or less rolled condition over the whole area examined, which extended from the present falls to the fifth gorge. Beyond the fourth gorge, only tools of this type occur and they were obviously left there by the river when the position of the falls was on the line of the fifth gorge. Similarly, Chellean, Acheulean, and Mousterian tools occur in succession back to the area of the first and second gorges. Since the pre-Chellean tools were deposited by the river, the gorge, which is nowhere less than 400 ft. in depth and 100 ft. in width, has been excavated by the Zambezi for a distance of five miles by the opening out of lines of faulting and shrinkage cracks in the basalt. A long period of time must be allowed for this erosion. But there is geological evidence that the erosion was not continuous and that there was an arid period when the Zambezi river was almost, if not completely, dried up, and at least one arid and one pluvial period have occurred since the implements of Acheulean type were dropped by their users near the river and washed into the gravels. Mr. Armstrong therefore concludes that the African series of lower Palæolithic stone implements is probably a whole period earlier than their European parallels, basing his belief on the equation of the pluvial periods of Africa with the glacial epochs of Europe.

A paper approaching the problems of the history of the south-eastern Bantu from a new point of view was read by Mr. A. J. H. Goodwin. He has worked among the AmaMpondo, and studied their royal regimental system. This system is based on the fact that when the 'Great Wife' of a chief is chosen, generally from the point of view of the value of her family as allies, her

son is heir to the chieftainship, and voluntary retainers attach themselves to him, thus forming the nucleus of a royal regiment. Mr. Goodwin gave details of the generation-regiments of the AmaMpondo, and showed how such details might be used as evidence for dating battles, since native historians carefully remember the names of the regiments present at battles. The Rev. W. A. Norton has attempted to date the regiments of the Ba Suto, but as yet nothing of this sort has been done for the south-eastern Bantu. Mr. Goodwin's paper also interested ethnologists, since it forms another link binding the eastern Bantu into a whole, the generational regimental system being well known everywhere farther north.

Action of Cinchona Alkaloids in Malaria.*

ALTHOUGH three centuries have elapsed since cinchona bark was introduced into European medicine for the treatment of malaria and it is nearly a century since the last of the four alkaloids—quinine, quinidine, cinchonine, and cinchonidine—which form the active constituents of the bark was discovered, there are still numerous problems to be settled in connexion with the use of the bark and its constituents in malaria. Until recently, chemotherapeutical work in this disease has been hampered by the fact that the relative values of drugs could only be investigated by extensive clinical trials in malarial countries. Much work of this kind has been done in India and Malaya by MacGilchrist, Acton, Fletcher, Sinton, and other British experts in tropical medicine, mainly to ascertain whether the present policy of concentrating on quinine as the only valuable cinchona alkaloid for the treatment of malaria is sound. Work of this kind is expensive and difficult, and final conclusions have not yet been reached.

Birds share with man susceptibility to malaria, and in recent years a method has been worked out of using them for testing new anti-malarial drugs. Facilities for such tests having been provided in Great Britain by the Chemotherapeutical Committee of the Medical Research Council, Dr. Henry, in association with Mr. J. A. Goodson, has been able to have the four cinchona alkaloids referred to above, together with a large number of their chemical derivatives, tested by Dr. Macfie in bird malaria. The results of this preliminary work support the conclusions arrived at from clinical trials that quinine and quinidine are more efficient than cinchonine, but the value of cinchonidine is still uncertain. Of the derivatives of quinine tried, the most promising is hydroquinine, which in these preliminary tests gave better results than any other drug examined. On oxidation, quinine is converted into an acid, quitenine, which is inactive in malaria, but it has been shown that activity is regained when the acid is esterified, and that in a series of such esters activity is slowly increased as the series is ascended, until at butyl and amyl esters the preparations begin to be curative instead of merely retarding the development of the malarial parasite.

In various tropical parts of the British Empire other drugs than cinchona enjoy local reputations as cures for malaria; for example, Alstonia bark in West Africa, the Far East, the Pacific Islands, and sub-tropical Australia, akuamma throughout Africa, and greenheart bark in British Guiana. All these also contain alkaloids, which have been tried in the course of this work, but the Alstonia alkaloids alone have shown any activity in bird malaria.

* Substance of a paper read by Dr. T. A. Henry before Section B (Chemistry) of the British Association at Bristol on Sept. 18.

University and Educational Intelligence.

CAMBRIDGE.—Sir James Jeans will deliver the Rede lecture at 5.30 P.M. on Nov. 4, taking as his subject "The Mysterious Universe".

The Appointments Committee of the Faculty of Engineering has appointed R. H. Angus, of Sidney Sussex College, to be University demonstrator in engineering.

The Appointments Committee of the Faculty of Physics and Chemistry gives notice that the Humphrey Owen Jones lectureship in physical chemistry is vacant owing to the appointment of Dr. E. K. Rideal to be professor of colloidal physics. Intending candidates for the Lectureship should send their names to the chairman of the Faculty Board of Physics and Chemistry, the Master of Pembroke College, not later than Nov. 12.

The Managers of the Balfour Fund, with the approval of the Faculty Board of Biology 'A', have made a grant of £150 from the fund to L. C. Beadle, of Pembroke College, for research on the biology of the East African Lakes.

EDINBURGH.—Sir James Barrie was installed as Chancellor of the University on Oct. 25 and conferred honorary degrees on Sir Thomas Holland, Principal of the University, and Sir J. J. Thomson, Master of Trinity College, Cambridge, among others.

LONDON.—The title of emeritus professor of electrical engineering in the University has been conferred on Prof. Ernest Wilson, on his retirement from the University chair of electrical engineering at King's College.

THE Council of the Institution of Naval Architects has awarded the Yarrow Scholarship in Marine Engineering (1930) to Mr. W. J. Reynolds, of Messrs. Alexander Hall and Co., Aberdeen. The Scholarship is of the value of £100 per annum and will be held at the University of Glasgow for four years.

"THE day of science is here in commerce as in industry." These words sum up the purport of Sir Francis Goodenough's paper read before section L (Education) of the British Association at Bristol on the subject of "Education for Business." No greater service could be rendered by the Association at this time than to promote the general recognition of the truth that scientific methods are imperatively demanded alike in the fields of production, management, and marketing. Scientific research is needed not only into methods of manufacture, handling and transport and methods of management, but also into methods of selling and the possibilities and requirements of the world's markets. In technical education for production there has been a great advance in the past twenty years, but education for marketing has not kept pace. Commerce has not hitherto been recognised as a science, and this vitally important business has been regarded too much as something people can 'pick up' as they go along. In the highly competitive and increasingly scientific world of to-day, it is essential that British commerce should find recruits endowed with "character *plus* brains raised to the highest power by education". There must be a general recognition of these facts and a determination on the part of all concerned to raise high the standards of efficiency and probity in the conduct of British commerce, to the benefit of all engaged in it and to the credit of the nation as a whole. So will be dissipated the still surviving prejudices which have for generations imposed a social handicap on those who follow a 'commercial' career and operate despite the congestion existing in other professions mistakenly regarded as more honourable.

Historic Natural Events.

Nov. 2, 1664. Great Plague of London began.—For some years London had been almost free from the bubonic plague, but an outbreak of great intensity began in the autumn of 1664, probably spreading from Holland. The first cases occurred on Nov. 2, and a few more in the following winter, which was severe. In May 1665 the epidemic became more noticeable and spread slowly through the City. The numbers of deaths reported from this cause were 43 in May, 590 in June, 6137 in July, rising to 31,159 in September. The total number reported was more than 68,000, and there were probably many thousands more which were kept secret. The population of London at the time was less than half a million, and of these, two-thirds fled to escape the contagion (incidentally spreading it widely over the country), so that of those who remained, nearly half died. The condition of London on Sept. 20, 1665, was described by Pepys: "But Lord! What a sad time it is to see no boats upon the River; and grass grows all up and down White Hall court, and nobody but poor wretches in the streets!" It was not until the cold weather of November and December 1665 that the plague abated and the refugees returned.

Nov. 2, 1898. Floods in the Lake District. As a result of heavy rains during a gale on Nov. 2, one of the worst floods on record occurred in the Lake District. At Kendal 3·6 in. of rain fell in two days, and the Kent rose 12 in. higher than the previous highest level of 1878, flooding the town to a depth of four or five feet and doing great damage. At Keswick nearly three inches fell in 24 hours, and Thirlmere being already at its full height, the water overflowed through Keswick, where many houses were flooded. Throughout Cumberland and Westmorland similar scenes occurred - bridges damaged or washed away, animals and poultry lost. At Cockermouth the Derwent rose to the highest point since the great flood of 1852 and the lower parts of the town were deeply flooded. Windermere reached a level a foot higher than the previous record.

Nov. 3, 1927. New England Floods. As a result of strong south-easterly winds blowing from the Atlantic, torrential rains fell over New England and eastern New York, exceeding 9 in. in several places. The ground was already saturated by excessive rain in October, and so heavy and extensive were the rains of Nov. 3 and 4 that destructive floods occurred even before the rain had ceased. The rivers exceeded their previous highest levels by several feet. At Montpelier, Vt., for example, the Winovski rose 16·5 ft. and there were 8-10 ft. of water over the whole business district. At White River Junction, Vt., the Connecticut rose 29 ft. in 24 hours. The greatest floods occurred at night, and the damage was estimated as more than 37 million dollars, more than 9000 persons were rendered homeless, and 88 lives were lost. Both life and property would have suffered far more but for the Weather Bureau warnings.

Nov. 4, 1926. Storm and High Tide on West of Scotland.—An unusually deep barometric depression travelled along the north coast of Ireland and north-eastward across Scotland on Nov. 4 and 5, causing severe gales. On the west coast of Scotland there was a very high tide. Many rivers overflowed their banks and caused considerable damage by flooding; roads were rendered impassable, in some cases railway services were delayed, and the telephone and telegraph services were dislocated.

Nov. 5, 1530. North Sea Storm.—On Nov. 4-5 a violent wind blew down many houses and trees in England. It was followed by a great inundation of the sea, which invaded the coasts of Essex and Kent and the Isle of Thanet, and was even more destructive in Flanders, Zealand, and Holland, where 25 towns and 24 smaller places were wholly or partly destroyed; Antorf and Antwerp suffered severely.

Nov. 6, 1909. Heavy Rain in Jamaica.—During the occurrence of an unusually strong northerly wind ('norther'), very heavy rains were experienced in the north-eastern part of the island, especially on Silver Hill. In eight days, Nov. 4-11, the total recorded was 135 in., of which 30·5 fell on Nov. 6. The rivers and gullies leading from the mountains were flooded, with much loss of property and some fatalities. At Radnor there was an immense landslide, which blocked the gorge of the Cascade River and raised the level of the water by 200 ft.

Nov. 6, 1916. Optical Phenomena near Amiens.—About 9.30 P.M., at Pont Noyelles, east of Amiens, there was a lunar halo of 22°, a horizontal circle or mock moon ring, and a halo of 90°. During the remainder of the evening gun flashes appeared as narrow vertical streaks centred 10° to 15° above the horizon, and a large red glow from a fire some miles away also appeared as a very large and fiery streak with a dark space at its centre, 32½° above the horizon. The appearance was described as "the Angel Gabriel crossing swords with the powers of darkness".

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 22.—The president announced the death of Philippe Glangeaud, of the Section of Mineralogy.—**H. Vincent**: The comparative cryptotoxic power of the sodium salts of some of the saturated fatty acids. It has been shown in earlier publications that minute doses of sodium oleate, palmitate, or margarate can neutralise very active toxins (tetanus, diphtheria, dysentery), and that this is due to a physical action of the soaps. The antitoxic power of these soaps extends also to venoms, certain alkaloids, and metallic salts. The present communication gives an account of the antitoxic properties of the lower terms of the fatty acid series. The effects are very irregular and do not depend on the number of carbon atoms in the molecule, the solubility, or the melting point of the acid. There is no connexion between the cryptotoxic power and the surface tension of the solution.—**Luc Picart**: The singular cases in the calculation of orbits. **R. Chodat**: New researches on the gonidia of lichens.—**C. Raveau**: The utilisation of streams at the mouth. **Jacques Chokhate**: Continued algebraical fractions.—**Paul Alexandroff**: The geometrical analysis of the dimension of closed ensembles.—**Georges Giraud**: The integro-differential equations in conjunction with integro-differential conditions at the boundary.—**Radu Badesco**: A functional equation.—**Pierre Dupin**: The vibration of cylindrical tubes in water under the influence of alternating vortices.—**D. Rosenthal and M. Mathieu**: Mild steel welding in the electric arc. The strength of the weld is much increased if during the welding the metal is protected from oxidation. Examination by X-rays proves the existence of stresses in the case of the non-protected welds.—**Constantin Salceanu**: The magnetic double refraction of phenol, naphthalene, and of phenanthrene in the fused condition. The passage from the benzene ring to naphthalene and phenanthrene results in a large

increase in the magnetic double refraction.—**A. P. Rollet**: A silver borate. The compound described was proved to have the composition $Ag_2B_4O_7 + 2H_2O$. —**André Meyer** and **Mlle. Suzanne Mathey**: The volumetric estimation of acetone. The acetone is precipitated as $3HgSO_4 . 5HgO . 2C_3H_6O$ by Denigès reagent (acid mercury sulphate), the mercury in excess being titrated by Volhard's method.—**L. Bert**: A new method of synthesis of phenylpropargyl alcohol and its homologues substituted in the ring. With commercial cinnamyl alcohol as a starting point, a method giving good yields of phenylpropargyl alcohol is outlined. **H. Mémery**: The summer of 1930 and the solar variations.—**W. Moycho**: The formation of the pigment in *Bacterium prodigiosum*. The pigment (prodigiosine) always appears at the period of the strongest development: it is formed at the death of the bacterium and oxygen is necessary for its appearance.—**G. Dinulescu**: The biology of the horse-fly.—**Edouard Ducloux** and **Mlle. Georgette Cordier**: Researches on the treatment of experimental bovine anaplasmosis in Tunis. This disease is curable, provided that the treatment is commenced sufficiently early.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 5, 1930).—**A. Archangelskii**: Investigations of phosphorite deposits in Russia. **A. Borisiak**: *Ursus spelæus rossicus* nov. n. Description of a new race of *U. spelæus* from five almost entire skeletons found in a cave near Krasnodar, northern Caucasus.—**P. Lazarev** and **N. L. Rodzevic**: The phenomena of ionisation of gases during the photochemical reactions in solids.—**A. Rolmačev**: Some unexpected floristic finds in the central region of the Taimyr peninsula. —**N. Vassojevič**: Geological investigations in the region of the Djava mineral waters, southern Ossetia.—**K. Flerov**: The white muzzle deer (*Cervus albirostris* Przev.) as the representative of a new genus *Przewalskium*. A full description of the new genus.—**E. Cheissin**: A contribution to the binomics of infusoria parasitic in various invertebrates of the Lake Baikal.

Comptes rendus, No. 6, 1930. **A. Vinogradov** and **M. Neustrueva**: Manganese in insects (2). Quantitative determinations of manganese in a series of insects.—**A. Zachvatkin**: Vertical distribution and diurnal migrations of the zooplankton in Lake Baikal.—**A. Birula**: A preliminary communication on the Quaternary Carnivora of Crimea. Sixteen species are recorded from the Quaternary palæolitic deposits in Crimea, while the present-day fauna contains only seven.—**A. Kovanko**: A class of periodic generalised functions.—**N. Bogoliubov**: Approximation of functions by trigonometric summations.—**V. Ambarcumian**: A deduction from Dirac's theory of protons and electrons.

SYDNEY.

Linnean Society of New South Wales, Aug. 27.—**J. McLuckie**: On *Grevillea Gaudichaudii*, a supposed natural hybrid between *Grevillea laurifolia* and *G. acanthifolia*. The relation of the hybrids to the parents is shown by a graph based on the coefficients of divergence from the midparental reference point. —**F. A. Craft**: (1) The topography and water supply of Cox's River, N.S.W. The region forms part of the Nepean-Warragamba catchment area, and may be considered under the headings of tablelands, level valleys, and canyons or deep gorges. The tablelands have a thick mantle of soil or are forested; they supply water permanently to the streams, areas of swamp lands acting as storage grounds. The level valleys, which vary in elevation from 300 ft. to 3100 ft. above sea-level, are in parts water-bearing, but they depend largely upon the tablelands for permanent streams. The sides of the steep gorges have a very quick run-off. The continued permanency of the streams will depend largely upon the preservation of upland swamps and forests.—(2) Goulburn, a vital point on the New South Wales Highlands. Goulburn is situated on the tablelands between two series of deep gorges. The main routes leading from Sydney to Riverina and the Southern Tablelands pass along a narrow strip of undissected country to Goulburn, whence there is a divergence of routes. These take advantage of gentle radial valleys converging on the town, which is, therefore, a natural centre for communications and trade.

VIENNA.

Academy of Sciences, July 3.—**G. Koller** and **E. Kandler**: The constitution of cetraric acid.—**G. Koller** and **W. Passler**: The constitution of capraric acid.—**A. Franke** and **A. Kroupa**: Ring-contraction in the formation of inner ethers (oxides) from glycols (1, 5-oxido-dodecane from 1, 12-dodecanediol).—**A. Franke** and **A. Kroupa**: The preparation of α-alkyl-pimelinic acids from 1, 5-oxidodecane and 1, 5 oxido-dodecane. —**A. Haas**: (1) The mean mass-density of the universe. (2) The possible connexion between cosmic and physical constants.—**G. Nöbeling**: A fixed point theorem for curves connected *im Kleinen*.—**G. Nöbeling**: Universal curves of finite order.—**A. Wald**: Axiomatics of the concept 'between' in metrical spaces.—**K. Strubecker**: Helical lines in elliptical space.—**I Leng**: The question of photographic activity of metals after exposure to sunlight. The author did not succeed in getting results reported by others. **H. Brell**: The question of the linearity of the Lorentz transformation.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 8, Aug. 15).—**G. A. Miller**: Groups which are decomposable into two non-invariant cyclic subgroups.—**Solomon Lefschetz** and **William W. Flexner**: On the duality theorems for the Betti numbers of topological manifolds.—**A. H. Sturtevant** and **T. Dobzhansky**: Reciprocal translocations in *Drosophila* and their bearing on *Œnothera* cytology and genetics. The suggestion that chromosome rings result from exchanges of ends between non-homologous chromosomes seems to apply to *Drosophila*.—**T. Elliot Weier**: Notes on the plastid and other cytoplasmic bodies during sporogenesis and spermatogenesis in *Polytrichum commune*. Previous to gametogenesis, the plastid assumes a form closely resembling a Golgi body.—**J. B. Conant** and **W. G. Humphrey**: The nature of the prosthetic group in *Limulus* hæmocyanin. A black material is obtained which contains copper and seems to be a complex salt of an amino acid containing sulphur.—**Lynn H. Dawsey**: The photochemical dissociation of nitrogen peroxide. Absorption spectra of nitrogen dioxide and tetroxide have been photographed at room temperature and at the temperature of liquid air. Primary photochemical decomposition of the mixture is due to the tetroxide and the threshold is at about 3800 A.—**J. B. Conant** and **F. H. Crawford**: The study of absorption spectra of organic compounds at liquid air temperatures. Absorption bands of porphyrins and similar coloured organic substances are resolved into finer lines at liquid air temperature.—**H. J. Schumacher**: A correction to "The Decomposition of Nitrogen Pentoxide at Low Pressures".

Official Publications Received.

BRITISH.

Journal of the Royal Microscopical Society. Series 3, Vol. 50, Part 3, September. Pp. xvi+297-385. (London.) 10s. net.

Journal of the Royal Statistical Society. New Series, Vol. 93, Part 4. Pp. 489-652+xiii. (London.) 7s. 6d.

Journal of the Chemical Society. September. Pp. iii+2037-2216+xii. (London.)

India: Meteorological Department. Scientific Notes, Vol. 2, No. 13: Atmospheric Instability of Agra associated with a Western Disturbance. By Dr. K. R. Ramanathan. Pp. 21-25+4 plates. 14 annas; 1s. 6d. Scientific Notes, Vol. 2, No. 14: Horizontal Atmospheric Visibility at Agra. By Barkat Ali. Pp. 27-36. 6 annas; 8d. (Calcutta: Government of India Central Publication Branch.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 3, No. 19: On Radioactive Diffusion in the Atmosphere. By O. F. T. Roberts. Pp. 225-242. 1s. 6d. Vol. 50, Part 3, No. 20: Certain Quinoline and Benzacridine Derivatives yielding Coloured Adsorption Compounds with Iodine. By Dr. William Ogilvy Kermack, Dr. Robert Henry Slater and Walter Thomas Spragg. Pp. 243-261. 1s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 27: The Old Red Sandstone of Shetland. Part 2: North-western Area. By Dr. T. M. Finlay. Pp. 671-694+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4s.

Royal Microscopical Society. List of Fellows, September 1930. Pp. 28. (London.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1930; with Appendices. Pp. 25. (London: H.M. Stationery Office.) 9d. net.

Annals of the Solar Physics Observatory, Cambridge. Vol. 2, Part 1: The Spectrum of β Lyrae. By F. E. Baxandall, under the direction of Dr. H. F. Newall, and later of F. J. M. Stratton. Pp. vi+24+3 plates. (Cambridge: At the University Press.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol 16, Part 1, September 8th. Pp. 118+24 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Quarterly Journal of the Royal Meteorological Society. Vol. 56, No. 237, October. Pp. 359-432. (London: Edward Stanford, Ltd.) 7s. 6d.

The Phenological Report, 1929. Edited by a Committee of the Royal Meteorological Society. Thirty-ninth Report. Pp. 207-270. (London: Edward Stanford, Ltd.) 3s.

Education, India. Pamphlet No. 28: Revised Series of Mental Intelligence Tests for Indian Scholars. Pp. iv+32. (Calcutta: Government of India Central Publication Branch.) 7 annas; 9d.

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1930. (M.O. 328.) Pp. 55. (London: H.M. Stationery Office.) 1s. net.

Memoirs of the Geological Survey of India. Vol. 55, Part 1: The Geology of the Mergui District. By the late Rao Bahadur S. Sethu Rama Rau. Pp. iv+62+xxii+8 plates. (Calcutta: Government of India Central Publication Branch.) 6.2 rupees; 10s.

Allahabad University Studies. Vol. 1. Pp. iv+428. 7.8 rupees. Vol. 2. Pp. iv+362. 7.8 rupees. Vol. 3. Pp. vi+307. 7.8 rupees. Vol. 4. Pp. vi+489. 7.8 rupees. (Allahabad.)

Forest Department, Punjab. Punjab Forest Conference, Lahore, 1930: Proceedings, Resolutions and Papers. Pp. iv+73. (Lahore: Government Printing Office.)

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1929. Pp. 11. (Zomba.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 23, 24, 25: Diazotisation in the Pyrazole Series, by Dr. J. Reilly and D. MacSweeney; Xylan, by Dr. J. Reilly, P. P. Donovan and Miss K. Burns; A new Synthesis of substituted Thio-Xanthhydrols, by Dr. J. Reilly, Dr. P. J. Drumm and B. Daly. Pp. 497-522. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

The Dyestuffs Act: Views of the Chemical Industry. Pp. 24. (London: Association of British Chemical Manufacturers.)

Medical Research Council. Tenth Annual Report of the Industrial Health Research Board (formerly the Industrial Fatigue Research Board) to 31st December 1929. Pp. 29. (London: H.M. Stationery Office.) 6d. net.

Proceedings of the Royal Society. Series A, Vol. 129, No. A810, October 1. Pp. 235-410. (London: Harrison and Sons, Ltd.) 9s.

Nigeria. Annual Report on the Agricultural Department for the Year 1929. Pp. 20. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2s.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 55, Part 2, September. Pp. 169-304+lxvii-clxxxii+x+52 plates. (London.) 7s. 6d.

East London College (University of London). Calendar, Session 1930-1931. Pp. 201. (London.) 1s.

The Royal Society of Tasmania: Papers and Proceedings, 1930. The Evolution of the Class Insecta. By Dr. R. J. Tillyard. Pp. 89. (Hobart.)

Memoirs of the Queensland Museum. Vol. 10, Part 1, August 28th. Edited by Heber A. Longman. Pp. 88+9 plates. (Brisbane.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1317 (Ae. 454): Flight Tests on the Variation of the Range of an Aircraft with Speed and Height. By Flight-Lieut. C. E. Maitland and A. E. Woodward Nutt. (T. 2818.) Pp. 7+12 plates. 9d. net. No. 1325 (Ae. 459): A Study of Polynomial Equations. By W. L. Cowley and Sylvia W. Skan. (T. 2920.) Pp. 20+2 plates. 1s. net. No. 1329 (Ae. 461): Maximum Force on Rudders. By F. B. Bradfield. (T. 2960.) Pp. 4+12 plates. 6d. net. No. 1320 (Ae. 456): Controllability at Low Speeds and Full Scale Measurement of Lift and Drag of Parnall "Peto" fitted with R.A.F. 15 and R.A.F. 31 Section Wings (Slotted and Unslotted). By R. K. Cushing. (S. and C. 844.) Pp. 11+9 Plates. 9d. net. (London: H.M. Stationery Office.)

FOREIGN.

Bulletin of the Earthquake Research Institute, Tōkyō Imperial University. Vol. 8, Part 3, September. Pp. 321-376. (Tokyo: Iwanami Shoten.) 63 sen.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 10. Pp. 399-418+plates 77-80. (Tokyo: Maruzen Co., Ltd.) 80 sen.

United States Department of the Interior: Geological Survey. Bulletin 813-A: Mineral Industry of Alaska in 1928 and Administrative Report. By Philip S. Smith. (Mineral Resources of Alaska, 1928-A.) Pp. ii+96+xiii. 15 cents. Bulletin 814: Geology and Ore Deposits of the Wood River Region, Idaho. By Joseph B. Umpleby, Lewis B. Westgate and Clyde P. Ross; with a Description of the Minnie Moore and Near-by Mines, by D. F. Hewett. Pp. xi+250+33 plates. 90 cents. Professional Paper 155: The Flora of the Denver and Associated Formations of Colorado. By Frank Hall Knowlton. A Posthumous Work edited by Edward Wilber Berry. Pp. vii+142+59 plates. 80 cents. Professional Paper 159: The Upper Cretaceous Floras of Alaska. By Arthur Hollick; with a Description of the Plant-bearing Beds, by George C. Martin. Pp. v+123+87 plates. 80 cents. Water-Supply Paper 634: Surface Water Supply of the United States, 1926. Part 12: North Pacific Slope Basins. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp vi+236. 25 cents. Water-Supply Paper 631: Surface Water Supply of the United States, 1926. Part 11: Pacific Slope Basins in California. Pp. ix+419. 65 cents. (Washington, D.C.: Government Printing Office.)

The Academy of Natural Sciences of Philadelphia. 1929 Year Book. Pp. 108+16 plates. (Philadelphia, Pa.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 81, 1929. Pp. iii+689+23 plates. (Philadelphia, Pa.) 6.25 dollars.

Proceedings of the American Philosophical Society. Vol. 69, No. 6. Pp. 295-396. (Philadelphia, Pa.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 66: Procès-verbaux (mai-juin 1930) Pp. 163. 6.25 kr. Bulletin hydrographique pour l'année 1929. Pp 118. 6.25 kr. (Copenhague: Andr. Fred. Høst et fils.)

Panstwowa Rada Ochrony Przyrody. Wydawnictwo Okregowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze w Poznaniu. Zeszyt 1. Pp. 48. Monografje Naukowe, Nr. 1: Lasy Białowieży (Die Waldtypen von Białowieża) By Józef Paczoski. Pp. 575. (Kraków: Państwowa Rada Ochrony Przyrody.)

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 10, October. Pp. 313-344. (London: The Mond Nickel Co., Ltd.)

Radiostol, Irradiated Ergosterol: the Original British Standardised Vitamin D. Pp. 15. (London: The British Drug Houses, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 31.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Corporation Electricity Showrooms, Swansea), at 6.—Sir A. Whitten Brown: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—H. T. Young: Is the Engineer of To-day making the Best Use of his Opportunities in Electrical Development in this Country?

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Prof. W. A. Bone: High-Pressure Reactions (Lecture).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at St. Enoch Station Hotel, Glasgow), at 7.30. Dr. S. Miall: Editorial Notes on the Journal of the Society.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. T. Westbury: The Two-stroke Engine.

GEOLOGISTS' ASSOCIATION (in Great Hall, University College), at 7.30.—Annual Conversazione.

INSTITUTE OF BREWING (at South-Western Hotel, Southampton).—A. Hadley: Some Aspects of Bottling.—H. L. Hind: Some Aspects of the Research Work.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science).—Prof. J. F. Thorpe: The Life and Work of W. H. Perkin, Junr.

MEDICAL SOCIETY OF LONDON.—Sir Almroth Wright and others: Discussion on The Prophylactic and Therapeutic Values of Vaccines.

INSTITUTE OF CHEMISTRY (Birmingham and Midlands Section) (at Grand Hotel, Birmingham).—R. B. Pilcher and others: Discussion on Co-operation.

MONDAY, NOVEMBER 3.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. P. Eggleton: On Recent Work in the Biochemistry of Muscle.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—D. H. Patey: Demonstration of Specimens illustrating the Pathological Conditions of the Salivary Glands.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—H. B. Millard: The Measurement of Water.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—H. A. Humphrey, D. M. Buist, and J. W. Bansall: The Steam and Electric Power Plant of Imperial Chemical Industries, Ltd., at Billingham.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Prof. F. J. M. Stratton: Solar Eclipse Photography.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Institution of Engineers and Shipbuilders, Glasgow), at 7.30.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

HUDDERSFIELD TEXTILE SOCIETY (at Technical College), at 7.30.—B. G. B. Slocombe: The Properties and Uses of Celanese.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Burlington House), at 8.—Prof. F. J. Spencer: Magnetic Susceptibility as a Means of Investigating Chemical Properties.—Dr. R. C. Farmer: The Mechanism of the Formation of Cellulose Nitrate and Other Nitric Esters
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff).

TUESDAY, NOVEMBER 4.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.—J. Verrall: Some Amputation Problems (Presidential Address).
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. W. E. Hume: Paroxysmal Tachycardia (Bradshaw Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: New Aspects of Radioactivity (1).
MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—A. Russell: An Account of British Mineral Collectors in the 17th, 18th, and 19th Centuries.—M. H. Hey: Cupriferous Melanterite from the Skouriotissa Mine, Cyprus.—Dr. C. E. Tilley: (*a*) The Dolerite chalk Contact-zone of Scawt Hill, Co. Antrim; (*b*) The Production of Basic Alkali-rocks by the Assimilation of Limestone by Basaltic Magma: with Chemical Analyses by Dr. H. F. Harwood.—Dr. F. Smithson: A Simple Method of Observing the Magnetic Properties of Mineral Grains.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—W. B. Cotton: Exhibition of Ears and Molars of an African Elephant.—Secretary: Exhibition of Photographs of Elephants taken by Mr. M. A. Wetherall in the Belgian Congo.—J. R. Norman: Exhibition of Photographs of a Living Shark with a Remora attached.—D. Aubertin, A. E. Ellis, and G. C. Robson: The Natural History and Variation of the Pointed Snail, *Cochlicella acuta*.—B. J. Marples: The Proportions of Birds' Wings and their Changes during Development.—A. G. Lowndes: On Entomostraca from the New Hebrides collected by Dr. J. R. Baker.—H. W. Parker: A Collection of Frogs from Portuguese East Africa.
INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir George William Humphreys: Presidential Address.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—The Oleobrom Process.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. R. H. Pickard: Some Applications of Chemistry and Physics to the Examination of Hosiery Yarns.
INSTITUTE OF METALS (North-East Coast Local Section) (in Armstrong College, Newcastle-upon-Tyne), at 7.30.—S. L. Archbutt: Gases in Metals.

WEDNESDAY, NOVEMBER 5.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—C. E. Rickard: Chairman's Inaugural Address.
LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—C. H. Faris: The Application of Electro-deposited Metals to Marine Engineering.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 29 Hart Street, W.C.1), at 7.—T. G. N. Haldane: The Operation of the Heat Pump and its Possible Application to Heating Problems, particularly Swimming Bath Heating
SOCIETY OF GLASS TECHNOLOGY (London Section) (at Holophane, Ltd., Elverton Street, S.W.1), at 7.30.—Discussion on The Etching of Glass:—Dr. S. English: Introductory Remarks.—E. A. Coad-Pryor: Etching of Bottles.—A. L. Marden: Etching of Lamp Bulbs.—E. Jacobs: Etching of Scientific Glassware.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—P. Arup: The Analysis and Composition of Vegetable Parchment used for Packing Dairy Products.—Dr. G. M. Moir: The Determination of the Milk Proteins.—Dr. S. G. Clarke: The Lead Reduction Method for the Volumetric Determination of Tin, and the Interference of Copper and Antimony.—W. J. Agnew: A New Method for Determining Traces of Chromium in Steel.
ROYAL SOCIETY OF ARTS, at 8.30.—Sir Edward Gait: Britain's Record in India (Inaugural Address).
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—C. H. Fagge: Presidential Address.
ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B.M.A. House, Tavistock Square, W.C.).

THURSDAY, NOVEMBER 6.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street, W.C.2), at 3.—Miss Beatrice Irwin: The New Art of Illumination.
ROYAL SOCIETY, at 4.30.—Prof. W. A. Bone and S. G. Hill: The Slow Combustion of Ethane.—Prof. A. M. Tyndall and C. F. Powell: The Mobility of Ions in Pure Gas.—A. Fage and W. M. Falkner: An Experimental Determination of the Intensity of Friction on the Surface of an Aerofoil.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. E. Gask: Vicary's Predecessors (Thomas Vicary Lecture).
IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.10.—Dr. F. W. Aston: Mass Spectra and Packing Fractions (Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: The Physiology of Water (1).
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—D. B. Hoseason: The Cooling of Electrical Machines.
INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—J. Bradley and S. A. Wood: Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen: Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.—A. H. Girling: A New Automobile Braking System.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of the Manchester Literary and Philosophical Society, British Association of Chemists, Institute of Chemistry, Institute of Fuel, Institution of the Rubber Industry, Oil and Colour Chemists' Association, Society of Dyers and Colourists, and Institution of Electrical Engineers) (at College of Technology, Manchester), at 7.—Sir William B. Hardy: Paper.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with North-Western Centre of Institution of Mechanical Engineers) (at College of Technology, Manchester), at 7.—K. Baumann: Some Considerations in the Future Development of the Steam Cycle.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—R. F. Taylor: Glass and Glass Making, with Reference to Special Glasses.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.—Dr. E. C. Smith: Cultivation of the Spirochætes associated with Tropical Ulcer.
TEXTILE INSTITUTE (Irish Section) (at Belfast).—A. J. Hall: Properties of Artificial Silk as affecting Industrial Uses.

FRIDAY, NOVEMBER 7.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir T. Vijayaraghavacharyar: The Work of the Imperial Council of Agricultural Research.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Dr. E. Sheehan: Cinematograph Demonstration.—Dr. Chevalier Jackson and others: Discussion on Precancerous Conditions of the Larynx.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. W. N. Bond: Turbulent Flow through Tubes.—J. S. Rogers: The Photographic Effects of Gamma-Rays.—J. S. Badami: The Spectrum of Trebly Ionised Cerium (Ce IV).—Prof. S. Chapman: The Absorption and Dissociative or Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Surgical Interest recently added to the Museum of the Royal College of Surgeons.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. J. W. Gregory: The Machinery of the Earth (Thomas Hawksley Lecture)
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—R. W. Allen: Feed-Water Systems for Steam Installations
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. Fawssett: Chairman's Inaugural Address
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section, jointly with other Manchester Scientific Societies) (at Milton Hall, Manchester), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at Thomas' Café, Swansea), at 7.30.—A. Stuart: The Study of Crystals with Special Reference to Chemistry.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—H. Marryat: Luminous Electric Tubes (Neon, Helium)

SATURDAY, NOVEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (1).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Stuart Age.

TUESDAY, NOVEMBER 4.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Russian Farming and Agriculture.
UNIVERSITY COLLEGE, at 5.30.—Miss M. A. Murray: Egyptian Statues.
UNIVERSITY OF CAMBRIDGE, at 5.30.—Sir James Jeans: The Mysterious Universe (Rede Lecture).
MEMORIAL HALL (Farringdon Street).—Sir George Newman: How England learned to control Disease.

WEDNESDAY, NOVEMBER 5.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. S. L. Cummins: The Prevention of Tuberculosis.
UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: Norway, the Land and the People. (Succeeding Lectures on Nov. 12 and 19.)
LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—Dr. M. Culpin: Modern Views of Nervous Troubles. (Succeeding Lectures on Nov. 12 and 19.)

THURSDAY, NOVEMBER 6.

KING'S COLLEGE, LONDON, at 3.—C. J. Gadd: Babylonian Religion.
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: History and Theory of Contraceptive Technique.
ROYAL SOCIETY OF MEDICINE (in Barnes Hall), at 5.—V. E. Negus: Some Observations on Semon's Law (Semon Lecture).
BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. H. Clay: Economic Responsibility.
BRITISH MEDICAL ASSOCIATION (in Hastings Hall, Tavistock Square), at 5.15.—Dr. M. Ray: The Treatment of Rheumatism (Chadwick Lecture).
MEMORIAL HALL (Farringdon Street).—Sir George Newman: Health Problems of the Modern Period.

SATURDAY, NOVEMBER 8.

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—A. Russell: Some Methods of Lightning Calculation.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Animal Childhood.

CONGRESS.

NOVEMBER 1 AND 2.

INSTITUTE OF SOCIOLOGY (at Imperial Institute).—Lectures and Discussions on Sociological and Survey Topics.

SATURDAY, NOVEMBER 8, 1930.

CONTENTS.

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Scientific Workers in Government Employment.

THE Report of the Committee appointed by the Treasury in May 1929 "to examine the functions and organisation" of certain specified scientific establishments in the Government Service, and "to report on the method of recruitment and conditions of service of the civilian scientific and technical officers employed therein", has now been published (H.M. Stationery Office, 9*d*. net). The specified departments were :

(*a*) The research and experimental establishments under the Admiralty, War Office, Air Ministry, and Department of Scientific and Industrial Research ; (*b*) the Department of the Government Chemist and the establishments under the Admiralty and War Office concerned with chemical analyses ; and (*c*) the Meteorological Office.

The Report contains a number of important recommendations, and although it introduces differentiations which will inevitably give rise to dissatisfaction among certain sections of the staffs affected, its proposals, if put fully into effect, represent on the whole a great step forward in the direction of both higher status and fuller economic recognition for the scientific worker in Government employment.

The Committee, over which Sir Harold Carpenter presided, was a strong one and included, in addition to an administrative element drawn from the Treasury and War Office, Sir Robert Robertson, the Government Chemist ; Dr. F. E. Smith, Secretary of the Department of Scientific and Industrial Research ; Mr. H. T. Tizard, his predecessor in office and now Rector of the Imperial College ; and Mr. H. E. Wimperis, Director of Scientific Research at the Air Ministry. Evidence was received from the heads of all the larger scientific establishments, while the views of the staffs concerned were represented to the Committee by the Institution of Professional Civil Servants.

The examination of radical proposals for a complete change in the relationships of the scientific departments would appear to have fallen well within the terms of reference. The Committee, however, showed the better part of valour by the ingenious gloss that, as the respective functions of the establishments under consideration had 'recently' (actually in 1928) been set out in considerable detail in the Report of the Research Co-ordination Sub-Committee of the Committee of Civil Research, they had "assumed the first part of our terms of reference to be an instruction, not to

criticise and report on those functions, but to take note of them as the basis of our investigation into the conditions of service of the staffs employed ". Accordingly, " we have considered it unnecessary for us to report, for example, on a proposal (admittedly not unanimous) made to us by the Institution of Professional Civil Servants, for a unified State Scientific Service in the form of a Ministry of Science ".

Although the idea of closer unity of which a Ministry of Science is but the extreme form of organisation did not command the unanimous support of both wings of the Institution's membership, it will be a disappointment to all concerned that such an authoritative Committee should not have given a definite lead, or at least some guidance for the direction of the future development of the scientific services. The Committee has, however, made a series of proposals, following in principle very closely those submitted to the Committee by the Institution and endorsed by the Association of Scientific Workers, which will achieve a greater measure of uniformity in the conditions of service of the staffs concerned, and so pave the way to a more harmonious and progressive development of the scientific services than is at present practicable with the existing departmental structure.

As regards the contention that the present salaries and financial prospects of the scientific staffs in Government service are shown to be generally inadequate by the difficulty of recruiting and retaining officers of the requisite standard, the Report states that " it is open to question whether the State Services are at present attracting a fair proportion of the best recruits. In any case, we think that the present supply is neither so large nor so good as it might be if the conditions of employment were made more attractive." The Report goes on to remark that " the fact remains that the State has to compete with private industry as well as with the universities for the services of research workers, and we are clear that some steps must be taken to make that competition more effective ".

The Committee's proposals for an improved and unified system of salary scales are subject, however, to certain important reservations. It insists—and here it had the full support of the staff organisations—not only that the standard of recruitment must be high, but also that duties must be strictly graded so as to ensure that scientific officers " are always employed either on investigations which definitely require originality of outlook and execution, or on work which, though not demanding exceptional originality, does require wide knowledge and special experience ". Work of an " ancillary character " must, it is urged, be devolved upon a class of ' technical assistants ' corresponding in principle with such existing classes as those of ' observer ' and ' technical assistant ' in the Department of Scientific and Industrial Research and ' test assistant ' at the Royal Aircraft Establishment, for whom improved salary scales and prospects are also recommended.

The new grades and salary scales do not go beyond the existing rank of Principal Scientific Officer at the National Physical Laboratory or its equivalent. Of this senior grade it is stated that the qualifications will normally include both scientific attainment and power to organise and direct research: but the latter is not regarded as essential, and the important recommendation is made that it should be possible for a research officer to reach this grade solely on his merits as an individual investigator. The Committee states that it looks forward to " the Government research establishments being ultimately so organised and recruited that every research officer will be able to reach this grade before retirement, provided only that his proved capacity on appointment is followed by normal development during service ". This departure from civil service practice is an innovation which will be warmly approved by those who feel that the principles and methods of promotion normally applied in the civil service among the non-technical staffs are somewhat too rigid in their application to those engaged in creative scientific work.

While the Committee's grading proposals are based on the conception of uniformity, they retain the present distinctions between ' research ' staffs on one hand and ' technical development ' and chemical staffs on the other hand, as regards provision for superannuation. For the former, the continuance of the Federated Universities Superannuation Scheme is proposed, and for the latter the normal superannuation provision for established civil servants made by the Superannuation Acts. Taking this line of cleavage, the Committee differentiates markedly between the careers to be offered on the respective sides, notably in the earlier stages of service. In the case of staffs under the ' F.U.S.S.', the new entrant, who will normally be a university graduate with first or second class honours, will be appointed as a ' junior scientific officer ' on a scale of £200-15-260 (basic). When he reaches his maximum of £260 steps are to be taken " to assess his capacity for

research work ". His record will be reviewed by a selection board, which will keep in mind that the next grade of 'scientific officer' "should include on the one hand officers who must be specially qualified to undertake research work, and on the other hand those who will be engaged on work which although of a responsible nature and best undertaken by officers recruited after graduation at a university, requires scientific experience rather than special aptitude for research ". If he is found to be qualified for the duties of a 'scientific officer', he will be promoted to that grade, the basic scale for which will be £300-550; while if he is recommended as exceptionally qualified to undertake research, he may enter the scale at £350 (basic). It is further recommended that a junior scientific officer "who after being two years at his maximum, has not been recommended as suitable for appointment as scientific officer, should be required to leave his department, unless he can be appointed to a vacancy in one of the assistant grades ". This process of selection for retention in the service as a scientific officer and the power of allowing the research worker of exceptional promise to jump to £350 (basic) are extremely important suggestions and will do much to render more attractive the research side of the scientific services.

Unfortunately, however, the counterparts of these proposals for the junior grades in the 'technical' and chemical establishments are not identical, with the result that although some existing anomalies are removed among the F.U.S.S. staffs, new differentiations will be introduced in the Air Ministry and Admiralty as between the 'scientific' and 'technical' pools, the members of which are at present uniformly graded. The differentiations will, however, on balance involve a wide measure of unification; for the existing welter of grades and salaries will be replaced by two simple hierarchies, which will be identical in the case of senior officers.

The claims made on behalf of the staffs within the Committee's terms of reference involved complete unification and a commencing basic salary of £250 after a suitable period of probation; and the suggestion that only "limited" prospects should be offered to the technical and chemical staffs of going beyond £450 (basic) will not only give rise to serious dissatisfaction, but also go far to nullify the Committee's efforts to make the State scientific services more attractive. So far as the technical and chemical departments are concerned, it will still be the case that a more lucrative career will be open to the secondary school boy of scientific leanings if he enters the civil service in a non-technical capacity, through, say, the Executive Class examination at the age of eighteen years, for success in that examination will ensure him a clear run through to a salary of £400 (basic) without special efficiency bars and without expensive training, and on first promotion he will be assured of a jump to a scale rising from £400 to £500 basic.

While the Committee makes no specific recommendations with regard to the posts graded higher than principal scientific officer which carry administrative as well as scientific responsibilities, it is pointed out that it is obvious that if the other recommendations are accepted, the position of senior officers will call for review, and that the salaries attaching to many of these posts will have to be increased. As some members of the Committee were in the category in question, it is suggested that a small *ad hoc* committee should be appointed to consider the higher posts. In this connexion it is pointed out that those members of the Committee who have had direct responsibility for recruitment to scientific research staffs have found the inadequacy of the prospects offered by the higher posts a serious obstacle.

On a superficial examination, the Report would appear to be primarily concerned with economic questions affecting the conditions of employment of the State scientific worker, but when the Report is read in conjunction with a knowledge of the diversity of minutely differentiated salary scales and general conditions of employment that obtains in the scientific departments, it will be seen that it represents a very important stage in the development of those services. The recognition of the fact that the scientific workers in State employment are as a class performing a distinctive service will be more readily achieved now that, like other distinctive classes of civil servants, their conditions of employment have been closely assimilated. Moreover, by its insistence upon the need for a departure from normal service practice in the case of the socially valuable but often unrecognised gifted individual research worker without administrative talents, the Committee has made a break with precedent which must have important results. While scientific workers in Government employment as a whole will deprecate the discrimination against technical and chemical staffs, they will, we are sure, be grateful for the care which has obviously been devoted to examining their conditions of employment, and it is to be hoped that the Government will refrain from devising the familiar official excuses for pigeon-holing the Report.

The Human Blood Groups.

Blood Grouping in Relation to Clinical and Legal Medicine. By Prof. Laurence H. Snyder. Pp. xi + 153 + 5 plates. (London: Baillière, Tindall and Cox, 1929.) 22*s.* 6*d.* net.

A PECULIAR value is lent to this book by the fact that its author is not a medical man and that his horizon is therefore not overclouded by the medical applications of his subject. It cannot be said that it has not a certain medical tinge, for Prof. Snyder states with modest pride that he has been concerned in a number of operations for the transfusion of blood; moreover, he has not been able to avoid an excursus into the history of blood transfusion which is interesting but not really germane to his subject. None the less, Prof. Snyder is primarily a biologist and thoroughly competent to deal with the relation of the blood groups to human biology, and this is where their main interest lies.

The best chapters in Prof. Snyder's book are those on Mendelian inheritance, the heredity of the blood groups, the blood groups in animals, and their racial distribution. It is a great pity that the two latter were not considerably extended; very little of the knowledge on these subjects has as yet been collected in book form. The chapter on the technique of blood transfusion cannot be recommended to those about to embark upon the procedure for the first time; it contains descriptions of the divers more or less elaborate pieces of apparatus which have been invented for this purpose by those having a passion for making the simple thing difficult, but fails to lay stress on the fact that all that is actually required in the way of special apparatus is a funnel, tubing and cannula, and an enamelled pint pot, such as is to be found in every nursery and most kitchens. It is, moreover, difficult to understand why Prof. Snyder does not regard direct matching of blood, without grouping, as a satisfactory means of selecting a donor.

The demonstration of the fact that the bloods of all human beings is not identical, but that they fall into four well-defined groups, is one of the most striking of the more recent advances in human biology; the facts of the case are not yet widely known, though much of the knowledge has been available for the past twenty years, and Mr. Snyder has performed a good service in crystallising the present state of knowledge in book form. The credit for the discovery of the groups must rest with Landsteiner; before his time various observers had reported the agglutination of the red cells of one individual by the serum or plasma of another, but up to then such occurrences had been regarded as pathological. Landsteiner in 1900 showed that the serum or plasma of certain normal individuals would agglutinate the red cells of other normal persons, and that this phenomenon was no indication of disturbed health; in 1909 he showed that on the basis of this reaction it was possible to distinguish at least four types of blood. The same thing was shown more or less independently and almost synchronously by Moss in America and by Jansky in Europe; these authors applied numbers to the four groups, but unfortunately they used different numbers for the same things, and thus laid the foundations of a confusion which exists to the present day. When an author speaks of Groups I. or IV. it is even now impossible to know to what he refers unless he appends the name of one of these observers. Landsteiner in his earlier work forecast the importance of the groups both in regard to the transfusion of blood and to legal medicine, but in spite of this, for many years his work was scarcely regarded.

In 1910 von Dungern and Hirzfeld made an intensive study of the inheritance of the groups in a series of families and showed that the observed facts were explicable on the postulation of two dominants presenting the agglutinable substance, which were resident in the red corpuscles, and were referred to as *A* and *B*, and two recessives represented by the corresponding agglutinins and resident in the plasma. Though this hypothesis has lately been the subject of important modification at the hands of Bernstein, the agglutinable factors, or, as it is now the abhorrent but ineradicable custom to describe them, the agglutinogens *A* and *B* still hold the field, and although Prof. Snyder is rather timorous about committing himself on this point, there is every reason that the numerical nomenclature of the groups should now be dispensed with and that they should hereafter be known by their agglutinogen content as *AB*, *A*, *B*, and O.

It is true that various workers have from time to time produced evidence purporting to demonstrate the existence of agglutinogens other than *A* and *B*. The most portentously long and detailed papers are those of Guthrie and Huck. Prof. Snyder adopts a cautious, not to say timid, attitude in regard to the possible existence of agglutinogens other than *A* and *B*, but it is now fairly evident that the whole structure of the groups is explicable on the postulation of these two only, and that observations reported as demonstrating the exist-

ence of others have depended upon errors of one sort and another, and more particularly failure to recognise that there are differences both in the titre and adsorptive power of agglutinogens and also in the titre of agglutinins in different bloods.

The history of the subject so far as it has gone offers an excellent demonstration of the weakness inherent in the experimental method. The original discovery of the groups and the elucidation of their structure were brought about by sound induction from observed facts. Further experimental work in the hands of many observers revealed what appeared to be exceptions to the general law laid down as a result of the work of Landsteiner, von Dungern and Hirzfeld, and others, and, modern science being firmly bound to the chariot of the experimental method, such observations were accepted at their face value. But the experimental method has its weaknesses. Next to the original discovery of the groups and of their structure, the greatest triumph in this field has been the enunciation by Bernstein of his hypothesis as to their inheritance. It does not appear that this worker performed a single experiment; he did, however, survey with care the data as to the distribution of the groups in various human races, and by the application of mathematical methods was able to show that this distribution could indeed be accounted for by the postulation of the agglutinogens *A* and *B*, but that they must be inherited, not as von Dungern and Hirzfeld had supposed, but as two of three allelomorphs, the third being their absence or 0. Further work has provided no significant exceptions to what may now be described as Bernstein's law.

In the face of the conformity of the known facts to Bernstein's law, it is difficult to believe in the existence of agglutinogens other than *A* and *B*, and in this respect and in spite of a great deal of experimental work and the expenditure of much paper and ink, the situation remains where it was twenty years ago. The whole episode serves to point the remarks of the prelate who at a recent meeting of the British Association pleaded for a seven years' truce of God to experimental work and a consideration of the data already accumulated.

The establishment and general acceptance of Bernstein's law is of considerable practical importance. On the original assumption of von Dungern and Hirzfeld, it is obvious that the appearance of the agglutinogens *A* or *B* in the blood of a child when absent from that of the alleged parents is conclusive proof that the parentage is not as supposed; Bernstein's law limits the possibilities even further; it follows from it that matings involving one *AB* parent cannot result in 0 offspring. It is true that *AB* is a rare group, but this narrowing of the field of possible inheritance is of the greatest importance in legal medicine. In Germany, Russia, and several other European countries, evidence based upon the blood groups is freely admitted in forensic proceedings both civil and criminal, but in the courts of Great Britain natural laws have yet to establish their validity. When it comes, the spectacle of the British legal mind wrestling with the laws of Nature will be full of interest and instruction.

In full-blooded American Indians, Prof. Snyder found more than 90 per cent Group 0 individuals, and his observations go far to support the view that this is the original constitution of the blood of the human race; the agglutinogens *A* and *B* seem to have appeared as mutations, the *A* factor somewhere in western Europe, the *B* somewhere in central Asia. The author wisely points out that the anthropological information to be gained from a study of group distribution is limited, and that up to the moment it fails to throw any light on the question of the single, double, or multiple origin of the human race.

S. C. DYKE.

Problems of Asiatic Geology.

The Structure of Asia. Edited by Prof. J. W. Gregory. (Methuen's Geological Series.) Pp. xi + 227 + 23 plates. (London: Methuen and Co., Ltd., 1929.) 15*s.* net.

THIS book contains a series of contributions to an international discussion, held at the British Association meeting in Glasgow in 1928, on problems of Asiatic geology.

Since the publication of the third volume of "Das Antlitz der Erde", more than a quarter of a century ago, wherein Eduard Suess gave his classic account of the geological structure of Asia, increasing evidence has been accumulating that many of his views on the origin and classification of the Asiatic mountain ranges are in need of modification. Thus, his representation of the structure of the eastern coast as bounded by a series of folded mountain arcs continuous with the Himalayan ranges has for many years been abandoned in view of von Richthofen's description of the great fault-blocks which constitute the dominant tectonic feature of that area.

There must, indeed, be many geologists who have found it hard to form an unbiased opinion of, for example, the relationship of the Altaid and Himalayan mountain systems when confronted with the

fundamentally different ideas expressed by Suess and Argand; and for the solution of this and other problems they will welcome the opportunity of obtaining the views of recognised authorities on the subject which is afforded by the publication of the volume now before us.

The introductory chapter by the editor, Prof. J. W. Gregory, which is replete with first-hand information obtained during his own travels in Asia, not only gives a clear and concise summary of much that is contained in the subsequent chapters, but also affords a valuable guide to the discussion of the more controversial questions.

Prof. F. E. Suess contributes an interesting account of modern views regarding the region of the Variscan horsts of Europe, in which he stresses the importance of studying 'intrusion tectonics' rather than mere trend-lines in determining the age of mountain chains and their structural connexions. From a consideration of the crystalline schists of the European Altaids, which, in opposition to the generally accepted view, he regards as having been formed by late Palæozoic granitic intrusions, he abandons his father's theories as to the pre-Palæozoic age of the crystalline schists of the nucleus of Asia.

A wealth of new information, now published for the first time, is contained in the chapter on the tectonics of the Iranian ranges by Dr. H. de Bockh and his colleagues on the staff of the Anglo-Persian Oil Co., Ltd. Their discovery and description of the great Iranian geosyncline appears to be in direct opposition to the view expressed by Argand that the movement of Africa north-eastwards against Asia continued as late as Miocene times, and their account of the strong Pliocene folding of south-west Persia is entirely inconsistent with the conception of the opening of the Mediterranean rift at that time.

It may be suggested that the cost of publication could have been materially lessened without in any way impairing the value of the work if this contribution had been reduced by the omission of much of the detailed evidence on which the conclusions are based. It is, moreover, difficult to see how the profile sections across the Andes of Colombia and Venezuela are germane to the present discussion.

Prof. D. I. Mushketov, in an interesting account of the tectonic features of eastern Turkestan, shows that north of the Pamir there was a northward direction of folding in the Kainozoic era as opposed to the general southward movement of the Himalayan ranges.

The structural evolution of the eastern part of the Asiatic continent is described by Prof. G. S. Barbour with the aid of a series of palæographical maps redrawn from those of Dr. A. W. Grabau, and an account of the structural features of the 'Old-rock floor' of the Gobi region, the result of personal observations made during the Central Asiatic expeditions of the American Museum of Natural History, is contributed by Prof. Berkey of Columbia University. Five periods of orogenic movement are described, each of which was accompanied by volcanism. Copious references throughout the volume furnish a valuable bibliography of the geology of Asia

Bushman Art in South-West Africa.

Bushman Art: Rock Paintings of South-West Africa, based on the Photographic Material collected by Reinhard Maack. By Hugo Obermaier and Herbert Kühn. Pp. xii + 70 + 39 plates. (London: Oxford University Press, 1930.) 84s. net.

In a people's art is of particular importance. When objects made for purely utilitarian purposes, such as tools and weapons, are alone available for comparison, the sceptic can often argue that similar implements made by two peoples in widely separated areas are merely the results of similar needs engendered by somewhat similar conditions of life, and that therefore no cultural relationship between the peoples concerned need be postulated. When however, the artistic productions of two such widely separated peoples manifest striking similarities of style and technique, it becomes difficult to deny some definite cultural connexion. The study of primitive art groups, both modern and prehistoric, in different regions of the world, is thus of vital importance in the elucidation of human history.

The volume under review presents the anthropologist with an account of a number of paintings found on the walls of rock-shelters and on boulders in what was formerly German South-West Africa. The original investigations were carried out some time ago by a German resident, Mr. Reinhard Maack, who has since handed over his photographs and copies of the paintings to Dr. Obermaier of Madrid; and it must be said at once that he could not have confided his valuable material into more competent and distinguished hands. The resulting monograph which Dr. Obermaier has written in collaboration with Dr. Kühn of Cologne, the editor of the *Jahrbuch für prähistorische und ethnographische Kunst*, is of very great scientific importance—as, indeed, we should expect it to be,

considering the European reputations of its authors. The second and larger half of the book is occupied by thirty-nine plates, of which thirty-two are in colour, the earlier part being devoted to a description of the sites and a general account of the problems connected with Bushman art.

In the opening chapter some notes on the Bushmen themselves and their art are given, together with a brief summary of the succession of stone age cultures in South Africa. Chap. ii. is devoted to an account of the pictorial material collected by Reinhard Maack. Chap. iii. is entitled "The Spirit of Bushman Art", and therein is attempted a study of the minds of the artists as seen through their work. Chaps. iv., v., and vi. are concerned with the occurrence of more or less similar art groups in South Africa, eastern Spain, and elsewhere. The last chapter discusses the meaning and significance of Bushman art. A selected bibliography is appended at the end of most of the chapters. Chaps. i., ii., iv., and v. are from the pen of Dr. Obermaier, while Chaps. iii., vi., and vii. are contributed by Dr. Kühn.

The investigations in the field seem to have been confined almost solely to the paintings themselves; no proper excavation seems to have been attempted in the floors of the painted sites, and although stone industries are sometimes mentioned as being present, no description of the finds is given. This, perhaps, is to be regretted, as in Southern Rhodesia and the Union of South Africa various phases of the Bushman art are often associated with stone industries belonging to different cultures. Stone implements occur in the district (as, for example, near Swakopmund), and it would have been illuminating to know what sort of industries were made by these South-west African artists. Again, though superpositions of paintings are alluded to, reproductions or descriptions of them -which would, perhaps, have afforded us sequences of styles or techniques—do not seem to have been given by Mr. Maack.

None the less, this book constitutes the first careful study of Bushman art in this part of Africa. On examining the excellent reproductions in colour, the obvious similarity of some of these paintings to early Southern Rhodesian examples on one hand, and to more recent examples in the Union of South Africa on the other, is at once apparent. That all 'Bushman art' in South Africa was made at approximately the same time is out of the question. Many a century, probably indeed many a millennium, elapsed between the making of the first and last paintings. Nor is it at all certain that men of quite the same race were the authors of the early as well as the later examples. It would seem more probable that the whole corpus of Bushman art should be considered as part and parcel of the general artistic activity of Neanthropic man, the work of various migrations of Neanthropic peoples into South Africa—the last of these migrations having ushered in the Bushmen themselves. In the same way, the rock-shelter art of eastern Spain, which is so similar to the earlier series of Southern Rhodesian paintings while differing somewhat from the more typical Bushman art found nearer the Cape, is equally to be connected with this general artistic activity of Neanthropic man and therefore perforce related to the African art groups. With these theories Dr. Kühn seems to be in general agreement. Dr. Obermaier remains rather more conservative and would like to see them confirmed by the finding of skeletal remains demonstrating the racial similarity of the Spanish and African artists. Such finds will probably be made some day. In the meanwhile the conservative attitude is, of course, a sound one and Dr. Obermaier presents the whole case to the reader in a clear and unbiased manner.

Altogether the book makes a notable contribution to knowledge, is well translated from the German, excellently produced, and priced at a distressingly high figure. But one such monograph, containing as it does information of permanent value, is worth many volumes which merely set forth the theories temporarily held by their writers.

M. C. BURKITT.

Physical and Chemical Properties of Interfaces.

(1) *An Introduction to Surface Chemistry.* By Dr. E. K. Rideal. Second edition, revised and enlarged. Pp. ix + 459. (Cambridge: At the University Press, 1930.) 21*s.* net.

(2) *The Physics and Chemistry of Surfaces.* By Dr. N. K. Adam. Pp. x + 332. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 17*s.* 6*d.* net.

IN August 1918, after sending to the late Lord Rayleigh some reprints and expressing to him my regrets that he had not continued his extensive pioneering work on surface tension, I received a reply from which the following is quoted:

"As regards what you say as to my not following up my own work on surface tension, etc., I may confess that I was rather disappointed at the little attention I then received. Besides that, I was and am rather badly equipped for speculations on the

chemical side. There is one point which I do not find noticed by you or Devaux relating to what occurs when a very limited amount of oil is deposited on a large clean water surface. I do not think the spreading can stop just when the layer has become monomolecular. At this stage there would be considerable outward motion extending downward a certain distance, which must carry the spreading further. Finally the drop is larger than necessary, and its contraction is not resisted by any force.

I am,
Yours very truly,
RAYLEIGH."

Fortunately to-day there is no lack of interest in surface tension and the varied phenomena occurring at the interfaces between phases. A striking proof of this lies in the nearly simultaneous publication of two excellent books in English dealing with this subject, which is so largely the outgrowth of Rayleigh's observations and speculations. Both books are by men who have themselves for several years made very important contributions to our knowledge of surface properties.

Although both books treat of the physics and chemistry of surfaces, there are considerable differences in the subject matter and the methods of presentation. Rideal's book is a revised and much enlarged (35 per cent increase in size) second edition of his book of 1926. There are six chapters covering surface tensions of liquids and of solutions, insoluble films on liquids, liquid-liquid, liquid-solid, and gas-solid interfaces. Two chapters treat the electric potentials at interfaces, stability of suspensions and emulsions, and the last chapter deals with gels and hydrated colloids. There are good indexes of names and subjects, but a table of contents giving more than the titles of the chapters would be desirable.

An excellent discussion of the various experimental methods for the measurement of surface tension is included in the first chapter.

Adam's book also has nine chapters, arranged in somewhat less logical order. The opening chapter considers the elementary theory of the capillarity of liquids, emphasising the importance of molecular motions and interactions. The methods of measuring surface tensions are considered in the last chapter of the book.

The second chapter, of about 75 pages, is devoted to insoluble monomolecular films on water. This chapter constitutes a particularly valuable summary of the rapidly accumulating knowledge of the properties and structures of these films—knowledge which has resulted so largely from the efforts of Adam and his co-workers. There is a detailed description of the latest form of balance for measuring the surface pressures of films and of the precautions required in its use. Films are classified as gaseous, condensed, liquid expanded, and vapour expanded. The history of the development of these concepts is admirably treated. The evidences that the films are monomolecular and oriented on the surface are emphasised and properly evaluated. Fundamental concepts are often strikingly illustrated. For example, in justifying the use of surface pressure, we note the remarks (p. 30): "How far should we have progressed if, in the study of gases, the pressure exerted by a gas on its confining walls had been regarded as the difference between the strong tension of the clean vacuum outside the vessel and the contaminated vacuum within? The surface pressure is the tangible, physical force; the surface tension merely the mathematical equivalent of the free surface energy."

In a few other cases the reviewer cannot agree so completely with the explanations adopted. For example, he believes that too much stress is laid on the 'angle of tilt' of the molecules in a film. A more useful view is that in liquid films of such substances as the higher fatty acids, the hydrocarbon chains are arranged almost as irregularly as in any liquid phase, subject only to the requirement that one end of the molecule must remain in contact with the water. The reviewer cannot agree (p. 75) "that the heads tend to hold the molecules together, while the chains try to disrupt the film". When there are no heads, the film actually contracts into a single droplet, proving that it is the heads that cause the spreading.

The study of surfaces is interrupted in Chapter iii. in order "to review the information available as to the properties of molecules obtained from other sources", such as X-ray studies of organic crystals and liquids, and then in Chapter iv. thirty pages are devoted to surface films of soluble substances and adsorption. The next chapter deals with results of the measurements of surface tension. The whole consideration of the interesting relations of the surface tensions and the total surface energies of benzene substitution products is brushed aside with the statement (p. 151) that "it seems doubtful if the values of the total surface energy can be made to furnish information as to the orientation of the surface molecules"—a conclusion with which the reviewer wholly disagrees.

The properties of solid surfaces, the spreading of liquids on liquids and solids and lubrication are discussed in the next two chapters. A chapter of sixty pages deals with the structure and the chemical properties of solid surfaces and adsorbed films

on them. A discussion of heterogeneous chemical reactions occupies about ten pages, but the electrical properties of surfaces are not considered.

Although both books cover nominally the same subject matter, the differences in treatment and even in the choice of topics make it desirable for every student in this field to read both books. Rideal's book is more comprehensive and gives the better general survey, but Adam's book is unsurpassed in those fields in which he has specialised.

I. LANGMUIR.

Our Bookshelf.

L'Appareillage électrique : le petit appareillage, le gros appareillage basse tension, l'appareillage haute tension, tableaux de distribution, postes de transformations ruraux ; construction, applications. Par Louis Lagron. (Nouvelle Encyclopédie Électromécanique, No. 3.) Pp. 587. (Paris : Albert Blanchard, 1930.) 36 francs.

THIS is the third volume of a useful electromechanical encyclopædia. The author classifies electric apparatus into four groups. First, there is small apparatus, that is, apparatus for use at low voltages and that does not take a current greater than twenty-five amperes ; next he deals with large low voltage apparatus which takes currents greater than twenty-five amperes. The third class consists of high voltage apparatus, the pressure not exceeding 33,000 volts but the current being of any value. The fourth class consists of very high voltage apparatus, the pressure exceeding 33,000 volts. We learn that the French Minister of Public Works standardised the voltage of supply at 230 in July 1925. The pressure of supply of all work completed after that date is to be 115, 230, or 460 for direct current supply, and 115 or 230 for all systems of supply installed after that date. The frequency also is to be 50. Like England, however, it will take a long time before all the pressures of supply are standardised.

Tables are given of sparking distances, and amongst the constants given for insulating materials are their electric strengths. The formulæ given for fuses and for the heating of cables are only roughly approximate. The laws of the convection of heat from bodies cooling in air are now well known and more accurate formulæ could have been given. English engineers will be interested in the information given for wooden poles, cement poles, and lattice towers.

Cours de mécanique professé à l'École Polytechnique. Par Prof. Paul Painlevé. Tome I. Pp. vi + 664. (Paris: Gauthier-Villars et Cie, 1930.) 100 francs.

FOR many years now the underlying principles of mechanics have been the subject of critical revision. In an elementary treatment of these principles from the point of view of teaching, however, it is quite impossible to approach the subject except largely from the classical point of view, if not because of the essential difficulties of the relativistic outlook, at least because a knowledge of classical mechanics appears to be essential for a true understanding of relativity.

M. Paul Painlevé seems to have found time from his political activities to produce in this "Cours de mécanique" a complete treatment of the first stages of this subject, as they have been expounded by him in his course at the École Polytechnique between 1905 and 1924. The course bears all the marks of a thorough and careful teacher, and the consistent striving after rigorous presentation is typically French in its precision. The earlier part of the course covers most of the material which is normally dealt with in English colleges under the heading of "motion of a particle and of a system of particles", with astronomical applications to planets and comets. In the later part the author goes on to discuss Lagrange's equations, D'Alembert's principle and its various extensions, the equilibrium of strings, and the nature of frictional forces.

Although the field has been well traversed in English books, nowhere has it been so carefully developed and so logically knit together as in this classic by a world-famous teacher.

The Conclusions of Modern Science. Plainly told by Walter Grierson ("The Enquiring Layman"). (The Outline Library, No. 10.) Pp. xviii + 198. (London : George Newnes, Ltd., n.d.) 2*s*. 6*d*. net.

IN this little book, "The Enquiring Layman" has marshalled the majority of the most important facts and conceptions of modern science. A layman he might claim to be, yet he cannot be a real visitor to the subject of science. He shows a definitely intelligent attitude towards it and presents his findings in a distinctly palatable style.

Astronomy, natural philosophy, biology, and the other conventional branches of science receive consideration, yet the author—quite unconsciously perhaps—has performed one important feat in showing that this conventional subdivision of science is essentially artificial. Of all the subjects dealt with, the most abstract, man the interpreter, is probably the author's *pièce de résistance*.

It is evident that "The Enquiring Layman" is keenly interested in the subject, and he has presented it in such a manner as will infuse a similar interest into his readers.

Practical Plant Biochemistry. By Muriel Wheldale Onslow. Third edition. Pp. vii + 206. (Cambridge : At the University Press, 1929.) 12*s*. 6*d*. net.

MRS. ONSLOW'S book fills a decided gap in botanical literature. Since its first appearance, it has been considerably extended by a chapter on the plant acids, as well as by shorter sections on the derivatives of these bodies, waxes, essential oils, and also nucleic acid. Serious changes of form are scarcely possible in a text-book of this character, but an additional chapter, in many ways the most interesting in the book, has now been added on the possible interrelationships of the hexose sugars, the pentoses, and the pectic substances. The recent work on the oxidising systems of plants is also summarised in a convenient form.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter.

ACCORDING to a fundamental formula of Einstein's cosmological theory of gravitation, the total mass of the universe, M, is connected with the radius of curvature of the universe, R, by the formula

$$(1)\quad M \quad {}_{2f}R.$$

In this equation c denotes the velocity of light and f the constant of gravitation.

If we regard the size of the universe as variable, and if we denote by a the 'disintegration constant' of matter and by v that 'cosmic velocity' which represents the differential coefficient of R with respect to time, we obtain from equation (1):

$$(2)\quad Ma = \frac{c^2\pi}{2f}v.$$

As is well known, a is equal to the mass equivalent of 2 ergs per gram-second in the case of the sun. The average value for all fixed stars undoubtedly agrees in order of magnitude with that value. Hence, approximately,

$$(3)\qquad \frac{4f}{\ }M \quad 1{\cdot}1 \times 10^{49}M.$$

If we insert for M, according to Hubble (*Astrophys. Jour.*, **64**, p. 369; 1926), $1{\cdot}8 \times 10^{57}$ gm., equation (3) yields for v a value of about 2×10^8 cm. or 2000 km. per second. This value agrees well with the magnitude of the velocity with which the farthest spiral nebulæ appear to recede from us.

ARTHUR HAAS.

University of Vienna,
Oct. 11.

Animal Husbandry.

THE term 'animal husbandry' is gradually becoming more employed by both administrators and scientists concerned with the live stock industry. That it is differently employed by different speakers is the apology for what follows.

The aim of the science of animal husbandry is the efficient production of farm live stock: it deals with the application of those basic sciences which affect the production and maturation of our farm live stock. The principal sciences from which it derives are genetics, nutrition, animal health, economics, and physiology, both reproductive and nutritional. These basal sciences seek to discern fundamental principles by the formation of hypotheses, which as evidence accumulates become theories, and eventually on final proof take their place as laws. In their turn these sciences draw on others.

The science of animal husbandry does more than apply the sciences from which it derives: it co-ordinates them. The real function of the scientific animal husbandman consists, not in the direct application of new knowledge or the mere testing upon a large scale of such hypotheses as its basal sciences may bring forth, but in the relation of new facts to existing circumstances. This implies that animal husbandry is not merely an applied science: it can evolve new techniques and can prosecute research.

Just as other sciences have various aspects, so has the science of animal husbandry. In a certain aspect one of its basal sciences may predominate. The science of animal husbandry in relation to a particular science applies that particular science to practice and at the same time takes into consideration the other basal sciences which affect the problem under consideration.

In Great Britain there is no school of scientific animal husbandry as such. Consequently this science has been largely developed by those institutes connected with agriculture which are concerned with research into the basal sciences, particularly genetics, nutrition, and physiology. Each kind of institute has, to a greater or less degree, developed animal husbandry. For example, there is the science of animal husbandry based upon the science of nutrition; the science of nutrition alone can make little contribution to the material welfare of mankind through live stock without taking into consideration the other basal sciences. Thus there are developed animal husbandmen who are primarily nutritionists but who also must have a sufficient understanding of the principles and findings of the other sciences to enable them to co-ordinate the work with which they are mainly identified. In the same way, there are animal husbandmen who are primarily either veterinarians or geneticists.

At the present time it is open to question whether the industry of agriculture can profit more from the new scientific discoveries which one may reasonably anticipate will be made by the research workers in the basal sciences or from an intelligent and co-ordinated application of that knowledge which is already available. Hitherto greater emphasis has been laid on the value of fundamental researches: and rightly so, since these are an absolute prerequisite to the proper functioning of the science of husbandry. It can, however, be fairly debated whether the time is not now ripe for an organised development of the science of husbandry. But whether this should be directed as a separate entity seems doubtful. Since its inspiration is drawn from the research institutes, separation would possibly sterilise it.

It would appear better were the science of animal husbandry to continue to be based on the various research institutes, but that the dissemination of results should be made, not through the existing county organisers (who have such a wide field to cover that they can be expert in no one subject without some sacrifice in another), but through advisory animal husbandmen, each operating in an area. These men would have no adminstrative duties. Their function would be to maintain contact with the various research institutes (they could, in fact, have their headquarters at one of these) and to apply the results of the animal husbandry sections of the various research institutes to the particular problems of their area. Such animal husbandmen would specialise in different aspects, such as pigs, horses, dairy cattle, etc. They would at the same time act as *rapporteurs* to the animal husbandry section of the research institute on which they are based. Undoubtedly there is a weak link in the chain which connects scientific research designed for the assistance of agriculture to the practice of farming. A recognition that animal husbandry exists as a science would do much to strengthen this link.

A precise definition cannot be confined to a few words. Briefly, animal husbandry may be defined as

that branch of science which interprets, co-ordinates, and finally applies the results of science to problems of live stock production.

A. D. BUCHANAN SMITH.

Animal Husbandry Section,
Animal Breeding Research Department,
The University of Edinburgh,
Oct. 16.

Highest Recorded Shade Temperature.

IN the issue of NATURE for Sept. 6, 1930, at the bottom of page 386, appears an item, "Sept. 13, 1922. Highest Recorded Temperature."

The validity of the reading at Azizia has been questioned by so eminent an authority as Dr. G. Hellmann -see *Monthly Weather Review*, May 1930, page 208. Weather Bureau authorities are of opinion that the Azizia record of maximum temperature cannot be classed as having been obtained under standard conditions of exposure. We are not unmindful of the fact that it is a difficult matter to determine the maximum temperature in a shelter situated in a desert region. The chief evidence against the Azizia record is the fact that it is not supported by the readings of other thermometers in the same region, as pointed out by Dr. Hellmann, and was independently developed by the Weather Bureau climatologists.

A. J. HENRY.

U.S. Weather Bureau,
Washington, Sept. 24.

THE observations at Azizia were published by Prof. F. Eredia in 1923 (*Roma, Boll. Inform. econ.*, 1923, No. 5). After describing the site, in a plain surrounded by hills, he tells how a complete meteorological station, including registering instruments, was established in 1913, of a permanent character, *similar to the other stations installed at various places in Tripolitania.* He adds that during the period when he lived at Azizia, he determined the frequency of high temperatures from hourly observations and also from the readings of a thermograph at a temporary station near by. Referring to the figure of 58° C. (136° F.) on Sept. 13, 1922, he notes that it occurred during a period of south-west winds and almost cloudless sky. He evidently accepts the reading as correct.

I was aware of Hellmann's criticism, but in view of the above summary, and the fact that Prof. Eredia is a competent meteorologist, I concluded that the high readings were probably due to the nature of the surroundings rather than to any defect of instruments or screen. An analogous case in England was described by Miss E. H. Geake (*Meteorological Magazine*, **61**, p. 78; 1926). The lowest screen minima at Garforth, Yorks, are 15°-25° F. lower than those at surrounding stations, and this is entirely due to the local exposure!

The maximum at Azizia is only 2° F. higher than that at Death Valley, California (see NATURE, vol. 126, p. 81; 1930), which is accepted as correct by the U.S. Weather Bureau. Both stations are in depressions in arid sub-tropical regions, and both maxima are isolated readings, for the 225 stations in California for which data appear in the *Monthly Weather Review* for July 1913 do not show any other maximum exceeding 119° F. To complete the parallel, both are criticised by Hellmann as too high. To my mind, the fact that the two maxima are so nearly identical is a reason for accepting both of them.

THE COMPILER.

Ball Lightning.

A CASE of globular or ball lightning was reported to me at East Hampton last summer, and I had an opportunity of questioning an eye-witness and investigating the premises. This account has value only for comparison with other cases, and I presume someone is making a collection of reports of this nature and studying the conditions under which the phenomenon occurs.

A large modern summer residence was struck twice within fifteen minutes. The owner was standing at a window watching the approaching storm, which came up over the ocean. He states that the flashes struck in the water, coming nearer and nearer, like advancing shell-fire; then a flash to the sand dune between his house and the ocean, another in the intervening field a hundred yards from the house, and a few seconds later he found himself 'coming to' in a dazed and very shaky condition. The chimney had been struck and blown to pieces, and his arm was resting on the mantelpiece over the fireplace. He saw no flash and heard nothing, though he did not fall. Fifteen minutes later, a second bombardment commenced, and a flash struck and melted the telephone wire just outside the house, following the wires into the cellar under the kitchen, and apparently dissipating its energy among a maze of criss-crossing bell wires and furnace pipes below the kitchen floor. The thin asbestos covering of one of the pipes had been burst open in places as if by small charges of an explosive.

The ball discharge appeared in the kitchen in the centre of the room (just over the furnace pipes), about three feet above the floor, and within three or four feet of the cook, who was standing up and facing the point at which it appeared. She told me that it appeared just after the thunder crash, was yellow like a flame, about five inches in diameter, and was spinning like a top. She was very positive about the whirling, and was looking down on the thing at very close range. I asked her whether it faded away or exploded. She said, "I didn't wait to see—I jumped for the cellar door and ran down the stairs"! There was no sound of an explosion. She also stated that the room was full of a smoky haze when she returned, and that there was a strong smell. I asked her whether it was 'like sulphur' (the popular description), and she said, "No, it was acid-like." This suggests an oxide of nitrogen. No marks of the flash could be found in the kitchen, but there had evidently been a heavy electrical disturbance below the floor. The cook was near enough to the ball to touch it, and it is regrettable that she neglected the opportunity of making a valuable contribution to our knowledge of this mysterious electrical phenomenon! I think that I should have reached for it, but am not sure.

R. W. WOOD.

Johns Hopkins University,
Baltimore.

Separation of Antibodies from the Serum Proteins.

ANTIBODIES are as a rule associated with serum proteins. In view of both the high theoretical and clinical importance, a large amount of work has been done in order to obtain protein-free antibodies. The failure of these endeavours has led to the assumption that antibodies are either themselves proteins or that they are in some way closely bound to proteins.

In experiments carried out with diphtheria antitoxin and antityphoid serum, we have succeeded in obtaining active antibodies chemically free from proteins. These results were obtained by the method of adsorption and specific elution developed in their recent

studies on enzymes by Willstätter and his co-workers, who succeeded in preparing protein-free solutions of enzymes after previous autolysis of cell proteins.

Antisera diluted 1:10 were adsorbed by large amounts of kaolin (usually one part kaolin to one part serum). This mixture was allowed to stand about 24 hours at 37° and filtered. Aliquot portions of the adsorbed kaolin-serum residue were then resuspended in a number of solutions of organic substances (glycocol, glycerol, glucose, etc.), which under certain conditions are effective eluents. Glycocol was first used by Fodor and his co-workers to elute peptide-splitting enzymes from adsorbate, thus obtaining solutions of enzymes which without previous autolysis were practically free from proteins.

Our experiments showed that antibodies adsorbed on kaolin could be obtained in solutions of glycocol in 2 per cent sodium chloride. The eluates of antibodies obtained corresponded to the protein-free enzymes in that they were chemically free from proteins. Not only the usual colour and precipitation reactions like that of Millon or Esbach, but also the more susceptible Jones-Spiegler test, which indicates 0·0002 per cent proteins, were negative.

The two known typhoid agglutinins reacted differently towards elution with glycocol-sodium chloride. By elution with a solution containing about 2 per cent glycocol and 2 per cent sodium chloride, only the flagellar agglutinin was recovered. However, on diminishing the quantity of sodium chloride (0·3-0·5 per cent), the amounts of flagellar agglutinin recovered became much smaller and at the same time small quantities of somatic agglutinins appeared. The antitoxin behaved like the flagellar agglutinins.

The antitoxin content of the protein-free eluates was tested by the intracutaneous neutralisation test employed by Roemer, while the agglutinin content was determined by the usual agglutination technique. The recovered antibody in the protein-free solutions was, both in the case of diphtheria antitoxin and flagellar typhoid agglutinin, about 20 per cent of the concentration in the original sera. This does not imply that this is the maximum recoverable percentage. In these experiments we were primarily concerned with the problem whether it is possible to purify antibodies by the method of adsorption and specific elution. The problem of yield and concentration as well as the various chemical and serological questions arising from the possibility of separating antibodies from the serum proteins are under investigation.

MAX FRANKEL.

Department of Biochemistry and Colloidal Chemistry.

LEO OLITZKI.

Department of Hygiene, Hebrew University, Jerusalem, Oct. 5.

Commensal Algæ and Reef Corals.

DR. YONGE has directed my attention to an error in my recent paper on coral reefs (*Bull. Mus. Comp. Zool.*, **71**, 6; 1930), the origin of which is of no importance. The statement is that *Millepora* and reef-building *Alcyonaria* do not possess commensal algæ. This is quite contrary to fact—for Prof. Hickson showed me them in *Millepora* upwards of forty years ago—and also to the main argument in my course of lectures delivered at the Lowell Institute at Boston. I had decalcified pieces of more than forty colonies of these various forms from surface reefs in the Indian and Pacific oceans and found that zoochlorellæ were present in all. They included *Millepora* and *Heliopora*, which in certain positions may be as important builders as reef corals, and the soft corals (*Sarcophytum*, *Sclerophytum*, and *Lobophytum*) so widely distributed on lagoon and protected reefs.

Prof. Hickson and I have recently examined between us five colonies of *Tubipora*, in all of which we have found the same commensal algæ. I did not think that they existed in *Millepora* from greater depths, having failed to find them by the teasing method in two of Agassiz's specimens of the same from more than 20 fm. Since my return to England I have found them in sections of both *Millepora* and *Heliopora* at various depths down to 50 fm., and believe them to be of universal occurrence in all these reef-builders, though varying in amount. I may add that I found these algæ in a species of the coral *Gardineria* from more than 222 fm., here presumably a parasite.[1]

The argument in the paper in question was that coral reefs have come into existence owing to the active growth of plants and of the above and other plant-animals, especially true corals, which necessarily are dependent *inter alia* on the depth to which light of sufficient intensity for their chlorophyll can penetrate sea-water. This varies mainly with the amount of plankton and other suspended material, but the maximum depth is about 50 fathoms. Under certain conditions the reef-building corals are covered by a white slime, which lies on and in the surfaces of their polyps, and ultimately kills them. This I suggest to be a precipitation of amorphous carbonate of lime from the supersaturated sea-water, owing to the chemical operations of their chlorophyll in utilising carbon dioxide. It is well seen on true corals in lagoon conditions below 10 fm., and I have found a similar slime on Lithothamnioneæ, but not on any of the other builders mentioned. If this be so, it is obvious that shoals cannot be built up on lagoon floors below 10 fm. except near passages or where there is an active flow of water. My object in writing was to induce biologists to examine this and other suggestions in the field. In particular, I should be grateful for any observations upon whether all these several animals digest their commensal algæ, if their feeding conditions are unfavourable. There are places of suitable temperature and with plenty of food, but none of these reef-builders seem to be able to live below 50-60 fm.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge, Oct. 21.

[1] *Terra Nova* Exp., Brit. Mus., **5**, 128; 1929.

Laterites and Lateritic Soils.

DURING the course of the past few months I have been afforded numerous opportunities of making field observations on soils over practically the whole range of Australian climatic conditions.

A conscious look-out has been kept for evidences of tropical soil weathering processes distinctive from those of temperate regions, and for evidences of laterite formation. Two outstanding results of these observations have been: on one hand, the inability to observe any real distinction between the leached tropical soils and the corresponding temperate series usually carrying eucalyptus savannah forests, both being entirely podsolic in character; and on the other hand, the observation that every authentic case of laterite, from the geologist's point of view, was fossil in character—that is, the laterite was to be regarded entirely as a parent material from which new soils were being produced in equilibrium with current climatic conditions. In certain cases, notably in Western Australia, such soils are quite abnormal and

cannot be placed into any of the recognised soil groups. It is only when the laterite sequence has been denuded away, exposing the parent rock, that soils are found falling recognisably into one or other of the zonal soil types.

The fossil character of the Western Australian laterites in the goldfields region has already been suggested by Walther,[1] and it would be of considerable importance if geologists and soil workers could reach some mutual agreement with respect to the definition of laterites. At the present time the geologists seem to be unanimous in the recognition of laterite, although not necessarily with regard to its origin; while amongst soil workers the confusion appears to be very considerable. This confusion probably originates in the fact that the original type laterites were first described from India, and have hence been presumed to be exclusively of tropical origin.

If every authentic laterite is indeed, as in Australia, the product of a past climatic cycle, the position will be very much simplified and laterite soils will find their place in Glinka's endodynamomorphic group. In this case the points of greatest interest will be the nature and period of these past climatic conditions: one feature will certainly be greater humidity, and possibly even water-logged conditions. I doubt whether it will be necessary to bring in higher temperatures, as has been suggested in the past.

J. A. PRESCOTT.

University of Adelaide,
Sept. 15.

[1] *Zeits. Deutsch Geol. Ges.*, **67**, 113; 1915

Flashing Afterglow in a Discharge Tube.

ALTHOUGH the observation recorded here may not be new, I have not been able to find a reference to it. A discharge tube was used for testing a vacuum pumping set. It was a straight tube of Pyrex glass $2\frac{1}{2}$ cm. diameter with plane nickel electrodes; the gas was air with residual gases from the walls of the apparatus; and the Crookes dark space was about 3 cm. long.

After passing a discharge from an induction coil there was a strong afterglow which persisted for several seconds, dying away apparently continuously. Before it became invisible it passed into a flashing condition, the flashes occurring at longer and longer intervals and ceasing after about ten seconds.

The phenomenon is almost certainly due to the dissipation of charges on the glass walls of the tube, as is indicated by the following experiment. Two strips of tin-foil were wrapped round the tube and connected to a valve amplifier and telephones. The 'continuous' afterglow was then accompanied by a rushing noise, and each flash in the later stage was accompanied by a loud click.

This effect may be important in the interpretation of discharge tube phenomena and in particular in work on the decay of afterglows. It is conceivable that it takes place more readily with a Pyrex tube and that this circumstance has helped it to escape notice.

H. J. J. BRADDICK.

Physical Laboratory,
Trinity College, Dublin.

Meiosis in a Triploid *Œnothera*.

MY recent statement (*Trans. Roy. Soc. Edin.*, **56**, 467-484; 1930) that a triploid plant of *Œnothera pynocarpa* Atk. and Bartl. had a closed ring of twenty-one chromosomes, has, following its questioning by Dr. Darlington (NATURE, May 17, 1930), been the subject of a reinvestigation. A brief statement of the results would seem desirable, since they confirm Darlington's observations and agree with recent work upon triploid Œnotheras, reported by Capinpin in NATURE of Sept. 27, 1930; moreover, it is as well to remove an error, as soon as it is fully comprehended, from the already too complicated field of *Œnothera* cytology.

Different nuclei at diakinesis and at the heterotypic metaphase show various combinations of the following types of chromosome groupings: univalents; ring and rod pairs; chain, Y-shaped, and ring-and-rod trivalents; various types of quadrivalents, quinquevalents, and associations of chromosomes involving higher numbers. The largest group seen was made up of a chain of eight chromosomes associated (at one end by a triple union) to one end of each of two other chromosomes, making ten in all. Analysis of all the configurations found shows that every one conforms to and may be predicted upon the segmental formula that must be assigned to this triploid on the basis of Darlington's hypothesis (*Jour. of Genetics*, **20**, 345-346; 1929).

A full statement of the facts, and of the theoretical deductions from them, is made in a paper appearing shortly in the *Journal of Genetics*.

DAVID G. CATCHESIDE.

Department of Botany,
University of Glasgow, Oct. 4.

Band Spectrum of Antimony Oxide.

I HAVE obtained and measured a large number of bands extending from λ3250 to λ6700 in the spectrum of the flame surrounding the antimony arc in air. Some of the bands were previously obtained by Eder and Valenta with different salts of antimony introduced into an oxy-coal gas flame. So far, their vibration quantum analysis has not been attempted. Some of these bands have now been classified and there are at least three systems, with origins approximately at 29619 cm.$^{-1}$, 26480 cm.$^{-1}$, and 24203 cm.$^{-1}$. The origins of the remaining systems have not yet been correctly ascertained. The bands show a doublet structure consistent with the fact that their emitter is the neutral antimony oxide molecule.

A detailed account of the investigation will be published elsewhere.

B. C. MUKHERJI.

Applied Physics Laboratory,
University College of Science,
Calcutta, Sept. 24.

Scientific Inexactitude.

IN recent scientific writing there is frequently a tendency to abbreviate to such an extent that a reader not conversant with the subject may be completely fogged. As an example the following quotation from a recent book on sound may be given: "A clamped steel bar electrically maintained is sometimes employed as a rough standard of frequency." This unfortunate sentence is evidently the result of the general use of the contracted but incorrect expression 'an electrically-maintained tuning fork' in scientific publications. The vibrations are maintained, not the tuning fork, and if this idea is to be conveyed in shortened form a word such as 'operated' or 'driven' should be used instead of 'maintained'. This is only one example of a tendency which, if unchecked, will produce a scientific slang.

CHAS. R. DARLING.

34 Eglinton Hill, London, S.E.18,
Oct. 20.

Evolution in Material Culture.*

By Dr. H. S. HARRISON.

BY the aid of *methods*, often dependent upon extraneous *means*, man employs *materials* for the achievement of *results*, many but by no means all of which persist as artefacts or other *products*.

Substance is the static warp, and method the dynamic woof, of man's material culture, whilst the products may be looked on as the fabrics, though these are not always tangible. Amongst the more obvious of those which are material in their nature are artefacts of all kinds, but it is clear that such products are themselves the means to further ends. These further ends are material in the case of implements, less immediately material in that of houses or canoes, and non-material in the case of shrines or musical instruments, which satisfy demands of social and individual mentality. Here we find our objective point of view overlapping the subjective—our material products require for their explanation some understanding of such aims and ends as lie outside the field of primary material needs. As soon as we get beyond the study of the instinctive quest of food and self-protection, and pass to that of the aims of the human artificer, we realise that aims and ends as well as ways and means are products of evolution. Man did very well before he was a man at all, and no one has given any reason why he ceased to be an ape.

THE DISTORTING MIRROR OF THE PRESENT.

Our attitude towards the problems that arise in the study of origin and development depends very largely upon the extent to which we ascribe to man a power of foresight enabling him to overrun the limits of environmental suggestion. If we assume that his progress has been based upon his opportunist reactions to such suggestion, we secure a vantage point from which to take a retrospective view of human progress. The visibility is not too good, and the details that are fundamental are often but obscurely seen, partly because the field of view is not only restricted by our ignorance but is also overshadowed by our knowledge. We can see too little of the past and too much of the present.

We have to make a big allowance for our own sophistication, when we are trying to explore the origins and growth of discoveries and inventions, and neglect of this precaution is not infrequent. In the case of pottery, for example, it is sometimes maintained that the plasticity of clay is so obtrusive, and its hardening by heat so easily made manifest, as to place the ceramic art amongst those human industries that may have been developed more than once, if not over and over again. The two essential properties of clay are obvious enough, given the conditions for its accidental hardening by fire, and both may have been discovered at various periods. Looking backward it seems evident to us that an early discoverer, looking forward, could have deduced from these two properties of clay the advantages of modelling this plastic stuff into the forms of vessels and baking them to hardness. Some may think that the deduction was an easy one, but the ease is purely retrospective. The potter was not a product of predestination. The conventional theory of the origin of pottery through the plastering of clay on the walls of baskets may or may not be acceptable, but it is in any case a recognition of the need that is felt to bridge the gap between the discoveries of two properties of clay, and the production of an earthenware pot. The discoveries were essential, but it is only in the light of our own knowledge that pottery appears to have been an inevitable result.

To take another example of the hasty reasoning which credits ancient man with anticipatory conceptions that in ourselves are due to knowledge, it is sometimes suggested that there is no improbability in the idea of the multiple origin of the pyramid, since the observation that piles of loose materials readily assumed a conical form must have been frequently made. To this it may be answered that pyramids are not small, are not made of loose materials, and are not conical in form; but this is only a small part of the relevant reply. The affiliation is indeed inconceivable, since the evolution of a pyramid depended not only upon many material factors, but also upon a number of social and religious sequences. Pyramids were not preconceived as being more pleasing to the gods, and more elevating to the human soul, than any other geometrical monstrosity; nor were they built out of mere Euclidean bravado. For such structures, even in their various modifications of material, form, and function, to appear independently in Mesopotamia, Egypt, India, Cambodia, Java, and America, would have called for parallel networks of coincidences rather than parallel chains.

MAN'S COMMON FACULTIES.

The question as to the nature and importance of the common faculties of the human mind—the components of the psychic unity—is one which demands more attention than it has yet received from anthropologists, Bastian notwithstanding. This is especially the case in relation to the subject of independent evolution. For our purposes it would not only be needful to isolate the common faculties, but also to identify those which have a bearing on the progress of discovery and invention. Here we should meet with the primary difficulty of distinguishing between an inborn human faculty and a traditional or inculcated mode of thought—an acquired type of reaction.

Assuming we had progressed so far in the comparative psychology of *Homo sapiens*, we should still be left with the problem of determining which—if any—of the common faculties are directive in their nature. It is not a question of deciding

* From the presidential address to Section H (Anthropology) of the British Association, delivered at Bristol on Sept. 4.

which faculties are permissive, enabling man to react in a similar way to similar external stimuli, but of determining which of them give him the power, whoever and wherever he may be, to override deflecting influences. Two environments may be similar, but only when they are the same are they identical, and our broad generalisations as to the cultural effect of surroundings such as deserts, mountains, forests, river-valleys, have a bearing upon the general mode of life they encourage or permit, and therefore upon a portion of the field which is open to the discoverer and inventor, but they ignore the differences in the details of any two environments of one general character; and it is discrepancies in detail that produce divergencies in end results. The human mind is very prone to skid on trifles. Moreover, even on the assumption that two similar natural environments are so nearly identical as to lead to similar reactions, under the guidance of the common faculties of the human mind, there still remains the most important factor of them all—that of the artificial environment, in gross and in detail, which formed the starting-point of two peoples whose artefacts and general culture are compared.

Taking all these difficulties into account, we see that the common faculties of man, if they are to be powerful enough to keep his independent lines of progress parallel, must be of an initiating and controlling character. If they are of such a character, history should reveal a wealth of examples of their power to keep man steadily progressing on his course, in all grades and aspects of his culture. But history has no such tale to tell, since it is merely a story of one provisional expedient following on another.

That there are mental faculties common to all men is undoubted, and it was in part by the exercise of such faculties that man secured advancement. Of the evolution of the human brain we begin to know a little, but we are not able to draw a line of demarcation between the innate and the acquired powers of its cells and tracts. In both mind and body we inherit potentialities which only unfold under certain conditions. For the development of the body we may define what are normal conditions, and they must not depart too widely from natural conditions; but for that of the mind the conditions may be almost wholly artificial. Heredity provides the aptitudes, but the grist is delivered through the sense-organs, and whilst the brain is a natural growth, the mind is a cultural construction. Human thought is compilation—a rehash of the past in the present—and no satisfactory record has ever been made of the mind of a man whose sole knowledge had been acquired without the tuition of his fellow-men.

The brain of Later Palæolithic man appears to have been like our own in all essentials, and a Cro-Magnon born to-day might become a skilled mechanic or an able bishop. But man had no more need to become a mechanic than he had to practise as a theologian, though he drifted into both professions. If the mental faculties that had survival value in the prevailing of our species were also those that were active in the initiation and pursuit of cultural advance beyond its needs, we are perhaps led to the conclusion that by far the greater part of human culture, material and immaterial alike, is an afterthought of evolution—an embroidering of the fabric. Man was given the means to earn a livelihood, and found himself commanding and inventing luxuries. In producing a new and cunning big-brained animal with hands, Nature overshot her mark, and we are struggling with the consequences.

The essence of my contention—and, of course, not mine alone—is that there are no common faculties of the human mind that are capable of overruling the vagaries of environmental and historical compulsions, and of directing man's progress in discovery and invention, in various times and places, along lines that are parallel. Beginning with the primary discoveries of early man, applied for material purposes, the prevailing outcome of his independent and opportunist reactions to the results of his own interference with natural materials and phenomena has been divergence and not parallelism.

DISCOVERY AND INVENTION.

It is obvious that discovery lies at the root of all man's material activities, since he must know something of the everyday behaviour of material substances before he can apply or adapt natural objects to his purposes. Discovery may result in the development of activities in which method remains the essential and controlling factor, as in agriculture and the domestication of animals, and we may then call the resulting system of techniques a discovery-complex; or it may initiate and further the development of artefacts, which we may provisionally call inventions. Perhaps few would be disposed to call an agricultural system an invention, and the same applies to techniques of metallurgy or weaving. If these arts are called discovery-complexes, what term may be applied to the products, such as bronze and woven cloth? Iron is an element, extracted from its ores, and man has not reached the stage of inventing elements. Bronze is an alloy of two elements, owing its first production to a series of discoveries, and we can scarcely call it an invention. We may perhaps best get out of the difficulty by using the term discovery-product for all artificially extracted, prepared, and compounded materials which have no significant form imposed upon them, but are merely the raw materials for the future production of shaped artefacts.

The application of the term 'invention' to any and every shaped or constructed artefact can only be justified on the grounds of expediency, and it must be understood that the concession is not meant to embody a definition of invention as distinct from discovery, in the relation of these words to the subjective workings of the human mind, or even to the objective results.

The word 'discovery', in its bearing on material culture, relates only to the subjective appreciation of the properties or reactions of material substances

or bodies, and it does not necessarily carry t e implication of an objective exploitation of t e knowledge gained. Only when the knowledge is applied to a useful purpose, more or less direct , for the initiation or development of a method an artefact, does the discovery play a practi l part. We may say, therefore, that a discovery s a subjective event which may in many cases e utilised in an objective application, and that it s these applied discoveries alone that are factors n human progress. It is therefore necessary to qual y the word discovery, and speak of an applied covery, before we can obtain an objective as w l as a subjective term. If we attempt to treat t word invention in the same way, and speak applied invention as the objective aspect of inve tion, we realise at once that we are doing violen to our conception of the meaning of the wor The word invention, in fact, unlike discovery, mainly objective in its significance.

Applied Discoveries.

It is clear that material progress began wi discoveries relating to materials, objects, and phen mena, of natural or chance occurrence, and th the initial value of such discoveries lay in the immediate practical use. It may have been t behaviour of stones he handled that first arous man's interest in them, but the utility of individu l stones as implements was more important to hi than the properties which made them useful. H generalising was unconscious, or even instinctiv , since animals discover, though man alone invent The making of discoveries was not the result of conscious search for means or methods to achie an end. Upon those which arose out of observ tion of simple natural phenomena, and of supe ficial properties of natural materials, were built u knowledge and experience which led man furthe and further away from his initial steps, until h was making discoveries about materials whic owed their character or composition to his develop ment of methods of treatment.

The general conclusion to which we are forced i that there are no absolute criteria by means o which we can decide what part may have bee played by independent discoveries in the produc tion of similarities in human culture. We are saf in assuming that simple primary discoveries, suc as that of the plasticity of clay, or the malleabilit of copper and gold, may or must have been mad more than once, but we are equally safe in assumin that, with every step beyond the first, an independ ent repetition of the same sequence becomes mor and more unlikely, and also that the more difficul a single discovery and the more difficult its applica tion, the less likely is its fruitful repetition.

Inventions.

The general recognition of the gradual character of the evolution of human artefacts—so obvious even under modern conditions—makes it unnecessary to dwell upon it. There are, however, no accepted definitions of the kinds of developmental changes or modifications, viewed either objectively or subjectively. If the initial steps in the evolution of simple artefacts are due to discovery alone, as already suggested, we have to decide in what way such steps differ from those which can be called inventive, if difference there is; and also to inquire into the nature of any other factors that may play a part in evolution. Moreover, if we call all artefacts inventions, there is no term left for single inventive steps. If, for example, the outrigger-canoe or the Chinese repeating crossbow is an invention, what distinctive term can we apply to the steps by which it has evolved, assuming these can be identified as due to individual discoveries, or to true inventions, whatever these may be? There is also the possibility—or the certainty—that changes may occur which are due to neither discovery nor invention, but to some slower and more gradual process.

If we begin with implements which were amongst the first to achieve an individuality of their own, those made of stone are for many reasons the most convenient for our purpose. We can scarcely doubt that accident, perhaps often repeated, led to the intentional breaking of stones for the production of edged or pointed implements, which gradually evolved into standardised forms. To summarise a sequence of events that arose out of more than one discovery, we may say that the first artificially shaped stone implement was due to the application of a discovery, and since the artificial shaping was a definite and decisive step it may be called a *mutation*. Since also it was the first intentional conversion of a particular kind of natural object or material into a kind of artefact it was a primary mutation. From such a mutation perhaps occurring more than once, developed the many forms of stone implements with which we are familiar. A mutation of this or any other type is an abrupt and discontinuous step, contrasting with changes which are trivial in character and produce their effect by a process of summation. For these the name of *variations* is appropriate.

In the shaping of the early types everyone agrees that forms such as hand-axes and 'ovates' were not preconceived as models to be aimed at; they must have been the end results of a gradual process of change, in which the shapes emerged through an opportunist selection and imitation of those which were most convenient and effective. This was in effect a process of variation, casual at first but later becoming more selective and adaptive.

Simple stone implements are thus to be traced to a primary mutation, a sudden jump, followed by variation, a gradual process. They were evolved, not invented to serve specific purposes. Similarly, beginning with a primary mutation in each case, the fighting-stick became the club, with its immense variety of form; the digging-stick became the spade, and perhaps the spear, with its derivative the arrow; the pick became the hoe and finally the plough; the hollow reed became the blow-tube. Even before the more evolved implements of these classes had got beyond their one-piece

sometimes intervened. That is to say, whilst the field of variation is that of form, it is not in exclusive possession of this field.

If a primary mutation was due to one or more discoveries made in relation to the behaviour of natural objects or materials, it is not unreasonable to suppose that similar discoveries concerning artefacts may have led to other mutations. As a hypothetical case, let us consider the origin of the bamboo spear-thrower of New Guinea, which has a socket for the spear, in place of the peg that is present on almost all other spear-throwers. We may suppose that this implement was derived from the ordinary type made of wood, such as is in common use in Australia, and that the first change was that of translation into bamboo. The carved or attached peg for the spear was at first retained, but during the manufacture or use of the appliance it would be easy for the discovery to be made that the bamboo rod readily supplied a natural socket, which would serve in place of the peg for effecting the discharge of the spear. Then followed the intentional construction of spear-throwers with socket instead of peg, and we may call the step —which may or may not be regarded as a progressive step—a free-mutation. If it happened as the result of a discovery, as suggested, it was free from any influences from other implements or mechanisms. It is impossible to be sure that no such outside influence was at work, but the step being decisive and discontinuous, it was at any rate a mutational step and not variational.

We may assume with some degree of probability that free-mutation initiated the provision of the foot-rest on the digging-stick, a grip or handle on the stone knife, the detaching head of the spear to produce the harpoon, the sling-hafting of the flail, and that it was concerned in the origin of other types of hafting. Primary mutation, followed by variations which led to change in form, stimulated by discoveries in relation to method, and often influenced by substitution, led to other discoveries which could be applied for the improvement of the form or construction of artefacts, and these applied discoveries may be called free-mutations. In this way there were produced many implements of a simple character, some having form alone, others showing construction and often mechanism.

So far we have identified no inventive foresight of a kind that would lead directly to the subjective preconception of a new or improved type of implement, differing in any important respect from what had gone before. We know, however, that in our own times the inventor designs his products in advance. This is not to say that at some stage in the evolution of material culture there was a sudden change in the mentality of man. Discovery and imitation lay at the root of all his methods, initiated all his artefacts, and led to the appearance of free-mutations, but when he had established a variety of artefacts that had construction as well as form, he began that process of transfer and adaptation of structural and mechanical characters for which I have suggested the term cross-mutation. These, like the other mutations already defined, were abrupt and discontinuous changes which could not have arisen gradually by variation, but, unlike other mutations, they owed their origin to a combination of features, or an application of 'principles', which had evolved in independence.

The process corresponds to what Mr. Henry Balfour has laid stress upon as hybridisation. It is a process involving foresight, in predicting the possibility of combination, and ingenuity in effecting it. A cross-mutation is a true invention, a product of the inventive faculty, unaffected by discovery in its first conception, though the inventor nowadays may need to make discoveries in relation to materials and methods before he can test the viability of his inventive forecast. Through it all runs the opportunist thread that may be plainly seen in the historical retrospect. Combinations for inventive purposes can only occur to the mind in an artificial environment in which the two (or more) elements of the combination are at hand, and these may have been evolved in entirely different artefacts or contexts.

Accepting these arguments as valid, an invention proper—as distinct from our loose application of the term to shaped and constructed artefacts in general—may be defined as a single mutational step which owes its origin not to discovery, but to a combining of structures or devices already in existence. The result is objectively a structural combination, which is preceded subjectively by the action of the mind in recognising the advantages and the possibilities of the hybridisation, and in thinking out the method of effecting it.

In a further treatment of the subject of inventions it would have been desirable to discuss such factors as change of function, change in method of use, substitution, and numerical mutation, but sufficient has been said to indicate the analytical method of approach.

If we take into account all the factors involved in the development of artefacts, even in simple cases, independent evolution involves coincidences, few or many. It is also clear that the further the artefact from the primary mutation which began it, that is to say, the longer the series of variational and mutational changes that has been undergone, the bigger the draft on coincidence. Nevertheless, we are still unable to point to definite mutational criteria, and to say that it is impossible that some particular mutation—and especially a primary mutation—should have occurred more than once. But a primary mutation is only a first step. As in the case of discovery-complexes and discovery-products, it is necessary to consider each case on its merits, and endeavour to identify all the links in the evolutionary chain.

The general case against identity or similarity by independent evolution is, however, overwhelming, as is very widely admitted at the present day, but to a large extent it is based on cumulative circumstantial evidence, since there are grave difficulties in finding proofs that leave no loophole for the defence.

Periodicity in Australian Weather.

METEOROLOGISTS generally recognise that as the sun's radiation heats the earth's surface, provides the energy of winds, and evaporates the water which falls as rain, so most of the variations from year to year in temperature, wind, and rainfall must be in some way caused by variations of solar radiation. The literature of the subject is immense, but is mostly directed towards discovering direct and simple relationships between solar radiation, especially as represented by Wolf's sunspot numbers, on one hand and terrestrial weather on the other hand. With a few isolated exceptions, however, these efforts have met with little success, probably because a simple direct connexion rarely exists, the solar changes working rather through complex changes in the atmospheric circulation. In a recent paper,* Dr. E. Kidson approaches the problem, as it affects Australia, by studying the variations in the tracks and intensities of the moving anticyclones which traverse the country from west to east. The data employed were extracted from the Australian daily weather charts (usually including New Zealand) for the years from 1887 onwards; they are expressed in various ways, including the average latitude of the centres in different longitudes, the annual range in the latitude of the centres, the intensity, and the rate of travel, all of which give fairly concordant results.

The most obvious periodicity in these data is not the sunspot cycle of eleven years, but a shorter one of only eighteen months. The effect is not large – the range between the most northerly and the most southerly positions of the average tracks is only one or two degrees of latitude—and the data require smoothing to bring out the periodicity, but from an inspection of the unsmoothed figures it is probably real. The author believes it to be of terrestrial origin, and he writes: "An eighteen-months period in terrestrial phenomena may at first sight appear unnatural, but it is a period between a season in one hemisphere and the next but one of the same kind in the opposite hemisphere. This suggests an oscillation between the hemispheres which would be of quite a natural type."

Now one of the most striking features of Australian meteorology is a three-year cycle in the pressure of Darwin, which is the basis of long-range forecasts of rainfall in Java. A similar periodicity is widely distributed in other parts of the world, and the author suggests that this is really the same eighteen-month periodicity of the circulation which, having opposite effects according as its maximum falls in summer or winter, actually appears as a three-year cycle. This would account for the frequency with which the latter is interrupted by a secondary maximum. Moreover, this apparent three-year cycle at Darwin is not constant, but breaks down from time to time. These breaks are all near sunspot maxima, and this suggests that the cycle is controlled by solar variations and so kept in step with the eleven-year sunspot cycle. So we arrive at a mechanism in which seasonal changes, a natural oscillation of the earth's atmosphere, and solar control all combine to produce complex variations of weather.

The second half of the paper is devoted to the effect of the sunspot cycle in the rainfall of Australia. The rainfall data are grouped into districts, and the annual totals for each district are then combined to obtain the average variation during an eleven-year cycle. The curves produced in this way are mostly very irregular, and are smoothed over three years. This is legitimate as a graphical process, but the high correlation coefficients which the author obtains between these much smoothed rainfall data and the sunspot figures similarly smoothed can have little significance, and the arguments which he bases on them correspondingly little weight. The deduction of the eighteen-months cycle rests on surer ground, though the question whether this or the well-established three-year cycle is the real primary oscillation seems to need further consideration. C. E. P. B.

* Melbourne, Commonwealth of Australia Bureau of Meteorology. Paper 1. Some Periods in Australian Weather. By Edward Kidson.

Obituary.

DR. H. R. H. HALL.

BY the premature and sudden death, on Oct. 13, of Dr. H. R. H. Hall, the British Museum loses one of its most active and distinguished Keepers, and a large circle of colleagues and friends a genial, generous, and wholesome personality. Hall was born on Sept. 30, 1873, educated at Merchant Taylors' School and St. John's College, Oxford, and appointed to the Department of Egyptian and Assyrian Antiquities in 1896, during the long keepership of Sir E. Wallis Budge. He was promoted Assistant Keeper in 1919, and succeeded his old chief as Keeper in 1924.

Hall's father was an artist, and the dedication of Hall's first book, "The Oldest Civilisation of Greece" (1901), acknowledged and exemplified a very real debt, in its keen appreciation of the beauties as well as the scientific interest of that Ægean culture which he was one of the first to popularise in Great Britain, even before the Cretan material was available. To this culture, though it lay only on the outskirts of his professional studies, he recurred often and lovingly, in his "Ægean Archæology" (1915) and his Rhind Lectures of 1923, published in 1928 as "The Civilisation of Greece in the Bronze Age" with a wealth of illustration which testified to his mature artistic judgment. For, as he wrote, characteristically, "the plan of each lecture as delivered was to explain the pictures". At need, he would come back to Oxford, after his Museum-day, to 'explain pictures' on this favourite theme. Yet this was only one of

many personal interests, ranging from Dutch pictures to army buttons, wherein Hall's exuberant boyish vitality found expression. For him, as for Stevenson's happy child, "the world was so full of a number of things".

Meanwhile, in the Museum, Hall rapidly mastered the difficult technique of both sides of his department, Egyptian and Assyrian. He published hieroglyphic texts, Coptic and Greek documents almost as difficult, scarabs combining linguistic and historical with artistic problems, early metal-castings from Al-'Ubaid, and the monumental architecture of Dair-el-Bahari. A great museum's exhibition galleries rightly reflect the personality and outlook of its keepers, in liaison between the advance of learning and the broadening interests of its popular visitors. Certainly, with his keen eye for colour and modelling, and his strong historical sense of perspective, Hall left appreciably brighter as well as more intelligible those halls along which, swinging his keys, you met him striding as if over downland.

It was Hall's good fortune—as well as due to his quality—that he was one of the first assistants in the British Museum to be allowed, and later sent, to take part in excavation abroad; a practice now well established, and amply justified by its effects, as the recent Royal Commission has testified. Hall's first campaigns were with the Egypt Exploration Fund at Dair-el-Bahari (1903–7) and at Abydos (1910), under the veteran Edouard Naville, and with Prof. T. E. Peet in the party. At Abydos he excavated again in 1925. The War brought him in time, like other archaeologists, to the countries he most needed to visit, as a captain in political service in Mesopotamia; and as soon as circumstances permitted he organised the great series of excavations which the Museum has conducted jointly with the University of Pennsylvania, at Ur and in its neighbourhood, and himself discovered and brought home the wonderful early statues and relief work in copper from Tell-al-'Ubaid, published in the first instalment of "Ur Excavations" (1929). As responsible Keeper, after 1924, he was no longer able to conduct this field work; but the successes of Mr. C. L. Woolley and his colleagues owe much to his vigorous, methodical, and tactful conduct of the home-front.

Probably Hall's best-known book was an "Ancient History of the Near East", first published in 1912. It was the first handbook of the kind in English, since the days of Rawlinson, and is in its seventh edition; the soundness of its conception and workmanship is attested by the very small amount of remodelling which it has needed, in a period of rapid, multifarious discovery. Without attempt at fine writing, Hall tells his story as of a living world, with a historian's training, the museum-man's gift of easy reference to required fact, and the broad humanity and common sense characteristic of all he said and did. That indeed is what his Trustees, other learned institutions, and the Government valued in him increasingly; and his untimely death followed over-exertion as their representative at a series of important conferences abroad.

J. L. M.

WE regret to announce the following deaths:

Prof. Adolf Engler, formerly Director of the Botanic Garden and Museum at Berlin-Dahlem and joint author with Prantl of "Die Natürlichen Pflanzenfamilien", on Oct. 10, aged eighty-six years.

Col. J. W. Gifford, a pioneer in the use in Great Britain of X ray photography, who also contributed to the improvement of telescopic lenses, on Oct. 27, aged seventy-four years.

Mr. J. E. Purvis, of Corpus Christi College, Cambridge, who had been University lecturer in chemistry and physics as applied to preventive medicine since 1909, on Nov. 1.

Mr. B. B. Woodward, an original member and past-president of the Malacological Society of London, formerly librarian of the British Museum (Natural History), on Oct. 27, aged seventy-seven years.

News and Views.

THE Rede lecture delivered by Sir James Jeans at Cambridge on Tuesday last, on "The Mysterious Universe", was marked by the clarity and suggestiveness to which we have grown accustomed in his welcome utterances. Starting with the conception of mankind as the product of an accident in a universe the main course of which was quite other than towards the production of human life, he reviewed the successive ideas which these chance creatures have held of the universe outside themselves. He enumerated three stages, represented by an anthropomorphic, a mechanical, and a mathematical view of the nature of the reality behind phenomena. The last of these has lately been introduced by the advance of physics, and Sir James regards it as a far closer approximation than its predecessors to the 'ultimate reality', with which, however, we are not yet in contact. He made no attempt to evade issues which are the subjects of acute differences of opinion. "We discover", he said, "that the universe shows evidence of a designing or controlling power that has something in common with our own individual minds—not, so far as we have discovered, emotion, morality, or æsthetic appreciation, but the tendency to think in the way which, for want of a better word, we describe as mathematical." "This concept of the universe as a world of pure thought", he went on, "implies, of course, that the final truth about a phenomenon resides in the mathematical description of it; so long as there is no imperfection in this, our knowledge of the phenomenon is complete."

To Sir James Jeans, as—rather less tentatively—to Sir Arthur Eddington, the recent developments of physics seem to rule out determinism from the course of Nature. "The old science had confidently proclaimed that Nature could follow only one road, the road which was mapped out from the beginning of time to its end by the continuous chain of cause and effect; state A was inevitably succeeded by state B. . . . The new science . . . can . . . specify the relative probabilities of states B, C, and D. But,

just because it has to speak in terms of probabilities, it cannot predict with certainty which state will follow which." Sir James Jeans's views will not meet with general acceptance, and indeed it was one of the merits of the lecture that it was provocative of far more thought than it expressed. While it may be true that physics has led to a mathematical conception of Nature, it may well be asked whether it could possibly do anything else. The mechanical view which has been displaced was itself fundamentally mathematical, and the 'displacement' is in reality less a substitution than a purification. We may well ask whether we are justified in concluding that a mathematical description of a phenomenon is a complete one when our means of investigation could scarcely yield anything more. How could an æsthetic description, for example, supposing it to be possible, be given by the methods of physics ?

SIR JAMES JEANS dealt briefly with this point, but his remarks will probably not give universal satisfaction. Incidentally, we may note also that the view he advances is not altogether a modern one: it was not, in fact, unknown to the ancient Greeks, to whom the universe was a problem in geometry. "The Creator", says Plato—of whose ideas in another connexion Sir James Jeans made a striking application—"practises geometry eternally." The bearing of the new physics on the problem of determinism, too, is perhaps not so simple as it appears. It is not sufficiently emphasised nowadays that the departure from strict causality exists, if at all, only in a purely conceptual world, which, by its own innate requirements, can never possibly be observed. The determinism of Nature is not removed but merely re-interpreted, and the whole question is given an illusory bearing on the problems of philosophy and religion by the employment of the word 'probability' in a different sense from that in which it is generally understood. Sir James's lecture will serve a more than useful purpose if it becomes the means of dragging these questions out of the confusion in which they are now deeply immersed into the air of clear thought.

WHATEVER his political creed, no one familiar with the scientific work done by the dyestuffs industry in Great Britain could fail to be moved to uneasiness by the impending lapse of the Dyestuffs (Import Regulation) Act. The safeguarding of this new and virile national industry is not a matter merely of economic importance, although from this point of view and in relation to the volume of employment it is serious enough. The question, however, of the continuance of the protection is one which ought not to be regarded as necessarily being subject to the same mode of approach, or debated on the same political principles, as may fairly be applied to the general case of tariffs versus free trade. It has to be remembered that there are bound up with the fortunes of this branch of our chemical industry wide and serious problems of national scientific development in directions which lead far from the immediate interests of the colour industry.

THE Institute of Chemistry of Great Britain and Ireland has recently published a statement referring to the influence of the Dyestuffs Act during the past ten years on the education of British chemists and on the progress of research in industry. During this period of assistance, the laboratories maintained by the dyestuffs industry in Great Britain have followed the example of those established long ago in Germany, by serving as the focus of research and development not only in the extending range of coal-tar products but also generally in the domain of applied organic chemistry. This most desirable movement has called into being an adequate corpus of skilled chemists and technologists, and the protection afforded to the industry has encouraged the provision of substantial facilities for instruction and research. In short, good progress has been made along sound lines towards the re-establishment, on an independent footing, of our coal-tar colour industry; the future both of the industry and of organic chemistry in Great Britain would, however, be jeopardised if the Act were allowed to expire forthwith.

IT is announced that the Nobel Prize for Medicine for 1930 has been awarded to Dr. Karl Landsteiner, of the Rockefeller Institute for Medical Research, New York. Dr. Landsteiner was born in Vienna in 1868, and was educated at the University of Vienna, where he became professor of pathological anatomy in 1909, holding this chair until 1919, and becoming attached to the Rockefeller Institute in 1922. His published work includes studies on the virus of fowl plague and on infantile paralysis. In immunology, he has devoted much attention to the characters and individual differences of human blood as regards blood groups, corpuscular agglutinins and agglutinogens, and their inheritance, and to the serological properties of the blood of the anthropoid apes. He has also published investigations on the formation of bacteriolytic immune bodies, cell antigens and specificity, and serological specificity and chemical constitution.

OF the many pioneers of the steamboat, to Henry Bell—the centenary of whose death falls on Nov. 14—belongs the distinction of inaugurating steam navigation in the Old World, just as to Robert Fulton belongs the honour of inaugurating steam navigation in the New World. Fitch, Rumsey, Miller, Stevens and Symington had all achieved a certain amount of success with their experimental boats, but it is with the passages of Fulton's *Clermont* on the Hudson in 1807 and of Bell's *Comet* on the Clyde in 1812 that the history of the steamboat as a regular means of transport begins. Neither Fulton nor Bell were the originators of steam propulsion; neither of them constructed either the hulls or the machinery of their boats; neither of them introduced any improvement in steam engines or boilers; but it was to their imagination, confidence, and courage rather than to their mechanical ingenuity that they owed their achievements. Of the two, Fulton undoubtedly possessed in a greater degree the qualities requisite to a great pioneer, but our debt to Bell is not lessened thereby.

BELL was born in the Old Torphichen Parish Mill, Linlithgow, on April 4, 1767, and died at Helensburgh on Nov. 14, 1830. Brought up as a mechanic, he had worked under Rennie in London and had been the partner of a builder in Glasgow before settling in 1808 in Helensburgh. At this place he was proprietor of the Baths' Inn, and it was for conveying customers between Helensburgh and Glasgow that the *Comet* was built. Laid down in October 1811, at Port-Glasgow, the vessel was launched on July 24, 1812, and began running during the following month. Seven months later she found herself with a rival, and in 1813 no fewer than five steamboats were afloat on the Clyde. These proved superior to the *Comet*, which Bell tried for a time on the Forth and then on the west coast of Scotland, until on the afternoon of Dec. 15, 1820, she was caught by the tide and cast ashore off Crinan, and broke in halves. The forward part holding together, the engine was salved and to-day stands in the Science Museum, South Kensington. In spite of his efforts, Bell's fortunes never rose high, and during the latter part of his life he was given a grant by the Government and an annuity by the Trustees of the River Clyde. At his death he was buried in the parish churchyard at Rhu, near Helensburgh, and many years later the famous shipbuilder, Robert Napier, erected his statue there. A granite obelisk to Bell's memory was also set up on the front at Helensburgh, while another memorial at Bowling recalls his services to those who have occasion to pass up and down the most important shipbuilding river in the world.

A STRONG earthquake occurred on the morning of Oct. 30 along the sea-coast of the province of the Marches in Italy. The epicentre was probably submarine and close to the small town of Senigallia (near Ancona), where one-third of the buildings were destroyed, another third seriously injured, and ten persons lost their lives. Slight shocks were felt at Trieste (142 miles from Senigallia), Padua (145 miles), and Naples (195 miles), so that the area disturbed may have contained so much as 120,000 square miles, a rather unusual size for an Italian earthquake. Sea-waves are said to have swept the adjoining shores and damaged some of the quays, indicating, if the report is correct, that there was some displacement at the epicentre. The Kew seismographs recorded an earthquake of moderate intensity at 7 h. 16 m. 7 s., G.M.T. All along the coast of the province of the Marches, there are, according to Dr. M. Baratta, a number of minor seismic zones. Senigallia lay within the meizoseismal areas of the destructive earthquakes of Rimini in 1672 and Ancona in 1690, but the earthquake that bears the closest relation to the recent shock is the Senigallia earthquake of Sept. 21, 1897, by which nearly all the buildings in the town were more or less damaged. The epicentre was probably a few miles off the coast at Senigallia, and the disturbed area about 175,000 square miles.

FOR some years past, there has been a wish on the part of some of the inhabitants of Bournemouth to establish there a natural history museum. In 1912, Sir Ray Lankester addressed a public meeting upon this matter, and recently, Mr. J. B. Calkin, of Bournemouth, has been instrumental in again urging the need for such an institution. A letter signed by a number of influential citizens has been forwarded to the mayor, but it was felt that this should receive support of a more public nature, and an invitation was sent to Mr. Reid Moir, president of the Ipswich Museum, to address the Bournemouth Rotary Club upon the question. The meeting was held on Oct. 28, and was fully representative of the scientific and municipal life of Bournemouth. Mr. Reid Moir, after outlining the great richness of the area from the geological, archæological, and other points of view, remarked that a vast mass of important material has already left the district, and that this regrettable process will continue until a properly equipped museum is in existence to receive it. He urged the necessity of such provision, and suggested that, in its initial stages, the museum should be of a more or less local character. Mr. Reid Moir also stressed the ever-growing importance of museums in national education, and outlined the nature and value of a modern museum of natural history. He emphasised the need for erecting the building on a site where expansion can take place, and the expectation that large numbers of visitors to Bournemouth would be attracted to the museum. Judging from the support given to the proposal at the meeting, it is hoped that, before long, this progressive town will possess an adequate and up-to-date exhibition of objects of natural history.

MOST towns of considerable size have their occasional exhibitions to illustrate and commend the use of gas, the use of electricity, developments in domestic utensils, and so on, but few contemplate an exhibition to illustrate the wonders of science, as Hastings has done in recent years (NATURE, Oct. 25, p. 658). Of course, the practical exhibitions are backed by the hope of ultimate financial gain, while the wonders of science are fortunate to escape without financial loss; but nevertheless it is a little disturbing to think that the men of commerce are more determined to proselytise the people for a material end, than the men of science generally are for a spiritual. The attempt at Hastings to interest the people in science and add to their knowledge by means of a temporary Science Exhibition, accompanied by demonstrations, science talks, and formal lectures, is therefore to be encouraged. Such an exhibition can be planned in detail and carried out only by scientific men, but the organisation and the financial arrangements must be in the hands of a municipal or other authority, capable of looking beyond the monetary balance-sheet to the educational benefits which follow. Co-operation between municipalities, museums, and teaching institution, to this end should be readily obtained, and we trust that other towns may follow the lead which Hastings has given in introducing to the public some of the wonders of science.

AN exhibition illustrating the utilisation of photography in astronomy, arranged by the Royal Photographic Society of Great Britain, is being held at

the Society's rooms, 35 Russell Square, W.C.1, on Nov. 4–29. The exhibition is the second of a series planned by the Society to illustrate the uses of photography in the service of man. The Society is to be congratulated on having secured a comprehensive series of photographs representing the work of observatories and of individual astronomers not only in Great Britain but also in Canada, Egypt, France, Germany, India, South Africa, and the United States. The increasing application of photography to astronomical observations during the last fifty years has been rich in results to an extent almost unimagined, and there is ample evidence of this in the four hundred items of the exhibition. The number of exhibits requiring technical discernment for their full appreciation, such as solar and stellar spectra, is in reasonable proportion, and in many cases where the subject under illustration is not obvious, simple descriptions have been appended. The exhibition is worth careful inspection for more than one reason. In several instances exhibits have been arranged to present some elementary fact of astronomical observation—the sun's rotation, the rapid changes of solar prominences, the changing appearance of the surface of Jupiter with the shadow of a satellite—whilst the latest discovery pertaining to the solar system is shown by a photograph of the planet Pluto.

A FEW photographs of historical interest have been included in the Exhibition of Astronomical Photography to show the march of progress; one views with respect the results achieved by those early workers who used a wet plate or a recently invented dry plate with what would now be considered limited telescopic equipment. Concerning the wealth of recent work represented—it would be invidious here to particularise—astronomers have sent of their best results, and one cannot fail to be impressed with their spectacular record of many of the grandest aspects of the heavens known to man. In connexion with the exhibition, Prof. H. Dingle will deliver a lecture on "Spectrum Photography", on Nov. 17, and Mr. J. H. Reynolds will give "A Talk on the Slides and Films in the Exhibition", on Nov. 24. The Exhibition is open free to visitors between 10 A.M. and 5 P.M. on each day, except on Sundays. No tickets are required for the above lectures at 7 P.M.

ON Friday, Oct. 31, a public lecture on "High-Pressure Reactions" was delivered before the Institution of Chemical Engineers by Prof. W. A. Bone. Prof. Bone dealt briefly with the historical events leading up to an understanding of the rôle played by pressure in gas reactions. Within a period of less than fifty years has been included the first recorded synthesis of ammonia from its elements by the agency of a catalyst, the statement of the principle of mobile equilibrium, and the classical work of Haber and his collaborators upon equilibrium in an ammonia-nitrogen-hydrogen system. A more recent development has been the synthesis of various organic compounds from water-gas by the employment of suitable catalysts and high pressure, which has opened up a wide field for future exploration. The variety and complexity of these new processes, however, require much systematic and fundamental research before a clear understanding of their mechanism is obtained. One of the difficulties encountered in high-pressure gas reactions is the lack of reliable fundamental data on the physical properties of gases. No more useful link could be undertaken at present than a comprehensive determination or re-determination of such data as the compressibility of gases and of mixtures of gases and the effect of pressure on viscosity, dielectric strength, solubility, and thermal conductivity. Although such work falls within the scope of a high-pressure gas research laboratory rather than of a works routine laboratory, the cost of equipping and maintaining such a laboratory has hitherto proved an insuperable barrier. Some three years ago, however, a complete high-pressure gas research laboratory was established in the Department of Chemical Technology at the Imperial College of Science, and work has been commenced on a number of physical problems directly connected with high-pressure reactions. Prof. Bone's lecture will appear in full in the *Transactions* of the Institution of Chemical Engineers, vol. 8.

THE British School of Archæology in Egypt has found recently in the Wadi Gaza, and its tributary valleys in Southern Palestine, a very important series of flint implements of Lower Palæolithic types. These specimens, which were described by Mr. Reid Moir at a meeting of the Royal Anthropological Institute on Oct. 28, can be divided into two sharply defined groups, the oldest comprising coarsely flaked rostro-carinate implements, rostroid hand-axes, choppers, and points. There is no doubt that these specimens, in their method of evolution, forms, and technique, are comparable with others found in East Anglia and elsewhere, and known to be of Early Pleistocene date. The latter implements exhibit usually striation and abrasion by ice-action, while the Palestinian examples, which have not yet been discovered *in situ* in any ancient deposit, show manifold signs of collisions with other stones in rapid movement. It is supposed that the ice-sheets present farther north were represented in Palestine by extensive snowfields, which, on melting, gave rise to widespread floods, and the abrasion of any implements exposed to such conditions.

THE second group of Palestinian specimens described by Mr. Reid Moir differs very markedly from the first—as they are quite unabraded, and comprise beautifully made hand-axes of Late Acheulean types. Some of these implements have been found *in situ* beneath a considerable depth of sand at Sherah. It is evident that both the archaic and the later groups of specimens from Palestine were made each by a differing technique and upon a highly specialised plan. Further, it can be demonstrated that a precisely similar method of implement-making was in vogue in England, Africa, and India in remote times. It seems necessary to suppose that centres of dispersal of cultures existed in prehistoric times, as it is not a reasonable supposition that a race of people living, for example, in Palestine would, by coincidence, proceed to make their flint implements on the same

complex plan as that adopted by another race in England or India. The existence of these world-wide cultures in the Lower Palæolithic epoch appears to imply that the human race was even then more highly organised than has been hitherto supposed, and that very extended periods of time were involved in the spread of certain "fashions" in implement-making over such wide areas of the globe.

IN *Engineering* for Oct. 31 is an illustrated account of the closing of the arch span of the great Sydney Harbour Bridge in August and September. The span, which is 1650 ft. between the main supports, has been erected as two cantilevers from either side, each cantilever being supported by 128 steel wire cables connected to the top chord at the end of each end post, and carried down to the solid rock through a tunnel 120 ft. deep. The steel-work has been put into position by creeper cranes, each 605 tons in weight, travelling on the tops of the half-arches. There are fourteen panels in each half-span, and when thirteen and a half of these had been completed the total pull on the cables was 27,440 tons. When sufficiently far advanced for joining both upper and lower chords, the load was lessened on the cables one by one by means of hydraulic jacks. Included in the article are photographs of the forged steel saddles, with their alignment pins, for the bottom chords, and the jacking arrangements by which the correct compression was obtained in the upper chords. The forcing apart of these chords was done by means of four hydraulic jacks of nickel steel, each of 950 tons capacity.

AT the invitation of the Ministry of Agriculture and Fisheries, three committees of the International Council for the Exploration of the Sea met at the Fisheries Laboratory, Lowestoft, during the first week in November. Several foreign delegates and experts were present, and the president of the Council, Mr. H. G. Maurice, presided over the meeting of the Executive Committee, or Bureau. The other two committees dealt respectively with the plaice and the herring. It has long been known, as the result of marking experiments, that small plaice transported from the over-crowded grounds on the Continental coast to the Dogger Bank will grow very much faster on this famous fishing ground, and the Council decided at the last meeting that the possibility of carrying out such transplantation on a large scale should be very carefully examined. A committee has therefore been constituted to study the financial aspects of the question and to decide, if possible, whether the transplantation of, say, one million plaice can reasonably be expected to yield a commercial profit. The committee on the herring includes in its membership the principal experts from all countries bordering on the North Sea. It is engaged principally on technical questions, its main task being to secure uniformity and standardisation of methods of research and closer co-operation in the study of the herring. A scheme was presented by the English fishery workers for a more detailed study of the herring in the southern North Sea, with the view of rendering more exact the predictions of the great East Anglian herring fishery, which have already been made with some success.

A SCIENTIFIC Advisory Committee on Medical Administration and Investigation has been appointed by the Secretary of State for Scotland "to assist the Department of Health for Scotland in applying the results of scientific research to the details of public health administration and in promoting such medical investigations as come within the sphere of the Department or of the local authorities in Scotland". The members of the Committee are: Dr. Alexander Bowman, Scientific Superintendent, Marine Laboratory of the Fishery Board for Scotland; Prof. C. H. Browning, professor of bacteriology, University of Glasgow; Prof. E. P. Cathcart, professor of physiology, University of Glasgow; Prof. F. A. E. Crew, professor of animal genetics, University of Edinburgh, and Director of Animal Breeding Research Department; Sir Walter M. Fletcher, Secretary to the Medical Research Council; Sir Robert Greig, Secretary, Department of Agriculture for Scotland; Mr. John Jeffrey, Secretary, Department of Health for Scotland; Dr. J. Parlane Kinloch, Chief Medical Officer, Department of Health for Scotland; Dr. A. S. M. Macgregor, Medical Officer of Health, Glasgow; Prof. T. J. Mackie, professor of bacteriology, University of Edinburgh; Prof. J. J. R. Macleod, professor of physiology, University of Aberdeen; Prof. Robert Muir, professor of pathology, University of Glasgow; Dr. J. B. Orr, Director of the Rowett Institute for Research in Animal Nutrition, Aberdeen; and Prof. W. J. Tulloch, professor of bacteriology, University of St. Andrews. Dr. Parlane Kinloch is chairman, and Mr. George Wallace, of the Department of Health for Scotland, is secretary of the committee.

IT is announced in the *Museums Journal* for October that the Carnegie Trustees are now prepared to receive applications for grants from small museums administered by public authorities, under the following conditions, which will be strictly observed: (1) The grants will not exceed £250 to any one museum. (2) The museum authorities must show that they are prepared to adopt some definite policy and are re-organising their institution on the lines recommended by Sir Henry Miers in his 1928 Report to the Trustees. They must also show that they are prepared to provide an adequate annual revenue for the upkeep of the institute under the new policy. (3) The grants are to be confined to towns with between 10,000 and 70,000 inhabitants. They will be given in respect of capital expenditure only on the £ for £ basis. They will not be available for the erection or structural alteration of buildings, or for ordinary current expenditure. They are to be expended on special outlays (for example, purchase of cases, employment of temporary staff) in connexion with the reorganisation schemes in respect of which they are sanctioned. (4) Each museum applying must have, or be prepared to appoint, a competent curator. Applications should be addressed in the first instance to the Secretary, Carnegie United Kingdom Trust, Comely Park House, Dunfermline, Fife, Scotland.

THE *Australian Museum Magazine*, a quarterly edited by Dr. Charles Anderson, an Orcadian by birth, manages well to strike the balance between pure

science and popular reading. But the July-September number especially interests us, apart from its articles, by the evidences it contains of the activity of the Australian Museum. Notices on the covers direct attention to new series of postcards illustrating in four-colour process typical beasts and birds of Australia; other notices are attractive invitations to special exhibits in the Museum and to a series of popular scientific lectures in which "the subjects dealt with will be presented in a clear, lucid, non-technical manner, making known many unfamiliar facts concerning Nature and her ways". Finally, the telephone extension number of each specialist on the staff is given, and visitors are invited to apply for information, when they "will receive every attention from Museum officials". These are excellent methods of making the public feel that the Australian Museum exists for their service, and so of obtaining the widest public assistance and support. Museum officials in Great Britain perform the same services, but it is well that the public should be reminded so frankly of the willingness of the museums to help in the spread of scientific knowledge.

THE Leicester Literary and Philosophical Society, with a membership of more than three hundred, performs useful service to science in arranging a series of lectures on scientific (as well as literary) subjects, delivered by experts. In addition to these general lectures, more specialised meetings bring together members interested in particular branches of scientific work. The *Transactions* for 1929-30 (vol. 31) contain reports of these sections and an interesting address by the president, Mr. T. Kingdom, on "The Minor Legacies of Greece", in which he reviews briefly the contributions to knowledge made by some outstanding men of science among the ancient Greeks. Unfortunately, the statement of accounts shows a deficit of £15 on the year's working, but since there appears to be no entry for interest on War Stock and deposit account, there may be a hidden reserve to meet part of the loss. The Society deserves more local support, and the projected meeting of the British Association in Leicester in 1933 should give a fillip to its aims and to its membership.

MANY highly qualified translators have now been enrolled on the Aslib Panel of Expert Translators (see NATURE, June 28, p. 984). More than thirty languages are represented, from Arabic to Urdi, but the great value of the service offered by this scheme is that the members of the Panel possess that expert knowledge of special subjects without which trustworthy translations cannot be made. The range of subjects covered by the Panel is wide. Especially strong in pure and applied science, medicine, chemistry, engineering, etc., it includes also men and women experienced in law, industry, commerce, and many other branches of knowledge. Particulars of the scheme may be obtained from the Association of Special Libraries and Information Bureaux, 26 Bedford Square, London, W.C.1.

IN the article entitled "African Ethnology and Archæology" in NATURE of Nov. 1, p. 707, paragraph 2, it is stated that associated with the pottery of stone age cultures in Kenya were "tools of a Mousterian type". This phrase should read "tools of Upper Kenya Aurignacian type". Mr. L. S. B. Leakey informs us that the Upper Kenya Mousterian is contemporary with the Upper Kenya Aurignacian but is not associated with even crude pottery.

THE Year Book of the Commonwealth of Australia, of which the issue for 1929 has now appeared (Commonwealth Bureau of Census and Statistics, 5*s*.), is more than a statistical record of the country. There are many descriptive articles of considerable value, such as those on various aspects of agriculture and mineral wealth, and that on the structure and scenery of the federal capital territory. In several sections parallel figures for other countries add to the value of the statistics. The volume now runs to more than a thousand pages.

PART II. (Civil Tables) of "The Registrar-General's Statistical Review", 1929, has just been published at the reduced price of 2*s*. (London: H.M. Stationery Office). The estimated population (in thousands) of Great Britain and Ireland was 48,684. Compared with 1928, England and Wales show an increase of 0·32 per cent, Scotland and the Irish Free State decreases of 0·18 and 0·20 per cent respectively, while Northern Ireland remains stationary. Statistical data concerning marriages and divorces, passenger movements, births, and electors are included in the volume.

MESSRS. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, have recently issued a catalogue of nearly 700 second-hand works relating to scientific subjects which should be of interest to many readers of NATURE.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in engineering at the Cape Technical College—Chalmers and Guthrie (Merchants), Ltd., 9 Idol Lane, E.C.3 (Nov. 17). An assistant bacteriologist in the Public Health Laboratory of the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Nov. 17). A junior research assistant in the High Pressure Research Laboratories of the Imperial College of Science and Technology—The Registrar, Imperial College of Science, South Kensington, S.W.7 (Nov. 21). An agricultural chemist at the Agricultural Institute and Experimental Station, Kirton—The Principal, Agricultural Institute, Kirton, near Boston, Lincs (Nov. 22). An assistant in the Department of Pathology of the Hospital for Consumption and Diseases of the Chest—The Secretary, Hospital for Consumption and Diseases of the Chest, Brompton, S.W.3 (Nov. 22). An assistant pathologist at the Royal Surrey County Hospital, Guildford—The General Superintendent, Royal Surrey County Hospital, Guildford. A test assistant under the directorate of technical development of the Air Ministry, to assist in experimental metallurgical work—The Chief Superintendent, R.A.E., South Farnborough, Hants (quoting A.459).

Research Items.

Wastage in Imported Fruit.—Two special Reports of the Food Investigation Board, No. 38, by Dr. J. Barker, and No. 39, also by Dr. J. Barker and dealing with New Zealand apples (London: H.M. Stationery Office, 1*s*. 6*d*. and 6*d*. respectively), together with *Bulletin* No. 23 from the New Zealand Department of Scientific and Industrial Research, in which Mr. L. W. Tillar deals with the relation of storage temperature to the overseas carriage of apples, show that investigation is now actively proceeding into the many important scientific problems associated with the marketing of overseas fruit. Since 1926, with the co-operation of the Food Investigation Board, a small laboratory has been maintained near Covent Garden Market, and most of the data utilised by Dr. Barker in his more general report have been obtained through the opportunities thus provided for studying wastage, through the cordial co-operation of the Covent Garden salesmen. The problems are now seen to be many and various, but in many cases there seems to be clear indication as to the lines to follow for practical success. Thus, the condition of the fruit when gathered is seen to be of prime importance; 'bitterpit' in apples, for example—on which subject a valuable paper by W. H. Carne, H. A. Pittman, and H. G. Elliot was presented at the Imperial Horticultural Conference—can be practically avoided if the apple is picked at the rightly mature stage. New Zealand shipping experience shows the importance of prompt reduction of the temperature in the ship's hold; whilst South African experience has shown how wastage can be reduced by care and inspection during picking, the use of refrigerated trucks for long-distance rail transport, and improvement of the refrigeration systems on board ship. We are still ignorant often of the best temperature at which to maintain the fruit during transit and before sale. Also, in many cases, simple precautions such as tight packing, to avoid bruising in transit, are essential preliminaries to refinements as to temperature, ventilation, and humidity controls. The reports referred to, however, are ample evidence of the progress that has been made and of the necessity for further experimental investigation in a co-operation which extends from the orchard overseas to the retail counter at home.

Food of the Terns of the Dry Tortugas.—Mr. W. H. Longley (Year Book No. 28, Carnegie Institution of Washington, p. 288) gives some interesting observations on the food of the terns, especially the Noddy and the Sooty tern of the Bird Key Rookery, the material studied being the more or less digested fishes and squids dropped and lost by the parents when feeding their young. It is clear from these investigations that the pelagic fishes of the several hundred square miles of deep water over which the birds feed outside the Tortugas atoll provide the greater part of their food—the shallow water inshore relatively little. The chief food consists of the flying fishes *Parexocoetus mesogaster* and *Cypselurus fuscatus*, Carangids, especially *Caranx ruber* and *C. crysos*, and a variety of species belonging to various groups. Many rare forms occur in the list, some of which are new to the Tortugas. One adult *Amia* occurred and the deep water fishes *Bollmania* and *Lonchopisthus*. The little cephalopod *Spirula* is also eaten. *Coryphæna*, the 'dolphin' of these waters, also preys to a large extent on the flying fishes, but those up to six inches in length are themselves eaten by the terns, forming an important part of their food.

Mitogenetic Radiation.—Dr. Nine Choucroun (*Jour. Mar. Biol. Ass.*, vol. 17, No. 1, pp. 65-74, 1930) gives an account of experiments designed to test the validity of the hypothesis of mitogenetic radiation, formulated to account for the influence, at a distance, of dividing cells on other living tissues. Gurwitsch first observed the mitogenetic influence of embryonic tissues on the root of the onion and on yeast cells. According to him, this action, exerted only through quartz and not through glass, was due to an ultra-violet radiation, of wave-length of 2000 A., produced by the active embryonic tissues and capable of regular reflection. Dr. Choucroun exposed the developing eggs of *Echinus miliaris* to the influence of *Bacterium tumefaciens*, using as controls eggs not so exposed. He found that the observed mitogenetic influence undoubtedly exists, but, as a result of carefully designed precautions, he found that the influence could not reach Echinoderm eggs contained in flasks the stoppers of which were surrounded by a water seal. He concludes that the action of the bacterial culture on the Echinoderm eggs could not be ascribed to a radiation or to any influence acting through the walls of the receptacles containing the eggs. He believes that the observed action is the result of something material, given off by the bacterial culture and reaching the medium in which the eggs are developing, possibly as a monomolecular film which travels round the walls of the receptacles, penetrating any ordinary stopper or seal, but effectively stopped by a water seal such as he used in his experiments. He finds further evidence in support of his belief that the influence is the result of something material, in the fact that sea-water exposed first to the influence of a bacterial culture and afterwards used for Echinoderm eggs causes abnormal development of the eggs. The author, therefore, rejects the hypothesis of a mitogenetic radiation acting through the walls, whether of glass or quartz, of the receptacles in which the eggs were developing.

Northern Rotifers.—A recent part of "Die Tierwelt der Nord- und Ostsee" (Lief. 16, Teil 7.*e*: Rotatoria, von A. Remane. Pp. 156. Leipzig: Akademische Verlagsgesellschaft, m.b.H. 1929) contains a very complete and up-to-date account of the Rotifers of the North Sea and Baltic. This is a specially useful section and enables one to identify the species with ease besides learning much about the group as a whole. These tiny animals, scarcely reaching more than 2 mm. in length and usually much smaller, have always been favourites of the microscopist and one is not surprised at the large number of brackish water and marine forms recorded from these districts. They are predominantly freshwater organisms but may occur largely in water of various salinities, many being found in the sea. It is interesting to note that the order Seisonidea, containing the genus *Seison* living on *Nebalia*, possesses the most primitive characters and is purely marine, showing no trace of a freshwater ancestry. The remaining orders and suborders may occur in fresh, brackish, or sea water and it seems probable that they have mostly migrated seawards from fresh water. Here only one genus (*Zelinkiella*) is purely marine. There is a good general account of the group embracing the anatomy, reproduction, biology, and ecology, occupying about half the memoir, the remainder being devoted to the systematic part. Good keys are given, the illustrations are excellent, and the whole is recommended thoroughly to all workers in the group.

Fishes of Porto Rico and the Virgin Islands.—Mr. J. T. Nichols ("Scientific Survey of Porto Rico and the Virgin Islands." Vol. 10, parts 2 and 3. New

York Academy of Sciences, 1929) has provided a survey of the fishes of Porto Rico and the Virgin Islands, Part 2, the families Branchiostomidæ to Sciaenidæ, Part 3, Pomacentridæ to Ogcocephalidæ. This is a very useful work with a description of each species and in nearly every case a small and simple figure. Shore fishes are much the best known of the Porto Rico fauna, consisting of pelagic off-shore fishes which are for the most part cosmopolitan, and of West Indian species of the coasts, islands, and reefs from the Capes of the Carolinas to Brazil. The tropical pelagic species are usually wide-ranging surface fishes which approach tropical island shores rather freely and evidently had their origin from tropical shore forms. Of these, certain Scombriformes including *Coryphæna*, *Gymnosarda pelamys*, and various flying fishes (Exocœtidæ) are the most important. The fish fauna of these regions is very rich and all species should be easily identifiable from the present work, which not only describes and figures the species but also adds notes on distribution and in many cases on colour, feeding, and habits.

Transplant Experiments of the British Ecological Society.—A detailed account of preliminary results arising out of transplant work carried out at Potterne, Wilts, is given by Marsden-Jones and Turrill in *Journal of Ecology*, vol. 18, No. 2; August 1930. From stock plants of known homozygosity, large numbers of individuals have been obtained by cloning and selfing, and the resulting plants have been grown under carefully standardised conditions, in beds of sand, calcareous sand, clay, and chalky clay. Modifications resulting from growth under different soil conditions have been periodically recorded for *Centaurea nemoralis*, *Silene vulgaris*, *Silene maritima*, *Anthyllis vulneraria* and *Plantago major*. Of these, the first is least plastic and capable of surviving under a wide range of edaphic conditions, whilst *Anthyllis* is also non-plastic but is limited in its edaphic requirements. *Silene maritima* is more plastic than *Silene vulgaris*, which changes slowly under certain edaphic conditions. *Plantago major* is exceedingly plastic and varies between wide limits for the characters examined, namely, number of infructescences, maximum and minimum length of spike and of spike plus peduncle, on the different soils. The changes in this species, moreover, become apparent within the space of five months.

Swedish Cretaceous Mollusca and Brachiopoda.—The mollusca and Brachiopoda from the Cretaceous formation at Eriksdal, Sweden, have been investigated by R. Hägg (Sver. Geol. Undersök., *Årsbok* 23, No. 8); 130 species, including forms to which names have not as yet been given, are described and many figured. Of these, 16 gastropods, 18 pelecypods, and 1 cephalopod are new to Sweden. The geological and palæontological aspects of the containing beds are discussed, and it would appear that the Eriksdal fossils are referable to the Danian and Senonian horizons.

Neogene Shells from Japan.—Prof. Matajiro Yokoyama, to whose researches into the Tertiary molluscan fauna of Japan we have previously had occasion to refer (Cf. *inter alia*, NATURE, Aug. 24, 1929, p. 319), has now published further papers in this connexion (*Jour. Fac. Sci.*, Imp. Univ. Tokyo, sect. 2, vol. 2). From around Okuyamada, Tsuzuki county, Yamashiro province—not far from Kioto—he chronicles 37 species of Neogene mollusca, including a new species of *Umbonium*. Occasion is then taken to correct an error of determination and transfer his *Cochlioconus* from the Conidæ to the Fusidæ, as they used to be called, and place the shell in the genus *Thatcheria*. A further collection of Neogene mollusca from the southern half of the island of Karafto, or Sakhalin (Cf. NATURE, Mar. 8, 1930, p. 392), has yielded 45 species, including 5 new and some as yet indeterminate; descriptions and figures of the more important of these are given.

Length of the English Mile.—In a paper in the *Geographical Journal* for October, Sir Charles Close records some conclusions he has reached regarding the length of the old English mile as ascertained by measurements on old maps. The Bodleian map of about 1300 A.D. is the earliest detailed map of Great Britain. By comparing distances on that map, where distances between towns are marked in miles, and modern measurements, it would appear that the mile then in use was about ten furlongs. This, as Sir Flinders Petrie pointed out from a study of the same map some years ago, was about equal to the old French mile. In Lily's map of 1546 the mile was 7·4 furlongs, which was apparently the Italian mile. Mercator's map of 1564 had a mile of 9·47 furlongs. In Saxton's county maps of 1574–79 the length varied from 10·4 to 10·75 furlongs. In Speed's county maps of 1608–12 it was 10·3-10·4 furlongs on the average. In short, Sir Charles Close found out that from 1574 to 1695 the customary mile was about 10 furlongs, in spite of the statute of 1593 defining it as eight furlongs or 1760 yards.

Distribution of Earthquakes in Northern Europe.—Mr. K. E. Sahlström has recently published a valuable earthquake-map of Sweden, Norway, Finland, and Denmark (Sveriges Geologiska Undersökning, *Årsbok*, 1930). He uses a method previously applied by H. Renqvist to the earthquakes of Finland. On the map of the country, a network of points 30 km. apart is plotted. The disturbed areas of all known earthquakes from 1600 to 1925 are drawn on special maps and it is noted how many times each of these points falls within a disturbed area. Curves are then drawn through points of equal earthquake-frequency. The method thus depends on the mapping of disturbed areas rather than on the plotting of epicentres. The map shows that in northern Europe there are four principal areas of marked frequency—the fringe bordering the Gulf of Bothnia, the country round Oslo in southern Norway eastwards to Lake Vänern, the extreme west of Norway, and the west coast of Norway between the parallels of 64° and 68°. The regions free, or almost free, from earthquakes are southern Finland, Finnish Lapland, the interior of Sweden, and nearly all Denmark.

Pliocene Deposits in California.—The youngest Tertiary rocks on the south slope of the Santa Susana mountains, north of Simi Valley, California, are several hundred feet thick and consist of sandstones and conglomerates that lie unconformably on beds ranging in age from Upper Miocene to Eocene. They were examined during the course of work carried on by the 1929 summer field camp of the California Institute of Technology and the fossils collected determined and enumerated by W. P. Woodring (*Proc. Calif. Acad. Sci.*, Fourth Series, vol. 19). These fossils represent a warm-water Pliocene fauna which has been found at localities from Lower California northward to the Ventura basin and is best known as the fauna of the San Diego formation.

***Aa* and *Pahoehoe* Lavas.**—In *The Volcano Letter* for Aug. 14, 1930, a review of the *aa-pahoehoe* problem is given by G. L. Chang, with special reference to the basaltic flows of Kilauea and Mauna Loa. The rough blocky *aa* lava is due to partial crystallisation while the flow is moving rapidly. When the crust has crystallised so that it ceases to flow easily, the under-

lying current may be sufficient to break it up into a tumbled mass of blocks. The smooth, ropy *pahoehoe* lava has a chilled skin of glass. The lava below flows more slowly and the forces are insufficient to break up the smooth crust. The 1823 flow of Kilauea changed from *pahoehoe* to *aa* just as the lava reached the edge of a gentle slope and started down a much steeper incline. This sequence is usual. No flow which begins as *aa* has ever been found changing to *pahoehoe*. It commonly happens, however, that the earlier discharges of an eruption are dominantly of the *aa* type, whereas it is in the declining phases that most of the *pahoehoe* is formed. Chemically there is no significant difference between the two types, except that more iron is in the ferric state in the *aa* form. Gas is more readily released from the latter and the vesicles in consequence are very irregular in size and shape. In *pahoehoe* lava the gases are confined by the skin and the total volume of the vesicles thus tends to be greater than in *aa* lava. In the depths of both types the degree of crystallinity is alike.

Geology of Auckland, New Zealand.—A valuable study of the region south-east of Auckland City has been made by C. W. Firth (*Auckland University College Bull.* 10, Geol. Series No. 3, 1930). The Hokonui (Trias-Jura) strata were deposited in a geosyncline which then covered much of New Zealand. In early Cretaceous times the thick sediments were thrown into sharp folds and before the late Cretaceous submergence they were deeply eroded. Further erosion followed a later orogenesis, and Miocene beds are in consequence found lying on the Hokonui greywackes. Small andesitic volcanoes broke through the floor of the Miocene sea. This period of deposition was closed by the Kaikoura orogeny of the early Pliocene, and great fractures in two sets, north-west south-east, and north-east–south-west, broke up the district into blocks which were uplifted and tilted to the north-west. Great erosion and successive movements of uplift have since taken place, followed by a comparatively recent subsidence which caused the flooding of the deep, youthful valleys cut during the preceding uplift. Commencing just before this latest submergence, and continuing almost up to the present, basaltic lavas broke out and tuff and scoria cones were built up. A slight uplift of a few feet (relative to sea-level) has since occurred, but its effects on the embayed coastline of the vicinity of Auckland are almost inappreciable.

Solar Radiation at Sea.—The April–May issue of the *Bulletin* of the Polish Academy of Letters and Sciences (Mathematical Series) contains a summary of the results obtained by Dr. W. Gorczynski for the solar radiation at sea-level over the oceans he has traversed during the years 1923–28. Most of his observations were made with thermopiles and millivoltmeters, which were compared with other standard instruments from time to time. Of the 0·032 calorie per second which should be received on a square centimetre of the earth's surface if the sun were vertically over it and there were no atmospheric absorption, the atmosphere if dry absorbs and scatters 9·6 per cent, and if moist, with a humidity which is found to vary little from 80 per cent, 17·5 per cent in the North Atlantic in the latitude of the Azores and 23·7 per cent in the Indian Ocean. Absorption and scattering by dust account for a further reduction of less than 1 per cent in the North Atlantic in the latitude of the Canaries, the Gulf of Mexico, and in the Eastern Indian Ocean, and of more than 3 per cent in the Mediterranean and Red Seas. As a result, the Red Sea and the Indian Ocean get about 65 per cent, and the Gulf of Mexico, the Atlantic, and Mediterranean about 69 per cent of the possible solar radiation. On land at sea-level—for example, Bangkok—about 60 per cent is received.

The Ratio e/m for an Electron.—A determination of e/m for free electrons is described by C. T. Perry and E. L. Chaffee (in the first September number of the *Physical Review*) which, unlike other accurate measurements on free electrons, gives a value ($1·761 \pm 0·001 \times 10^7$ abs. e.m. units) in agreement with the value obtained spectroscopically. The method used was a development of the classical one of Wiechert, in which the time of passage of an electron between two points is compared with the period of a high-frequency oscillator, the electrons being driven by potentials of 10,000–20,000 volts and timed over a distance of 75 cm. in these experiments. If this result is accurate—and the measurements appear to have been made with great care—the question arises as to why earlier investigations of free electrons have led to a substantially higher value for e/m. The suggestion made by the authors, that this has been due to the effect of residual gas in the apparatus, can presumably be readily checked, and if it proves correct, will provide a welcome solution of an outstanding discrepancy.

Field-free Enclosures.—In an important class of experiments on the properties of gases at low pressures, they are subjected to bombardment by a beam of electrons introduced with known energy into an almost closed metal vessel, and the assumption is made that the whole of the interior of the vessel is at the potential of its walls. A direct test of the validity of this assumption, described by Dr. F. L. Arnot in the October number of the *Proceedings of the Royal Society*, shows that it is not accurately true. Two methods were employed. In the first, the velocities of the positive ions, which diffused out at right angles from the path of the main electron beam, were measured by a retarding field, and it was found that with the particular apparatus used, potential differences of rather more than two volts could occur in the enclosure. In the second method, the condition of the gas was analysed by a small auxiliary electrode and the results deduced from the speeds of the positive ions confirmed, and the electrons outside the main beam shown to have a random distribution of velocities equivalent to more than 20,000° abs. The potential gradient is set up by the unequal rates of diffusion of positive ions and electrons from the main beam (much as in an electrolytic concentration cell), and the method indicated for reducing it to a minimum is to work with as small a current of electrons in the main beam as is compatible with the other requirements of the experiment.

Available Phosphoric Acid in Soils.—An improved method for the determination of available phosphoric acid in soils by means of an extraction with one per cent potassium carbonate instead of the generally employed citric acid solution, has been shown by S. Das to be particularly useful in the case of calcareous soils. This new method has now been tested out on a large number of Indian soils, including acid, laterite, humus, alkali, calcareous, and non-calcareous types, all of known cropping and manurial history, and the results compared with similar estimations based on the citric acid extraction (*Soil Science*, 30, p. 33). The potassium carbonate method is shown to be equally applicable to all varieties of soil, whereas the citric acid method proved untrustworthy on alkali or calcareous types. Further, since potassium carbonate is able to extract phosphorus in organic combination in humus, which citric acid fails to do, the new method gives a truer measure of the probable fertility of the soil with respect to available phosphoric acid, and is recommended as a substitute for the citric acid methods now generally in use.

Aspects of Carbohydrate Metabolism.

II.

INVESTIGATION of the utilisation by the body of various compounds related to the sugars may be expected to throw light upon the intermediary metabolism of the carbohydrates and is, at any rate, of scientific interest. In this connexion, dihydroxyacetone, methylglyoxal, and glyceric aldehyde may be cited. Although the former antidotes insulin hypoglycæmia in both man and animals, yet, administered by mouth to human beings on a fasting stomach, it itself produces a definite hypoglycæmia (E. P. Cathcart and J. Markowitz: *Biochem. Jour.*, vol. 21, p. 1419; 1927). The fall may be compared with the secondary decrease in the blood-sugar after the ingestion of glucose, and may be due to stimulation of secretion of insulin from the pancreas. At the same time, the increased tension of carbohydrate in the liver may arrest the processes of glyconeogenesis and glycogenolysis.

In the rabbit, on the other hand, dihydroxyacetone raises the blood sugar (M. W. Goldblatt: *ibid.*, vol. 22, p. 464; 1928). In comparison with glucose this author found that dihydroxyacetone raised the respiratory quotient and increased the oxygen consumption to a greater extent but was not so effective in inhibiting the ketosis produced experimentally in man by starvation. Starvation reduces the sugar tolerance and the respiratory quotient is not raised so much as normally following the ingestion of carbohydrate. The antiketogenic influence of glucose is exerted simultaneously with the maximum increase in oxygen intake, that of dihydroxyacetone later. It appears that the latter forms glycogen less readily than glucose and cannot be considered as an intermediate stage in the breakdown of the glucose molecule. In muscle, on the other hand, W. O. Kermack, C. G. Lambie, and R. H. Slater failed to demonstrate any significant difference in the power of glucose or dihydroxyacetone to cause deposition of glycogen (*ibid.*, vol. 23, p. 416; 1929). The experiments were carried out on decerebrate, depancreated cats, in which the liver remained in circulation.

Glyceric aldehyde is another compound which may play a part in the intermediary metabolism of carbohydrate. H. G. Reeves, however, found that it was toxic to the isolated heart of the rabbit, although it could augment and accelerate the beat of the frog's or toad's heart (*Quart. Jour. Exp. Physiol.*, vol. 18, p. 277; 1927). It is possible that the difference between the mammalian and amphibian hearts is due to the difference in the temperatures at which the perfusions are necessarily carried out. It appears, therefore, that, at any rate in mammals, glyceric aldehyde is not an intermediate in the utilisation of glucose by cardiac muscle.

Goldblatt has found that carbohydrate metabolism is seriously interfered with in man by the administration of alkali, with the consequent production of a state of alkalosis (*Biochem. Jour.*, vol. 21, p. 991; 1927). Glucose by mouth now increases the blood-sugar to a greater extent than normally and some is excreted in the urine; at the same time the rise in the respiratory quotient is less marked. These results indicate that both the storage and oxidation of carbohydrate are depressed. Similarly, alkali decreases the response of the rabbit to an injection of insulin, as well as the deposition of glycogen in the liver and muscles of the rat.

A considerable amount of work has been carried out on the carbohydrate metabolism of isolated tissues. G. S. Eadie has examined the conditions of action of rat's liver amylase (*Biochem. Jour.*, vol. 21, p. 314; 1927). The enzyme was obtained by drying the organ with acetone and extracting the powder with 50 per cent. glycerol, afterwards filtering and dialysing the extract. It was found that the liver enzyme was contaminated with blood amylase unless the organ was first perfused with Ringer's solution. The optimum pH of liver amylase is at 6, whilst that of blood amylase is at 6·8–6·9. The optimum salt concentration is 0·1 per cent; addition of adrenaline has no effect upon its activity. The enzyme and its substrate glycogen coexist in the same cell. E. F. Lesser (*ibid.*, p. 1128) considers that the amylase is to a large extent adsorbed upon surfaces within the cell and so unable to act upon the glycogen.

J. T. Irving has investigated the glucose metabolism of kidney tissue *in vitro* (*Biochem. Jour.*, vol. 22, p. 964; 1928). In the presence of oxygen, but not in its absence, chopped cortex incubated in phosphate or carbonate buffer converts glucose to lactic acid together with a small amount of hexose diphosphate; at the same time glycogen is utilised. The mechanism is therefore different from that found in muscle.

E. G. Holmes has continued his researches upon the metabolism of nervous tissue (*Biochem. Jour.*, vol. 23, p. 1182; 1929; with C. A. Ashford, *ibid.*, p. 748; with R. W. Gerard, *ibid.*, p. 738; and with M. Sherif, *ibid.*, vol. 24, p. 400; 1930). In the case of brain it was found that free phosphate was liberated on both anaerobic and aerobic incubation, in the presence or in the absence of glucose; no evidence of the synthesis of hexose phosphate in the process of formation of lactic acid was obtained, although the tissue can perform this operation to a small extent. Sodium fluoride inhibits this liberation of phosphate, when present in high concentration; even low concentrations markedly inhibit the formation of lactic acid, so that the two processes appear to be independent; in fact, it was found that lactic acid is freely formed from glucose in the absence of phosphate and its addition does not increase the velocity of formation of the acid. Brain tissue forms less lactic acid from glycogen than from glucose; sodium fluoride inhibits both phosphate and acid production, and removal of phosphate stops the formation of acid. It appears, therefore, that there are two lactic acid mechanisms in brain: one, quantitatively the more important, involves glucose and is independent of phosphate; the other involves glycogen and depends on the availability of phosphate. The source of the phosphate in the former case is obscure.

On anaerobic incubation, mammalian nerve produces lactic acid, two-thirds of which come from the free carbohydrate of the tissue and one-third from glycogen; in oxygen, no lactic acid is formed, but there is a definite fall in the free carbohydrate. Preformed lactic acid is not removed in oxygen (as is the case with brain and muscle). The oxygen consumption of nerve is much less than that of brain; about 60 per cent of the resting metabolism can be accounted for by the observed oxidation of carbohydrate. These carbohydrate changes apparently play no part in the extra metabolism of stimulation, since the nerve will still give a response after disappearance of all the carbohydrate. As the carbohydrate is consumed the oxygen consumption of resting nerve decreases; in the presence of small amounts of glucose or galactose, however, the consumption remains linear for several hours; brain, on the other hand, does not apparently use galactose.

The chemical composition and metabolism of non-

medullated nerve are different from those of medullated; for these experiments Holmes used the nerves of crabs. The free carbohydrate, and especially the glycogen content, is very much higher; the latter may form 20 per cent of the total solids. Under anaerobic conditions at rest, the glycogen decreases, with a coincident increase in the free carbohydrate and lactic acid; in oxygen the fall in glycogen and the rise in free sugar are considerably less, and there is no increase in lactic acid, although preformed lactic acid is not removed. In the nerve-ganglia the presence of a polysaccharide was detected.

J. Pryde and R. W. Humphreys (*Biochem. Jour.*, vol. 20, p. 825; 1926) have shown that the oxidic bridge of the galactose in the cerebrosides of ox brain is of the stable amylene type.

The carbohydrate metabolism of cancer cells differs from that of most normal tissues in that aerobic glycolysis is a prominent feature, whilst the oxidative removal of lactic acid is a relatively slow process. B. E. Holmes (*Biochem. Jour.*, vol. 20, p. 812; 1926) has shown that certain tumour tissues contain very little reduced glutathione and have only a slight activity in reducing the oxidised form when added. H. G. Crabtree (*ibid.*, vol. 22, p. 1289; 1928) has found that certain pathological overgrowths, aroused by different viruses, behave like malignant tissue in their carbohydrate metabolism; this change from the normal was not seen when the virus failed to produce hyperplasia.

F. Dickens and F. Šimer (*Lancet*, vol. 2, p. 10; 1930) have recently shown that the respiratory quotient of normal tissues runs parallel with their power of anaerobic glycolysis; tumours have a low respiratory quotient, indicating a poor ability to oxidise carbohydrate, although actively glycolytic. The inability to oxidise lactic acid is peculiar, since tumours, like normal tissues, oxidise pyruvic acid.

S. T. Harrison and E. Mellanby (*Biochem. Jour.*, vol. 24, p. 141; 1930) have investigated the inhibitory action of pancreatic and other extracts upon the formation of lactic acid in cancer and muscle. It has been known for some time that pancreatic extracts inhibit acid production by muscle hash. D. R. McCullagh (*ibid.*, vol. 22, p. 402; 1928) confirmed this for muscle extract; he also showed that the former prevented the disappearance of carbohydrate, but caused an increase in the free phosphate content instead of a decrease. In the presence of sodium fluoride, pancreatic extract prevented the formation of hexose phosphate, and the author considers that this is the cause of the failure to produce lactic acid. In a later paper, working with E. M. Case, it was found that the inhibition was probably due to the amylase present in the pancreatic extract (*ibid.*, p. 1060).

The properties of the unknown factor and the enzyme are very similar: inhibition is observed when malt or taka diastase replaces the pancreatic extract, or when glycogen is used as substrate instead of starch; and the formation of lactic acid from activated glucose by muscle extract is not inhibited. Harrison and Mellanby confirmed the inhibition when starch is used as the source of the lactic acid, and the failure of inhibition with glucose; they also found, however, that inhibition occurs with hexose diphosphate but not with hexose monophosphate. They therefore consider that the pancreatic extract does not act by inhibiting the esterification of hexose but by forming maltose, which is only slightly acted upon by the muscle system with the production of lactic acid. They agree that the inhibition is due to amylase; the inhibition of lactic acid formation from hexose diphosphate, however, cannot yet be explained. The same authors have also shown that various preparations of amylase inhibit the glycolysis, anaerobic and aerobic, of tumour tissue; the latter cannot form lactic acid from hexose di- or mono-phosphate or from starch to any appreciable extent, so that in this case also the inhibition cannot be due to inhibition of ester formation.

Pancreatic extracts have also been reported to contain an antiglyoxalase. Phenylglyoxal is converted to mandelic acid by liver extract; pancreatic extract inhibits the reaction. J. O. Giršavičius (*Biochem. Jour.*, vol. 24, p. 446; 1930) has found that pancreatic extract itself produces acid from phenylglyoxal; a reaction appears to occur between the phenylglyoxal and diamino-acids and polypeptides in the extract with production of an orange substance. It does not appear that this reaction can be responsible for the antiglyoxalase activity of pancreatic extracts, since the substances involved are thermostable and dialysable.

Mosses as Epiphytes.*

WISNIEWSKI has surveyed parts of the virgin forest of Bialowieza, with special reference to the epiphytic Bryophyta. His results and the discussion of their significance bring out several points of interest bearing on the nature of epiphytism in this group. He recognises four associations of mosses on the trees, the first two of which appear to be true epiphytes, whilst the other two are more closely related to the vegetation of the ground flora.

The two epiphytic associations are:

(1) On broad-leaved trees (except *Betula* spp.): *Leucodon sciuroides* (chiefly on *Carpinus betulus*) and *Anomodon viticulosus* (chiefly on *Acer platanoides* and *Fraxinus excelsior*).

(2) On coniferous trees and *Betula* spp.: *Drepanium* (*Hypnum*) *cupressiforme*, var. *filiforme* and *Orthodicranum montanum*.

The other two associations under consideration are: (3) In damper situations on any type of tree: *Eurhynchium striatum*.

(4) In drier situations on any type of tree: *Pleurozium Schreberi*.

Considering possible factors influencing the ability of mosses to grow in different situations, it is clear that neither light nor temperature is a limiting factor. The light intensity lies well within the limits at which at least some of the species under consideration have been found to flourish, according to the work of Zmuda and Malta, and the same applies to the temperature range. The question of water supply is, however, a vital one for mosses as their method of water absorption is entirely different from that of root-bearing plants. It is clear from the work of Schimper and others that the rhizoids of a moss are ineffective in the uptake of water, for even if the lower parts of a moss plant are actually in water, the upper parts may be seen to wilt. The chief method of water absorption seems to be imbibition by the walls over the whole surface of the plant, whether dead or living, as is illustrated by the rapid recovery of form on moistening dry specimens. Wisniewski found an interesting difference in this respect between the epiphytic mosses and those of the ground flora, for whilst the dry plants of the former group

* Wisniewski, T. "Les associations des Muscinées (Bryophyta) épiphytes de la Pologne, en particulier celles de la forêt vierge de Bialowieza." (*Bull. Internat. de l'Acad. Polonaise des Sci. et des Lettres*, pp. 293-342; 1929.)

recovered either instantaneously or at most after a few seconds on moistening, those of the latter took 40-50 sec., or often longer.

Müller points out that mosses cease to condense atmospheric moisture when the tension of water vapour is lower in the air than in the cells, so that this method is of significance to the moss only at times when the atmosphere approaches saturation. In the forest, the saturation deficit of the atmosphere increases with the distance from the ground level, and the rate of this increase depends chiefly upon the permeability of the soil and the type of forest (that is, broad-leaved or coniferous). Partly as a result of this, the moss life of the *Leucodon* and *Anomodon* type in the broad-leaved forest extends up the trees to a height of 20 m., whilst the *Drepanium* and *Orthodicranum* type in the coniferous forest only extends 3-4 m. The heights to which the mosses can extend is evidently controlled to some extent also by properties of the mosses themselves, since only certain species—the epiphytic species—can extend up the tree more than about 30-50 cm.; below this level one finds some of the species characteristic of the ground flora, for example, *Eurhynchium striatum*, *Pleurozium Schreberi*, along with certain Phanerogams, such as *Oxalis acetosella* and *Geranium Robertianum*.

The general occurrence of certain epiphytes on broad-leaved and others on coniferous trees might be explained to some extent by the humidity of the type of forest formed by such trees, a factor which is seen to influence the flora of the undergrowth and tree bases. There is, however, something more than this obvious relationship between the true epiphytic mosses and their hosts, for one finds that trees of a particular kind, for example, *Pinus sylvestris*, have their characteristic epiphytic mosses whether growing in a typical pine association or occurring as an isolated example in an association consisting typically of broad-leaved trees, and vice versa. Further, one finds that within an association, a particular moss may show a preference for a particular kind of tree, for example, *Leucodon* for *Carpinus betulus* and *Anomodon* for *Acer platanoides* and *Fraxinus excelsior*—a curious fact which future investigation may show to be associated with the type of bark (fissured or scale) and the consequent difference in the rate at which water flows away.

An unexpected feature that is without any explanation is that, as regards epiphytic moss vegetation, *Betula* spp. are classed with the conifers—a fact which is further supported by the distribution of epiphytic lichens by Räsänen in Finland.

The connexion between an epiphytic moss and its host cannot be regarded as strict, by any means. Wisniewski points out that, although the types he regards as epiphytic are rarely found in other habitats, there are very few of them which have not been recorded as growing on rock or stone as well. The marked preference for the epiphytic habit is further emphasised by the fact that very few of them are recorded from altitudes or latitudes beyond the tree zone. A study of the literature on moss distribution brings out the fact that the majority of the epiphytic forms—48 per cent—of the Bialowieza forest are holoarctic in distribution, extending across Europe to North Asia and China on one side, and to North America on the other. It is curious to find that of the twelve species of trees serving as the commonest hosts for epiphytic mosses in the Bialowieza forest, none occurs in North America, so that evidently the same species of mosses in the latter continent must have transferred to other hosts.

World Geometry in its Time Relations.

PROF. R. C. TOLMAN, of the Norman Bridge Laboratory of Physics, Pasadena, has published, in recent issues of the *Proceedings* of the U.S. National Academy of Sciences, a series of papers on world geometry in its time relations. The subject is the same as that of recent papers by Lemaître, de Sitter, and Eddington, namely, the existence of non-static solutions of Einstein's gravitational equations. Prof. Tolman's papers are admirably concrete and free from paradox, and will appeal to those who are attracted by a certain definiteness of point of view.

After discussing the recognised weaknesses of the Einstein line-element (full, static universe) and the de Sitter line-element (empty universe), Prof. Tolman proceeds to determine a line-element on the basis of five assumptions: (1) spatial spherical symmetry; (2) symmetry with respect to past and future time; (3) a criterion of stability; (4) and (5) conditions of isotropy with respect to the volume defined by a system of nebulæ and with respect to the average density of matter. These conditions are shown to determine the form of the line element uniquely save for a certain function of time only, which occurs as a multiplier in the space part of the line element. As a first approximation, Prof. Tolman takes this to be a linear function of the time, and reduces its determination to the ascertaining of the numerical value of a single parameter, which must be a physical constant. This constant can be interpreted in terms of the time-interval between the sending out of two light-impulses by a nebula and the time-interval between their receptions. If these are not equal, the nebula will appear to be in motion in the line of sight, and the lines in its spectrum will be displaced with red or violet. The discrepancy between the two intervals will increase with the distance of the nebula, and Prof. Tolman deduces a proportionality between distance and line-displacement. This is in agreement with the empirically found relation between red-shift and distance for nebulæ, and, using the observed numerical values, the author infers the values of the constant in his formula for the line-element.

Prof. Tolman then shows that owing to the presence of this time-factor in the line-element, the mass enclosed within a given volume must be changing, and he identifies this change with the transformation of matter into radiation—that is, he identifies the reduction in measured mass with the mass disappearing from the volume in the form of radiation. The value of the time-constant deduced from the observed recession of nebulæ should thus be connected with the rate of evolution of energy per gram by the stars. From the nebular recession, Tolman finds $k = 5{\cdot}1 \times 10^{-10}$ (years)$^{-1}$, whilst the values of k deduced from the observed masses and luminosities of the stars as tabulated by him vary from $1{\cdot}7 \times 10^{-10}$ down to $2{\cdot}3 \times 10^{-16}$.

In a later paper of the series Prof. Tolman shows that the addition of higher terms to his linear approximation for his undetermined function of time may seriously modify the values of k deduced from the observed rate of annihilation of matter, and concludes that the discrepancy is not fatal. One is naturally tempted to make the criticism that the rate of annihilation of matter must be governed by the physics of the energy-generating process in stars, and so is surely a different physical phenomenon from the recession of the nebulæ, implied by such considerations as those of stability and symmetry in the universe. This, however, is not incompatible with the view that the transformation of matter is the

primary process, and that this by conditioning the mass-change of the universe is the 'cause' of the world-geometry which predicts the nebular recession.

The same confusion between perhaps diverse physical phenomena is seen in another paper of the series, where Prof. Tolman gives an actual formula for the luminosity of a nebula in terms of its distance and red-shift. This appears to assume some common property in the nebulæ, but it is obvious that nebulæ (like stars) could have intrinsically different luminosities for the same distance. The whole discussion is, however, most stimulating, and will certainly help to provoke more accurate and extensive observations of the most distant nebulæ.

Thinning Operations in Forestry.

FOR a century or two it has probably been the desire and aim of the scientific forester to endeavour to bring the work of thinning a wood, at various ages in its development, within the circumscribed limits of a definition. There are many experienced foresters, and probably some of the most expert in this part of the forester's work, who maintain that any definition of the work involved or the laying down of any hard-and-fast rules is impracticable—if for no other reason than that in any wood the soil and other factors vary from place to place, with a consequent variability in growth. It follows from this state of affairs that the thinning operations must, if properly carried out, be based upon the condition of the individual trees and their crowns at any spot; and this condition will be a variable quantity. Greater regularity may be found in well-managed coniferous woods, and even in young well-grown broad-leaved crops; but so far as the forests of the British Empire are concerned, such conditions are only exceptionally present.

Some of these points are recognised in the brochure entitled "Classifications of Thinnings" (*Indian For. Records*, vol. 15, pt. 1, 1930. Govt. of India, Calcutta Press). One of the reasons for the persistent effort to evolve some method of classifying thinnings has been the desire to have some rules or rule-of-thumb methods of dealing with certain types of crops which would be simple enough in practice to enable their carrying out by the subordinate staff. In view of the enormous and increasing amount of this type of work which faces the numerically small staffs of the Empire Forestry Departments, it will prove almost a necessity to place a portion of the thinning work in the hands of the non-gazetted grades. But it has long been accepted that the best amongst thinning experts are born with the gift; that such are to be found in the lower ranks as well as in the upper. In either case the young forester requires to be trained by the senior who is an expert in practice, and not by any rule of thumb such as the brochure here under review attempts to prescribe.

This is not to say that the attempted classification is not of use to those who have a first-hand practical acquaintance with thinning work, either in one type of crop (mixed or pure), or in varying crops managed under different sylvicultural systems. But a very considerable amount of experience would be required before this attempt at classifying thinnings could be translated into practice: even then a wide and varying meaning can be given by different performers to the definitions given under the subdivisions on "Intensity of Thinnings". These subdivisions speak for themselves (for the definitions the pamphlet must be consulted). I. Ordinary Thinning: (1) Light thinning (A grade): (2) moderate thinning (B grade); heavy thinning (C grade); very heavy thinning (D grade). II. Crown Thinnings: (1) Light crown thinning (L.C. grade); heavy crown thinning (H.C. grade). To make use of this brochure with intelligence, and without danger to the crops being treated, the forester requires to possess a clear knowledge of the relative significance of the words and phrases used in the definitions, combined with a very considerable previous practice in the carrying out of one of the most important and interesting of his duties.

Curious Markings on Stones in Scotland.

THE *Glasgow Herald* of Sept. 17 contains an article by Mr. L. MacLellan Mann describing the markings on some stones at Langside and Cleuch, near Glasgow. The markings on the two stones are nearly alike, consisting of series of rings, arcs, and cup-like depressions. Mr. Mann claims that these have astronomical significance; some of the groups of cups are shown to resemble the Sickle in Leo and (more doubtfully) a star-group in Scorpio. He further claims that he can identify records of ancient eclipses; it would, however, need a fuller explanation of his method to induce astronomers to accept his claims in full. He states that he identified the date of a recorded eclipse as B.C. 2983 Mar. 28* Gregorian reckoning from the stone itself, and afterwards found by consulting astronomers in Berlin that there was a total eclipse on that date, the track of totality passing over or near Glasgow. The writer of the present note has verified this latter fact independently, making use of the new-moon tables by the late C. Schoch that are contained in "The Venus Tablets of Ammizaduga" (Langdon and Fotheringham, 1928). These tables make use of the latest values of the solar and lunar accelerations; but there is of necessity a considerable margin of uncertainty in computing the tracks of very early eclipses.

This eclipse affords a good illustration of the use of M. Oppert's long eclipse cycle of 1805 years; the name 'megalosaros' has been suggested for it; it is about a hundred times as long as the 'saros', and shares with it the useful property that the parallaxes of sun and moon nearly repeat themselves. The following table gives the tracks of the three successors of this eclipse; they are from Oppolzer's "Canon" and Schrader's sequel to it:

Date.	Sunrise Point.		Noon Point.		Sunset Point.	
2982 April 21 6			47 W.			
1177 April 16·43	41 W	1 N.	20 E.	40 N.	99 E.	58 N.
628 April 10·03	99 E.	9 N.	161 E.	51 N.	104 W.	63 N.
2433 April 20 46	50 W.	6 N.	13 E.	48 N	106 E.	56 N.

The first three dates are by the Julian calendar, the fourth by the Gregorian one.

It will be seen that the cycle enables us to make a close approximation to the latitude of the eclipse track; the longitude offers greater difficulty owing to the large effect of the secular acceleration in such a long period. Oppolzer's older eclipses themselves require a considerable shift in longitude to reduce to Schoch's values of the accelerations.

Mr. Mann claims to have found similar records of still older eclipses; thus he refers to one in New Mexico of the date B.C. 3457 Sept. 5. It would, however, be well for him to make the full case for the 2983 eclipse accessible to astronomers before asking them to consider these more remote ones.

* Mr. Mann gives Mar. 27, but 28 appears to be correct.

University and Educational Intelligence.

CAMBRIDGE.—The title of Girdlers lecturer in economics has been conferred on Mr. G. F. Shove, of King's College. Mr. H. H. Nicholson, of Selwyn College, has been appointed University lecturer in agricultural chemistry.

The following elections have been announced:—To an Isaac Newton studentship, founded for the encouragement of study and research in astronomy and physical optics, value £250 a year for three years: R. van der Riet Woolley, of Gonville and Caius College, formerly of the University of Cape Town, who was a wrangler with mark of distinction in the Mathematical Tripos of 1928; to additional Isaac Newton studentships, tenable in each case for one year: V. V. Narliker, Non-Coll., and L. C. Young, Trinity.

At the annual general meeting of the Cambridge Philosophical Society held on Oct. 27, Prof. F. J. M. Stratton was elected president, and the following new members of the council were elected: Mr. J. W. Landon, Dr. E. D. Adrian, Mr. F. Debenham, and Mr. W. R. Dean.

NOTICE is given by the Chemical Society that applications for grants from the research fund of the Society must reach the assistant secretary, on prescribed forms, by at latest Dec. 1. Applicants are reminded that the income arising from the donation of the Goldsmiths' Company is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry, and that the income from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal tar and allied industries.

THE Association of University Teachers has as one of its objects the promotion of exchanges of opinion not only between the universities of Britain but also between them and the universities of other nations. To further this aim, a short visit to French universities was recently organised with the cordial and very efficient help of M. Desclos, of the Office National des Universités et Écoles françaises. Fifteen members of the Association took part in the visit, which embraced the three universities of Paris, Lille, and Dijon. A report of facts elicited in the course of their investigations, with an account of some of their impressions and inferences, is published under the title "The French University System" in the October number of *The Universities Review*, issued by the Association, price 2*s*. This gives, in thirty pages, an informative and interesting conspectus of the university in relation to the State; the relation of the university to the general system of education; the university in relation to the cultural and economic life of France and other countries; the constitution and establishment of the university; university finance; staffing; student life and work; and courses and examinations. The report brings out some instructive comparisons and contrasts. At the head of each of the seventeen regional units, known as 'académies', in which the administration of public instruction in France is organised, stands the 'Recteur de l'Université'. Of this functionary the report observes that his duties comprise those of vice-chancellor, principal, president, and treasurer of the university, and in addition those of local director of education, member of the university grants committee, and official of the board of education. "Formidable and even autocratic as the authority of the Recteur may appear to be, we found that university dependence on the State entailed far less sacrifice of educational freedom than we were inclined to expect."

Historic Natural Events.

Nov. 9, 1883. Brilliant Sunset in England.—About ten minutes before sunset, the sky being very clear and a deep blue except for a few fleeces of cirro-cumulus nearly overhead, the sun turned unusually white and descended in a slight haze, with curious greenish white and yellowish white opalescence in the upper part. About 15 minutes after sunset the sky turned a brilliant but delicate pink, beneath which a shining green and white opalescence hung like a luminous mist. The effect grew with increasing darkness, and lit up the landscape, although the moon was shining brightly. The horizon, remained deep red until nearly 6 P.M. These remarkable sunsets, and similar effects at sunrise, were visible throughout the winter, and were due to the dust thrown into the air by the explosive volcanic eruption of Krakatoa, on Aug. 26–28, 1883.

Nov. 11, 1099. Storm in the North Sea.—A violent storm at high tide flooded the coasts of Holland and England as far as Kent, including the Thames Estuary. It is said that 100,000 persons lost their lives.

Nov. 11, 1572. Nova Cassiopeiæ.—On this date, Tycho Brahe at his observatory at Uraniborg saw that a new star, surpassing the other stars in brilliancy, had appeared in the constellation Cassiopeia. At first the nova was as bright as Venus at its maximum brightness and could be seen by keen-sighted people near midday. It then slowly declined, but in February and March 1573 it was still as bright as the first magnitude stars; by February 1574 it had reached the sixth magnitude, and by the end of March it ceased to be visible to naked-eye vision. There were accompanying changes in the colour of the nova—from white to yellow, then to a reddish hue, and lastly it became "like lead, somewhat like Saturn". Measurements of its position convinced Tycho Brahe that "this star is not some kind of comet or a fiery meteor . . . but that it is a star shining in the firmament itself—one that has never previously been seen before our time, in any age since the beginning of the world". Pliny records that Hipparchus is said to have observed a new star; since that of 1572, there have been thirteen bright novæ discovered, the most notable being those of 1604, 1901, and 1918.

Nov. 12, 1236. Inundations in East of England.—The sea burst out with such high tides and tempests of wind that the marsh countries were drowned and overflowed, and great herds and flocks perished, besides many persons. The sea rose continuously for two days and one night without ebbing, owing to the great violence of the wind. At Wisbech and neighbouring villages many people were drowned, one hundred in one village.

Nov. 14–15, 1574. Aurora.—Stow records in his "Annals" that there "were seen in the Air strange Impressions of Fire and Smoak to proceed forth of a black Cloud in the North towards the South . . . the next Night following, the Heavens from all parts did seem to burn marvellous ragingly, and over our Heads the Flames from the Horizon round about rising did meet, and there double and roll one in another, as if it had been in a clear Furnace".

Nov. 14, 1854. "Balaclava" Storm.—The British and French fleets and transports lying outside Balaclava Harbour, in the Black Sea, were wrecked and scattered by a violent gale, accompanied by rain which afterwards turned to snow. The loss of stores caused intense suffering among the allied troops in the severe winter which followed. The course of this storm across Europe was afterwards studied by the

French astronomer Leverrier, as a result of which he organised the international exchange of telegraphic weather reports and the first storm-warning service in Europe.

Nov. 14, 1866. Meteor Shower.—The occurrence of notable meteor showers in November 1799 and in November 1833 led to the prediction of a recurrence on a similar scale in 1866 on Nov. 14. Expectations were realised and a shower began about 11 P.M. on Nov. 13, culminated in a wonderful display between 1 and 2 A.M. on Nov. 14, and died away about 4 A.M. As the shower progressed, the radiant point in Leo was ascending above the eastern horizon. In brightness great numbers of the meteors equalled first magnitude stars, many were as bright as Jupiter, and some exceeded Venus at its brightest. It was estimated from systematic counts made by observers that at the height of the display about 6000 meteors were seen in one hour.

Nov. 14, 1923. Floods in Northern England.—On Nov. 12 and 13 a deep barometric depression passed north of Ireland and across Scotland along the line of the Caledonian Canal. The south-westerly gales in Lancashire were associated with heavy rains on the Pennines. On Nov. 14 the Mersey overflowed its banks, the floods at Sale being the most severe on record. At Sale Priory the water was 11 ft. deep, at Clitheroe 300 houses were flooded, and at Bury fire engines had to be called to pump the water out of houses.

Nov. 15, 1905. Aurora Borealis.—A remarkable display of aurora borealis was seen in all parts of the British Isles between 6 and 9.30 P.M. At Epsom, according to Mr. Spencer Russell, it first became visible in the north at 7.30 P.M., a narrow arc of pale yellow spanning the horizon. "Frequent displays of rays and streamers were noticed rising and falling rapidly from the arc, their colour varying from pale pink to a blood-red crimson. By 8.55 P.M. the aurora had extended considerably and was of an irregular form, a most noticeable feature being the variability in colour, fading at times to a pale subdued pink, brightening up with a peculiar twitching movement to a deep crimson." The display was very brilliant in the west of Europe—so much so that at Ghent and Turnhout in Belgium alarms of fire were raised. It is noteworthy that in Scotland the aurora appeared to the south of the zenith, in southern England to the north.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 29.—**E. L. Bouvier**: A new type of ceratocampian Saturnioid.—**Mlle. Marie Charpentier**: The Peano points of a differential equation of the first order.—**Paul Montel**: Some consequences of Rolle's theorem.—**A. Rosenblatt**: Linear equations with total differentials.—**Miron Nicolesco**: The extension of the theorem of Gauss to harmonic functions of p order.—**Podtiaguine**: The upper limit of the canonical product of infinite order.—**L. Escande** and **M. Teissié-Solier**: The chronophotographic study of the flow [of a fluid] round a plate normal to the current. The velocity measured on the surface of discontinuity is constant and equal to the velocity at infinity, agreeing with that indicated by theory. The velocities found experimentally at various points give a law of retardation in good agreement with the theoretical law.—**L. Goldstein**: The principle of exclusion and intramolecular statistics.—**Pierre Chevenard** and **Albert Portevin**: The secondary tempering of hyper-tempered steels and the stability of austenite.—**Jean Lugeon**: Simultaneous investigation by atmospherics at Zurich and in the Sahara. On the basis of three years' records, the following conclusion can be drawn: out of every 100 atmospherics recorded in a year, 20 per cent are of distant origin, some thousands of kilometres; 70 per cent have a range of between 100 and 1000 kilometres; 10 per cent are local, with a range of less then 100 kilometres. The Kennelly-Heaviside layer is always higher at El-Golea (Sahara) than at Zurich. **Jean Piveteau**: Contribution to the study of the fossil Ganoid fishes: the family of the Catopteridæ.—**Louis Baudin**: The variation of the respiratory exchanges of fishes as a function of the barometric pressure. By experiments at Lausanne and at Concarneau it has been established that fish are very sensitive to changes in the barometric pressure, and this sensibility is measured by large differences in the gaseous exchanges and in the respiratory coefficient.

Oct. 6.—The president announced the death of Paul Wagner, *correspondant* for the Section of Rural Economy. **J. Costantin**: The phytopathological guarantees of non-degenerescence of the potato in North America. Since 1922 the author has recommended the use of seed potatoes collected in cold countries or in the mountains. Further support of this view has been obtained from results in America and Canada. The climate probably acts in limiting the extension of disease, in facilitating the selection of healthy individuals, and perhaps in suppressing disease. **Paul Helbronner**: The polar aurora of Sept. 3, and on its action on radio-telegraphic transmissions. A list of wireless communications interrupted by this aurora is given. **Léon Guillet, Jean Galibourg**, and **Marcel Ballay**: Thermal treatment hardening grey cast irons.—**E. Bataillon** and **Tchou Su**: The reaction peculiar to the egg in *Hyla*. Perivitelline and infertility of the hydrated virgin material. **A. Buhl**: Wave geometry. Propagated waves and integral invariants.—**P. Rachevsky**: Sub-projective spaces.—**B. Kagan**: Sub-projective spaces. **H. Chapiro**: Sub-projective spaces.—**V. Romanovsky**: A class of linear integral equations.—**Mezin**: The kinematics of the elements of lines and surfaces applied to meteorology. **E. Coupleux** and **Givelet**: An electric organ. An outline of an entirely new type of instrument, based on the triode valve.—**A. Bogros**: The saturated vapour pressure of lithium. **Charles Platrier**: The broadcasting in France of the landing of the aviators Costes and Bellonte in the United States.—**Nicolas G. Perrakis**: The influence of the developer on the properties of a photographic plate. A quantitative study of the action of two different developers, other variables being maintained as constant as possible.—**A. Kastler**: The Raman effect in liquids possessing rotatory power. The molecular asymmetry shown in the transmission of light (rotatory power) and in its absorption (circular dichroism) does not appear in the Raman diffusion spectra.—**A. P. Rollet** and **L. Andrès**: The alkaline pentaborates.—**J. Fromaget** and **J. H. Hoffet**: The extension of the littoral facies of the upper Devonian and the palæogeography of northern Indo-China. **E. Saurin**: The existence of post-Lias granites in Cochin China and South Annam.—**A. Loubière**: The intramedullar vascularisation of the Trigonospermales.—**Ad. Davy de Virville**: The existence of an unnoticed zone of vegetation on the coast of the Armorican massif: the *Caloplaca marina* zone.—**H. Lagatu** and **L. Maume**: The explicit reply of leaf diagnosis when other means of observation fail.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 7, 1930). — **G. Krutkov**: A problem of the theory of perturbations.—**S. Sobolev**: The wave equation in the case of a heterogeneous isotropic medium.—**A. Mordvilko**: Aphids of the tribe *Hormaphidina*. General considerations on the relationships and life histories.

A. Tolmačev: A new species of *Draba* from northern Siberia. Description of *D. prozorovskii* sp. n., from the river Khatanga.—**E. Kozlova**: Bionomics of *Pratinocola insignis* Blyth. This species nests in the subalpine zone of the Khangai mountains, northern Mongolia; nest and eggs are described, and notes on the colour of nesting birds are given.

Comptes rendus, No. 8, 1930. **F. Loewinson-Lessing**: The delimitation of liparites from dacites. The percentage of silica is a less reliable character than the acidity coefficient. **R. Kuzmin**: The Diophantine approximations of algebraic irrational quantities.—**A. Andronov** and **A. Witt**: Inconstant periodic movements and the theory of multivibrators of Abraham and Bloch.—**V. Česnokov** and **E. Bazyrina**: The factors limiting photosynthesis. The intensity of light and the carbon dioxide concentration are not direct factors limiting the photosynthesis; the actual limiting factor is the velocity of the penetration of carbon dioxide through the protoplasm, and this velocity increases with the intensity of light and with the concentration of the carbon dioxide.—**D. Gerasimov**: Distinctive characters of the pollen of *Larix* and *Pinus cembra* in turf. The main difference is the structure of the air-sacs.—**P. Schmidt**: The Pacific halibut, *Hippoglossus hippoglossus* L., of the Atlantic, does not occur in the Pacific, and is replaced there by *Hipoglossus stenolepis* Schmidt.

MELBOURNE.

Royal Society of Victoria, Sept. 11.—**John Clark**: A new species of Lymexylionidæ (Coleoptera). Under the name of *Atractocerus crassicornis*, a new species is described and figured, together with the remarkable elongated, slender larvæ. A résumé was given of the habits of the beetle and larvæ. The latter are usually regarded as pin-hole borers and cause extensive damage in growing trees, particularly Eucalypts, in Australia.

ROME.

Royal National Academy of the Lincei, May 18. — **G. Scorza-Dragoni**: A problem on the partial maxima and minima of a function.—**D. Montesano**: The normal descendencies of geometric Cremonian groups (1).—**G. Nicoladzé**: A general method of investigating the invariant properties of geometric figures.—**E. Čech**: A demonstration of Cauchy's theorem and of Gauss's formula.—**M. Maggini**: The spectral type of the components of a double star, determined by means of the interferometer. Determination of the colour indices and hence of the spectral type of the components of a double star by measuring the visibility of the fringes, is described. —**G. Viola**: Circular orbit of U Cephei.—**G. L. Andrissi**: The system 61 Cygni. The existence of an orbital motion of the two components of 61 Cygni, first proved by Schlesinger, and hence that of a physical connexion between these components, are confirmed.—**A. Baroni**: Action of magnesium ethyl bromide and of oxidising agents on diethyl polysulphides. The action of magnesium ethyl bromide on diethyl polysulphides leads to the complete demolition of these polysulphides, with formation of diethyl sulphide and mercaptan. Diethyl trisulphoxide is obtained by the action of nitric acid on diethyl trisulphide, and diethyl disulphone and trisulphone by the action of nitric acid on diethyl disulphide. The bearing of these results on the various formulæ proposed for the alkyl polysulphides is discussed.—**C. Jucci**: Distribution of the pigment in the strata of the cocoon of the reciprocal crosses (F_1) between two races of silkworms, the Chinese gold and the native yellow.

VIENNA.

Academy of Sciences, July 10.—**F. Friza** and **H. Przibram**: Johnston's sense organs in the tentacles (*Aristopeden*) of *Sphodromantis* and *Drosophila*. Concerning the nature of the regeneration after the amputation of the first or second joint of a limb.—**H. Przibram**: Influence of infundin and of adrenalin doses on the colour of the frogs *Rana esculenta*, *R. fusca*, and *H. arborea* (Causes of animal coloration, 12). Doses were kept below the fatal limit. The change of colour is not merely a death signal. There is a brightening of colour with weak doses of infundin. **H. Przibram**: Rôle of visual perception for colour changes in the frogs *R. esculenta*, *R. fusca*, and *H. arborea* (Causes of animal coloration, 13). To eliminate the effects of rough or smooth surfaces the frogs were placed in glass dishes, these being surrounded by coloured papers. The darker colour of the frog when on a darker background appears to be a visual effect.—**R. Zieske**: Influence of the extirpation of hypophysis or eyes on the colour changes of the frog *H. arborea*. A hormone of the hypophysis provokes an expansion of the melanophores and hence a darkening of the skin.—**J. Pollak** and **K. Deutscher**: The preparation of an *o*-amino-thio-phenol-sulphonic acid.—**E. Katscher**: Xylenol-sulpho-chloride and -sulphonylide. **A. Muller** and **P. Bleier**: Two syntheses of hepta-methylene-imine.—**A. Kailan** and **A. Irresberger**: The esterification of 3, 5 diamino- and of iodo-benzoic acid by ethylalcoholic hydrochloric acid.—**A. Kailan** and **A. Irresberger**: The influence of neutral salts on the velocity of reaction in alcoholic solutions. The varying results are explained as partly due to the combination of water with the salt. —**L. Waldmann**: Geology of the Rosalia hills. **L. Waldmann**: Geological studies in the mica schist zone of southern Bohemia.—**H. V. Graber**: Report on the geological and petrographical investigations in the Upper Austrian and south Bohemian primitive rocks. —**J. Regen**: The formation of stridulation sounds in some of the saltatory Orthoptera.—**A. Dadieu** and **K. W. F. Kohlrausch**: Studies on the Raman effect (10). The Raman spectrum of organic substances. Sixteen amino-bodies have now been studied. **A. Brukl** and **G. Ortner**: The sulphides of gallium. Three sulphides are reported, Ga_3S_2, GaS, and Ga_2S. —**F. Urbach**: The interpretation of Stokes's law. —Radium Institute Communications (No. 264), **F. Urbach** and **G. Schwarz**: Luminescence of the alkali halides. Measurements of thermo-luminescence on the hypothesis of 'loosened regions' (*Lockerstellen*). (No. 265), **F. G. Wick**: Experiments on radio-thermo-luminescence. Fluorites show a series of sharp bands possibly due to rare earths.—**B. Karlik**: Experiments on the luminescence of zinc sulphide and diamond under the influence of radioactive radiation. The α radiation from polonium destroyed the blue and green bands of zinc sulphide. The capacity for luminescence in the diamond was also destroyed by α-radiation.—**F. Hölzl**: The mobility of some ions containing iron. —**O. Dischendorfer**: On *o*-chlorbenzal-dinaphthol.—**O. Dischendorfer** and **H. Suvan**: Researches in the field of phyto-chemistry (6). Allobetulin.—**R. Reinicke**: The evaluation of the Raman spectrum of

CH_2Cl_2 by K. W. F. Kohlrausch. A discussion with the help of the tetrahedral carbon model of the exact angular positions of the chlorine atoms.—E. Bondy-Horowitz: Contributions to the anthropology of north-east New Guinea, published in book form.

Official Publications Received.

BRITISH.

Southern Rhodesia. Geological Survey Bulletin No. 16: The Geology of the Chromite and Asbestos Deposits of the Umvukwe Range, Lomagundi and Mazoe Districts. By Dr. F. E. Keep. Pp. 105+12 plates. (Salisbury, S.R.)

H.M. Treasury. Report of the Committee on the Staffs of Government Scientific Establishments. Pp. 45. (London: H.M. Stationery Office.) 9*d*. net.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 4th November 1930. Pp. 40. (Newcastle-upon-Tyne.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 20, 21, 22: The Ecology of the Mountains of Mourne with Special Reference to Slieve Donard, by J. I. Armstrong, J. Calvert and C. T. Ingold; Re-Colonisation after Peat-Cutting, by J. M. White; The Ecology of the Moss Lane Region, Lough Neagh, by Mary Duff. Pp. 440-496+plates 5-14. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 5: January, February, March, 1930. By Ernest A. Hodgson. Pp. 67-86. 25 cents. No. 6: April, May, June, 1930. By Ernest A. Hodgson. Pp. 87-100. 25 cents. (Ottawa: F. A. Acland.)

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1929-30. Pp. 43. (London.)

FOREIGN.

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 7, No. 2, September. Pp. 101-198. (Tokyo: National Research Council of Japan.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico Internazionale 1900.0. Zona di Catania fra le declinazioni $+46°$ e $+55°$. Vol. 8, Parti 7ª e 8ª: Declinaz. da $+53°$ a $+55°$, ascens. retta da 18h a 24h. (Fascicoli N. 63 e 64.) Pp. xi+151. (Catania.)

The University of Colorado Studies. Vol. 18, No. 1, August. Pp. 42. (Boulder, Colo.) 1 dollar.

United States Department of the Interior: Office of Education. Bulletin, 1930, No. 12: National Ministries of Education. By James F. Abel. Pp. ix+158. (Washington, D.C.: Government Printing Office.) 25 cents.

City Noise: the Report of the Commission appointed by Dr. Shirley W. Wynne, Commissioner of Health, to study Noise in New York City and to develop Means of abating it. Edited by Edward F. Brown, E. B. Dennis, Jr., Jean Henry, G. Edward Pendray. Pp. xii+308. (New York City: Noise Abatement Commission.)

Clouds. By Prof. Alexander McAdie. Pp. iii+22+52 plates. (Readville, Mass.: Blue Hill Observatory.)

Sailplaning. Pp. 43. (Clarendon, Va.: Soaring Flight Co.)

Memoirs of the College of Science, Kyoto Imperial University. Series B, Vol. 5, No. 3, July, Article 12: Contributiones ad Caricologiam Asiae Orientalis, Pars Prima. By Jisaburo Ohwi. Pp. 247-292. (Tokyo and Kyoto: Maruzen Co., Ltd.)

CATALOGUES.

New Design Vacuum Grating Spectrograph. Pp. 4. (London: Adam Hilger, Ltd.)

Watson's Microscope Record. No. 21, September. Pp. 32. (London: W. Watson and Sons, Ltd.)

Vegetable Parchment: its History, Manufacture and Uses. Pp. 12+2 plates+samples. (Northfleet, Kent: British Vegetable Parchment Mills, Ltd.)

Dr. Muller's Improved X-ray Goniometer Spectrograph. Pp. 24. (London: Adam Hilger, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—A. R. Tweedie: Presidential Address.—Dr. D. McKenzie: The Pathogenesis of Cholesteatoma.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Vijaya Raghava Acharya: The Work of the Imperial Council of Agricultural Research.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion. In Chair, Sir Gerald Lenox-Conyngham.—Sir Gilbert Walker: Microseisms due to Meteorological Causes, followed by Dr. F. J. Whipple and A. W. Lee.—Dr. H. Jeffreys: (*a*) The Damping of Seismic Waves, and (*b*) The Revision of the Seismological Tables.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Dr. Chevalier Jackson and others: Discussion on Precancerous Conditions of the Larynx.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Prof. S. Chapman: The Absorption and Dissociative or Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth.—Dr. W. N. Bond: Turbulent Flow through Tubes.—J. S. Badami: The Spectrum of Trebly Ionised Cerium (Ce IV).—J. S. Rogers: The Photographic Effects of Gamma-Rays.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Surgical Interest recently added to the Museum of the Royal College of Surgeons.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. J. W. Gregory: The Machinery of the Earth (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—R. W. Allen: Feed-Water Systems for Steam Installations.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Adelphi Hotel, Liverpool), at 6.30.—W. V. Wood: The Economic Position of Railways.

INSTITUTE OF TRANSPORT (Leeds and District Section) (at Town Hall, Leeds), at 7.—J. W. Mitchell: Some Aspects of Indian Transport.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. Fawssett: Chairman's Inaugural Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—Discussion on Prints contributed to the P.G. Portfolios.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Literary and Philosophical Society and Manchester Sections of British Association of Chemists, Institute of Chemistry, Institution of Electrical Engineers, Institute of Fuel, Institution of the Rubber Industry, and Oil and Colour Chemists' Association) (at the College of Technology, Manchester), at 7.—Sir William B. Hardy: Problems of the Boundary State (including Friction and Lubrication) (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at University College, Swansea), at 7.30.—A. Stuart: The Study of Crystals with Special Reference to Chemistry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—H. Marryat: Luminous Electric Tubes (Neon, Helium).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. H. W. Featherstone: A Visit to some of the Hospitals in Canada and the Mayo Clinic (Presidential Address).

SATURDAY, NOVEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (1).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute) (Extraordinary General Meeting), at 3.30.

MONDAY, NOVEMBER 10.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5.—Group Capt. Martin Flack: Air-sickness and Sea-sickness.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens illustrating the Pathological Conditions of the Scalp and Cranium.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institute of Transport and Commercial Users' Association) (at Institution of Electrical Engineers), at 7.—G. J. Shave: Passenger-carrying Vehicles.—C. le M. Gosselin: Goods-carrying Vehicles.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. F. Stevenson and others: Discussion on V.I.R. Cables; their Failures, their Future, and their Rivals.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—D. B. Hoseason: The Cooling of Electrical Machines.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—N. C. Marples: The Applications of High-Nickel, Nickel-Copper Alloys and Pure Nickel in Industry.

SOCIETY OF MOTION PICTURE ENGINEERS (London Section) (at Royal Photographic Society), at 7.45.—C. W. Glover: Sound Proofing a Studio.

SURVEYORS' INSTITUTION, at 8.—E. H. Leeder: Presidential Address.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8.30.—Symposium on The Nature of Stammering to be opened by Dr. Millais Culpin and Dr. E. J. Boome.

MEDICAL SOCIETY OF LONDON.—Prof. Chevalier Jackson: The Diagnosis and Treatment of Malignant Disease of the Chest.

TUESDAY, NOVEMBER 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: New Aspects of Radioactivity (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Prof. A. W. Nash, H. M. Stanley, and Dr. A. R. Bowen: Synthetic Lubricating Oils.

INSTITUTE OF MARINE ENGINEERS, at 6.—Eng. Lt.-Comdr. S. F. Dorey: Tubes for High Pressure Water-Tube Boilers.

INSTITUTE OF METALS (Swansea Local Section) (at Y.M.C.A., Swansea), at 6.15.—Dr. H. W. Brownsdon: Alloys—Some Reasons for their Composition.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—A. Hindley: Some Unusual Jobs.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. W. Oliver: Progress in Colour Photography.

Hotel, Coventry), at 7.30.—G. J. Shave: Pass

—C. le M. Gosselin: Goods-carrying Vehicles.

SOCIETY OF GLASS TECHNOLOGY (jointly with Ceramic Society) (at North Stafford Hotel, Stoke-on-Trent), at 8.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester) (jointly with North-Western Centre of Institution of Mechanical Engineers).—D. B. Hoseason: The Cooling of Electrical Machines.

WEDNESDAY, NOVEMBER 12.

SOCIETY OF GLASS TECHNOLOGY (jointly with Ceramic Society) (at North Staffordshire Technical College, Stoke-on-Trent), at 2.30.—J. T. Randall, H. P. Rooksby, and B. S. Cooper: The Structure of Glasses: The Evidence of X-Ray Diffraction.—E. J. C. Bowmaker: A Method for Determining the Plasticity of Clays and Clay Mixtures suitable for Glass House Refractories.—W. J. Rees: Specifications for Tank Blocks. —W. Emery: Notes on the Casting of Refractories.

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street, W.1), at 5.30.—A. M. Hocart: Spirit Worshippers of the South Seas.

ROYAL SOCIETY OF MEDICINE (Surgery Section Sub-Section of Proctology), at 5.30.—L. E. C. Norbury: Multiple Primary Malignant Growths, with Special Reference to the Colon and Rectum (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.—R. E. Horley: Oil-filled Cables.

ROYAL SOCIETY OF ARTS, at 8.—Prof. A. E. Richardson: The Royal Society of Arts Competition of Industrial Designs.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Leicester Museum), at 8.—F. Dransfield: Fuels (Presidential Address).

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute) (Annual Meeting), at 8.15.—Dr. R. S. Hutton: Presidential Address.

TELEVISION SOCIETY.

THURSDAY, NOVEMBER 13.

ROYAL SOCIETY, at 4.30.—G. Endres, B. H. C. Matthews, H. Taylor, and A. Dale: Observations on certain Physiological Processes of the Marmot, I.-V.—Dr. J. Gray: The Mechanism of Ciliary Movement.—W. S. Duke-Elder and P. M. Duke-Elder: The Contraction of the Extrinsic Muscles of the Eye by Choline and Nicotine.—*Papers to be read in title only:*—Dr. C. D. Darlington: A Cytological Demonstration of 'Genetic' Crossing-Over.—W. Moppett: The Differential Action of X-Rays on Tissue Growth and Vitality, II., III., IV.—Prof. J. Mellanby: Prothrombase—Its Preparation and Properties.—Dr. D. Keilin and R. Hill: The Porphyrin of Component *c* of Cytochrome and its Relationship to other Porphyrins.—A. Geiger: The Isolation by Cataphoresis of Two Different Oxy-hæmoglobins from the Blood of some Animals.—R. Deanesly: The Development and Vascularisation of the Corpus Luteum in the Mouse and Rabbit.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5. A. Bloch and G. Polya: On the Roots of Certain Algebraic Equations. —R. D. Carmichael: Expansions of Arithmetical Functions in Infinite Series.—W. L. Edge: On the Quartic Developable.—R. M. Gabriel: The Rearrangement of Positive Fourier Coefficients.—J. Hodgkinson: Note on one of Ramanujan's Theorems.—L. S. Bosanquet and E. H. Linfoot: On the Zero Order Summability of Fourier Series.—Prof. L. J. Mordell: A New Waring's Problem with Squares of Linear Forms.—A. Myller et O. Mayer: Géometrie differentielle centroaffine. Courbes Planes.—L. Roth: On Plane Forms in Four Dimensions.—Prof. G. N. Watson: Theorems Stated by Ramanujan (XIV.). A Singular Modulus.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. L. S. T. Burrell: Indications for Treatment in Pulmonary Tuberculosis (Mitchell Banks Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—J. H. Fisher: Ocular Muscles, Movements, and Judgments (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: The Physiology of Water (2).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—A. E. Norris: The Methods of a Modern Reformatory.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. L. Stevens: Testing the Control of Aeroplanes.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—E. R. Hall: Waste Heat Recovery.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—Dr. W. H. Hatfield and others: Discussion on Metals and Alloys of the Future.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—A. Coleman: Demonstration of the Finlay Colour Process.

SOCIETY OF DYERS AND COLOURISTS (Midland Section) (at University College, Nottingham), at 7.30.—R. Burgess: Factors affecting the Development of Mildew on Wool.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Demonstrations of Photo-electric Cell Applications, illustrating some Important Properties which are made use of in Optical Work, Research Staff of the General Electric Co. Ltd.: The Use of the Spectrograph in Metallurgical Analysis, D. M. Smith: A New Spectrophotometer, H. Buckley and F. J. C. Brookes.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—D. B. McKenzie: Automatic Railway Control.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—A. E. Shorter: Metal Surface Hardening.

ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections), at 8.30.—Dr. A. Lindau, T. Collins, Sir Percy Sargent, and others: Discussion on Vascular Tumours of the Brain and Spinal Cord.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. H. Thomas: The Slow Contraction or Expansion of a Fluid Sphere.—M. Bronstein: Note on the Temperature Distribution in the Deep Layers of Stellar Atmospheres. —V. C. A. Ferraro: (*a*) Note on the Possible Emission of Electric Currents from the Sun; (*b*) On Recombination in Ionised Streams of Corpuscles from the Sun.—Dr. H. Jeffreys: (*a*) The Resonance Theory of the Origin of the Moon (second paper); (*b*) Convection in Stars.—W. H. McCrea and G. C. McVittie: On the Contraction of the Universe. —R. H. Fowler: The Solutions of Emden's and Similar Differential Equations.—R. M. Peek: Photometric Observations of Nova Persei 1901.—S. Plakidis: Observations of Comet Forbes (1930 *c*) made with the Doridis Reflector of the National Observatory of Athens.—K. Nakamura: On the Observation of Faint Meteors, as experienced in the case of those from the Orbit of Comet Schwassmann-Wachmann, 1930 *d*.—A. Pannekoek: The Theoretical Contours of Absorption Lines. —Prof. E. A. Milne: The Analysis of Stellar Structure.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—R. D. Lawrence and R. A. McCance: The Effect of Phloridzin, Thyroid and Adrenaline on the Glycogen Distribution of the Rat.—E. C. Barton-Wright and J. G. Boswell: An Electric Furnace for the Micro-Combustion Method of ter Meulen.—B. C. P. Jansen, H. W. Kinnersley, R. A. Peters, and V. Reader: Curative Activity of Rice Antiberiberi Vitamin.—W. J. N. Burch: Esters of Phosphoric Acid.—R. K. Callow: The Purification of Yeast Ergosterol and the Separation from it of *a*-Dihydroergosterol.—F. Challenger, L. Klein, and T. K. Walker: A Note on the Mycological Production of Kojic Acid.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: An Account of Col. McCarrison's Experiments in the Production of Urinary Calculi, with an Exhibition of his Specimens.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—E. F. Spanner: Disembarkation of Passengers in Emergency at Sea.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. I. Illingworth: The Economic Application of Electricity to Space Heating.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30. —J. A. Macintyre: The Lighting of Offices and Public Buildings.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Chemical Engineering Group) (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—W. S. Coates: Caustic Embrittlement.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at Technical College, Cardiff), at 7.30.—Prof. S. Knox: The Chemist and the Coal Industry.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—Dr. H. Hyman: Unsoundness in Metals.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30. Annual General Meeting.

SATURDAY, NOVEMBER 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (2).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 8.

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—A. H. Russell: Some Methods of Lightning Calculation.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Animal Childhood.

MONDAY, NOVEMBER 10.

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. E. Bayliss: The Respiratory Functions of the Blood. (Succeeding Lectures on Nov. 17, 24, and Dec. 1.)

UNIVERSITY OF LEEDS, at 5.15.—Prof. J. W. Gregory: The Structure of Eastern Asia.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (jointly with London Safety First Council—Industrial Section) (at Institution of Mechanical Engineers), at 6.—Dr. G. H. Miles: The Psychology of Industrial Accidents.

TUESDAY, NOVEMBER 11.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: Russian Farming and Agriculture.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Leonard Hill: Atmospheric Pollution.

GRESHAM COLLEGE (Basinghall Street), at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Nov. 12, 13, and 14.)

MEMORIAL HALL (Farringdon Street).—Sir George Newman: Modern Collective Humanism at Work.

WEDNESDAY, NOVEMBER 12.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. R. S. Williams: The Importance of a Complete Study of the Nutritional Value of Milk.

UNIVERSITY COLLEGE, LONDON, at 5.30.—L. A. Burgess: Public Libraries in Wales.

BELFAST MUSEUM AND ART GALLERY, at 8.—Rev. W. F. A. Ellison: Suns and Stars.

THURSDAY, NOVEMBER 13.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: Present Day Technique and Clinical Results in Contraception.

BRITISH SCIENCE GUILD (in Goldsmiths' Hall, E.C.), at 4.30.—Sir William Pope: Science and Modern Industry (Norman Lockyer Lecture).

KING'S COLLEGE, LONDON, at 5.—Dr. W. Robson: The Metabolism of Proteins. (Succeeding Lectures on Nov. 20, 27, and Dec. 4.)

MEMORIAL HALL (Farringdon Street).—Sir George Newman: Gains and Losses in National Health.

FRIDAY, NOVEMBER 14.

BOROUGH POLYTECHNIC INSTITUTE, at 3.30.—Prof. J. T. MacGregor-Morris: Iron, Nickel, and Highly Permeable Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 21 and 28.)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.15.—J. H. Coste: The Object and Methods of Sewage Treatment, particularly in relation to Inland Towns and Isolated Institutions (Chadwick Lecture).

SATURDAY, NOVEMBER 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. St. George Gray: The Lake Villages of Somerset.

SATURDAY, NOVEMBER 15, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Organic Chemical Research in relation to Industry.

AT the Bristol meeting of the British Association a discussion took place in Section B (Chemistry) on the position of the dyestuffs industry in Great Britain and the effect which the passing of the Dyestuffs Act, ten years ago, has had on the development of the industry and on activities connected therewith. The matter is of importance, because, unless some step is taken to renew the Act, either in its present or in a modified form, it will automatically lapse in December of this year.

Three questions arise in connexion with the working of the Act, and it is upon the answers to these questions that the issue depends. They are :

(1) What was the purpose of the Act ?

(2) Has it achieved that purpose ?

(3) If the answer to (2) is in the affirmative or qualified affirmative, will the lapse of the Act tend to re-establish the conditions which it was enacted to alter ?

In connexion with the first question, it is perhaps well to remember that the Act is an unusual measure, since it prohibits the import of all dyestuffs and intermediate products related thereto unless under licence. Licences are granted by a committee composed of dye-makers and dye-users, with a certain number of neutral members, and are issued in cases where the substances required are not manufactured in Great Britain.

The object of the Act is stated in an announcement made by the Government in 1920, which read as follows : "It is the settled opinion of the Government that for national security it is essential that synthetic colour-making factories should be in existence and be maintained in operation with their staffs of chemists and other experts in this country, and that the equipment should be equal in extent to that of any other possibly hostile nation."

This statement dealt with the subject from the point of view of national security in time of war—a matter of the highest importance, but one that has been stressed so often that no further comment is necessary here. The existence in Great Britain of highly trained chemists in control of plant and equipment of a type readily adaptable to the purpose of the manufacture of munitions of war is, unfortunately, essential until conditions are reached which will render the most elementary precautions unnecessary. Nevertheless, it is clear that the object of the Act was the establishment of a strong industry in connexion with the manufacture of dyestuffs and the intermediate products from which

they are derived, which would serve as a means for development and progress in times of peace but which would also be available in time of war; for it must be remembered, in the latter connexion, that it is the simplest of operations to utilise, at a moment's notice, the plant and personnel employed in dye and intermediate manufacture for the purpose of producing munitions of war. Moreover, it should be realised that, although not expressly stated, the Act covered and has influenced a far wider field than that it was designed to foster, because many substances dealt with in the fine chemical industry, and in industries dealing with medicinal substances and organic compounds of chemo-therapeutic interest, are either directly or indirectly related to the dyestuffs intermediates and are, therefore, covered by the Act.

The answer to the second question—Has the Act achieved its purpose ?—will be found by reference to the record of the meeting of Section B and to an excellent pamphlet just issued by the Association of British Chemical Manufacturers. The latter document deals with the views of the dyestuffs manufacturers on the progress which has been made under the Act of 1920, and although essentially an 'ex parte' statement, is nevertheless so concisely and clearly expressed that opponents to the extension of the Act, if such there be, will have some difficulty in combating the very cogent facts contained therein. The industrial and other difficulties which have militated against the development of the industry are enumerated and the conclusion is reached that, in spite of these, the Act has largely succeeded in achieving its main object, and that, as a consequence, we now have a well-organised, technically efficient, and virile industry. The 1929 production was more than six times that of 1913 by weight, and the home production now provides ninety per cent of the home consumption by weight and seventy-four per cent by value. The conclusion reached is that "while a sound foundation has been laid, and a strong structure is steadily being erected on efficient lines, there is still considerable headway to make before the industry can meet the full requirements of the colour-users, secure its proper share of the export trade, and withstand unaided the intensive foreign competition and price cutting which would result if this Act were allowed to lapse. The removal of the present protection would jeopardise the consummation of the work which it was the object of the Act to achieve." The dye-makers put forward the suggestion that, in order to ensure that no hardship should be placed on the colour-users, the Act should be extended i[illegible] form which will provide that prohibition of imports will only apply where a British maker is prepared to supply an equivalent product at an equal price.

In the summary of conclusion reached by the dye-makers it is stated that "the industry employs a larger proportion of technically-trained men than probably any other manufacturing industry in this country, and its existence is essential for the adequate maintenance of instruction and research in organic chemistry which are vital to our national prosperity and security". In other words, our research schools in organic chemistry are dependent on the industry for the employment of the trained men they produce, and, on the other hand, the industry is dependent on the schools of research for providing the skilled chemists without whom its work would be impossible. Prior to the War, manufacturers in Great Britain did not realise the need for highly trained men for service in the industry. Usually, all that was considered necessary was that a man should have obtained a sound general training in chemistry and allied subjects. It is certain that the pre-War predominance of Germany in scientific manufactures, and the fact that, in this connexion, we were rapidly becoming a nation of merchants, was due to the difference between the methods of training in the two countries. In Germany every chemist received a training in the methods of research, whereas in Great Britain probably ninety per cent of those seeking employment after graduation obtained no such training but entered the industry directly they had finished their course. Of the ten per cent remaining, the greater proportion went abroad to receive further instruction. Nowadays all that is altered.

Manufacturers have come to realise that, whether it is intended to place a man in the works as a process chemist, or whether it is intended that he should, in the first instance, enter the works' research laboratory, it is essential that he should have received at least one if not two years' training in research methods after graduation. It is fashionable in some quarters to disparage the Ph.D. degree, and to doubt the wisdom of the universities which have introduced it. No one who has any knowledge of the working of a large organic research school would do this. The degree is usually conferred after two years' training in research and indicates that the holder has undergone this training. It is a definite hall-mark which manufacturers are beginning to recognise, because they understand that the chemist possessing it has been trained to [illegible] know that no system of education can [illegible] dent with the technical minutiæ of

their manufactures—these can only be provided by them on the spot; but they know full well that a man with a trained mind will pick up those details very much more rapidly and effectively than one without such an advantage.

When the whole field of organic chemical research is envisaged, one realises the vast importance of the subject and the need to prevent any occurrence which may in any way hamper or hinder its development There are strong schools of research in most of our universities and university colleges, and from these emanates a steady stream of thoroughly trained men which is quickly absorbed into the industry There is no lack of employment. Indeed, during the past few years the demand has been in excess of the supply and heads of organic research laboratories have often been unable to provide the men asked for. Moreover, the demand is increasing, and this must inevitably be so, because the number of industries based on organic chemistry is increasing and is bound to increase Closer touch will also be effected between chemical industry and the research laboratories and further schemes will be devised for linking up the two, whereby the great potentiality for investigation and discovery resident in the universities will become available industrially.

It has been suggested that a certain measure of danger underlies the possession by a nation of strong and wealthy industries based on science, in that the best men turned out by the research schools may be attracted, by the offer of larger salaries, to abandon an academic career. If this were so, it would be fatal to the future development of both industry and academic science. If all the best men were attracted to industry, the second-rate men who remained would be unable effectively to control the research schools, which would then no longer be able to turn out first-class men. It is, of course, hopeless to suggest that matters could be adjusted by the universities paying salaries in any way commensurate with those obtainable in industry, but adjustment is certain to be reached by temperament: for in the future, as in the past, there will always be a number of first-class men to whom the 'loaves and fishes' of industry will offer no attraction, and who will be content to carry on research and investigation without any ulterior object. Moreover, there are many men to whom the love of teaching is a thing apart, and it is to these one must look for the adjustment of conditions which, at the present time, do undoubtedly present certain alarming features.

JOCELYN THORPE.

Taking Stock of Rubber.

(1) *Latex: its Occurrence, Collection, Properties and Technical Applications.* By Dr. Ernst A. Hauser. With Patent Review compiled by Dr. Carl Boehm von Boernegg. Translated by Dr. W. J. Kelly. Pp. 201. (New York: The Chemical Catalog Co., Inc., 1930.) 4 dollars.

(2) *Handbuch der Kautschukwissenschaft.* Herausgegeben von Prof. K. Memmler. Pp. xxiv + 766 + 10 Tafeln. (Leipzig: S. Hirzel, 1930.) 57·50 gold marks.

SCIENTIFIC investigation of rubber and rubber technology, apart from scattered researches, is a work of the present century. Growth of knowledge has been very rapid in the last decade, parallel with the enormous growth of the rubber planting industry in the East and of the tire industry in America and Europe. The two books under review give a timely and encyclopædic summary of current ideas in the field.

(1) Until a few years ago, latex, outside the producing countries, was only a colloid curiosity, but recent developments in its direct application, for example in the impregnation of textiles and in electro-deposition and dipping processes, have made it one of the most interesting materials in the rubber industry. Dr. Hauser was well fitted to write a monograph on the subject. He has made important contributions to our knowledge of latex, has investigated latex fresh from the tree in the East, and has studied one of the most urgent technical problems (that of latex concentration) intensively and on the works scale. In the result his book is admirably balanced and full of implications for further work. It may be said here, also, that the translation is done in lucid, enjoyable prose.

A historical introduction recalls the earliest patents for the use of latex, taken out in Great Britain by Samuel Peal and Thomas Hancock many years before the time was ripe for their inventions. The story is brought up to the foundation of the plantations from which the modern rubber industry dates. There follow chapters on the most important latex-bearing trees, on the collection of latex, the physical and chemical properties, non-rubber constituents of latex, less important latices, coagulation, evaporation, preservation and shipping, concentration, vulcanisation, and industrial applications. Chapter headings scarcely reveal the wealth of material dealt with in the book. Many difficult problems are critically examined and the text is frequently amplified by exhaustive bibliographies.

(2) Too many books devoted to general survey offer nothing but a superficial patchwork. Memmler's "Handbook" is very different from that; it is a comprehensive digest packed with detail, and offers an invaluable work of reference to the state of knowledge of rubber science at the present day.

There are seven main sections. The first, by Zimmermann, is devoted to the botany, cultivation, and preparation of rubber. There are chapters on every aspect of this field work, and such recent developments as electrophoretic and Emka rubber are discussed alongside *Hevea*, Manihot, and Jelutong. The chemistry of rubber is treated in the second section by Pummerer and Koch, and in this field we find the most important advances over the older text-books. Some chapters, such as those on halogen and oxygen derivatives of caoutchouc, contain little more than previous writers could say, but the chapters on the purification, crystallisation, and fractionation of rubber, on internal molecular rearrangement (cyclisation), on hydrogenation, and on the molecular weight and chemical constitution, show the remarkable progress recently made. A long chapter on synthetic rubber will be read with special interest on account of its author's association with the I. G. Farbenindustrie A.-G. The special question of vulcanisation is given a separate section by Kindscher and contains a good account of the part played by accelerators, while some less practical but theoretically interesting work on various types of vulcanisation, such as the Peachey process and the use of selenium and nitro-bodies, is adequately treated.

The fourth section, also by Kindscher, is on the chemical analysis of rubber. This is the one department of rubber science which has made little progress in recent years. The great interest taken in the mechanical testing of rubber, which began a couple of decades ago, has caused a definite neglect of chemical analysis. Such problems, for example, as the detection and determination of organic accelerators and preservative agents in rubber are barely touched upon; what little is said about them only emphasises the difficulties without throwing any helpful light.

The fifth section, by Hock, covers the fascinating subject of rubber physics. The mechanical structure of rubber stands out as the fundamental problem of rubber science in view of the unique mechanical behaviour of the material. In this book the structural conceptions are based on the thermo-elastic properties, and the important contributions of X-ray analysis to the subject are fully treated. Other chapters are devoted to the thermal, optical, and electrical properties of rubber, to its swelling and solution in fluids, and to rubber as a dispersing medium for filler particles. The sixth section, by Memmler and Schob, on mechanical testing, substantially follows the earlier work of Hinrichsen and Memmler, but contains valuable new sections on the plasticity of crude rubber and on ageing tests. The final section, by Pohle, constitutes the first general discussion of rubber microscopy yet written. It is illustrated with numerous beautiful reproductions in black and white and in colour of photomicrographs. The use and effect of stains in connexion with the dispersion of fillers is a revelation of delicate work.

Both these books conclude with full indexes of names and subjects, and are well printed.

T. R. D.

The Mosquitoes of North America.

A Handbook of the Mosquitoes of North America: their Structure, how they Live, how they carry Disease, how they may be Studied, how they may be Controlled, how they may be Identified. By Prof. Robert Matheson. Pp. xvii + 268 + 25 plates. (London: Baillière, Tindall and Cox, 1929.) 25s. net.

MALARIA, once very prevalent in the northern United States, has almost disappeared there, and is also less prevalent in the southern States, although here its diminution has been less marked and has proceeded at a slower rate. It has been suggested that the possible factors contributing to the decline of the disease have all been closely related to the agricultural development of the country, and, therewith, the reduction of habitats favourable to the breeding of the anopheline vectors. The danger of a serious increase of malaria in the northern States is not considered great, but under the less better developed conditions in the south, the likelihood of a recrudescence of the disease is much greater. In America, as elsewhere, mosquito campaigns in the past have been organised only when outbreaks of mosquito-borne diseases occurred. After the outbreak had diminished or disappeared, the passivity of responsible authorities frequently nullified the results of previous good work, and control operations had to be renewed with the recurrence of fresh outbreaks.

The successful control of mosquitoes depends on a thorough knowledge of their habits, which vary with the species. It is, therefore, essential that an exhaustive survey of the mosquitoes of the par-

ticular area to be controlled should first be made, including those that are migrants from adjoining districts, and finally, a topographical map of the area should be prepared showing the breeding grounds of the different species. With this information available, a definite plan for the ultimate reduction and elimination of breeding may be undertaken. Any plan will depend largely on local conditions, the extent and character of the breeding grounds, and the species of mosquitoes concerned. Whilst, then, malaria and yellow fever have been the greatest single factors conducive to the undertaking of active measures of mosquito control, it must not be forgotten that the anopheline carriers of malaria are but a mere fraction of the world's mosquito fauna, the majority of species of which are not concerned in the transmission of any disease, but thrust themselves unduly on the attention of man by their excessive abundance in certain regions and their irritating bites. Under such conditions, man's capacity for work and enjoyment in the open air is seriously interfered with, and valuable lands are rendered almost uninhabitable and remain undeveloped. This is particularly true of summer seaside and lake resorts, or urban areas subject to mosquito invasion, and of manufacturing and industrial districts.

In the United States the mosquitoes of New Jersey enjoy a reputation for bloodthirstiness that is second to none. Their abundance is traceable to the ideal breeding grounds, which occupy thousands of square miles of tidal salt-marshes adjoining the Atlantic seaboard. Here there flourish such migratory species as *Tæniorhynchus perturbans*, *Aedes vexans*, *A. sollicitans*, *A. cantator*, and *A. tæniorhynchus*. The abatement of the nuisance depends for its success on the ditching and drainage of the marshes. A true index of the success of the New Jersey anti-mosquito campaign is the steady appreciation in the land-values of adjacent residential areas during the past decade. Dr. T. J. Headlee, State Entomologist, New Jersey, is the authority for the statement "that where salt-marsh mosquitoes have been largely eliminated during the last ten years, there has occurred an average annual increase in taxable land-values of seventy-five per cent more than where they are still present or very recently reduced".

Problems of mosquito eradication similar to those of New Jersey also exist in California. In the valleys of most of the larger rivers of North America there occur special problems of mosquito control due to the annually recurrent conditions of flooding produced either by the melting snows of spring or the early summer rains. The mosquito pestilence of the lower Fraser River valley is entirely due to such conditions, and in some years assumes such proportions as to interfere seriously with the outdoor activities of the agricultural communities scattered along the valley. Likewise dependent for their development on the pools formed as a result of the melting snows are the majority of the species of *Aedes* of the northern Canadian prairie and tundra lands of the North-West Territories. No summer traveller to the Arctic but has experienced the annoying persistence of the countless myriads of *Aedes*, which in point of actual numbers far transcend any mosquito plague of the tropics. These northern species are but single-brooded, hatching from eggs deposited at random in the vegetation the previous summer. Whilst the period of overwintering diapause or latency only terminates with the recurrence of the requisite conditions of spring moisture, it is frequently prolonged so that many eggs only hatch after two or more periods of submersion separated by longer or shorter intervals. A comparable prolongation of the egg-stage of *Aedes argenteus* has recently been explained by Roubaud[1] (1929), not so much as an adaptation enabling the species to survive periods of dryness or unfavourable winter conditions, as a period of reactivation, during which the inhibitory effects of inherited toxins are overcome.

In connexion with mosquito breeding, one of the most urgent problems awaiting solution is the ascertaining of the physical, chemical, and biological factors, which determine the presence of certain species of mosquito larvæ in some pools and their absence in others. Variations of the *p*H values do not alone seem to offer a satisfactory explanation. Recent investigations would indicate that specific substances present in the water or produced by the decomposition of vegetable matter may be responsible for the growth of specific micro-organisms suitable or unsuitable as food for the larvæ.

The book before us discusses in a conventional manner the facts of mosquito morphology and biology, the relation of mosquitoes to disease, and the methods now commonly employed in combating mosquitoes. The final two chapters of the book are devoted respectively to a systematic account of the North American species of Anophelini and Culicini; of the former 8 species are described, of the latter 73 species belonging to 9 genera. It will serve as an admirable introduction to the more comprehensive work of Howard, Knab,

and Dyar, "The Mosquitoes of North and Central America and the West Indies", and of Dyar's "The Mosquitoes of the Americas". One of the great drawbacks to the advancement of culicidology has been the irksome synonymy, for which systematists and other students of the group have been largely responsible. It is, therefore, refreshing to those weary of tracking species invested with a protean nomenclature to find that at last systematists are beginning to agree upon the identity of many of our nearctic and palæarctic forms, with a consequent welcome reduction of spurious species. Further investigation will doubtless show that many others are merely varieties and not valid species.

The book is well illustrated by 23 text-figures and 25 plates, 7 of which are photographs of the breeding habitats of common species, whilst the remainder are composed of clear diagrammatic representations of larval and adult structures important in identification. There is a useful general index.

A. E. CAMERON.

[1] Roubaud, E. "Recherches biologiques sur le moustique de la fièvre jaune. *Aedes argenteus* Poiret. Facteurs d'inertie et influences réactivantes du développement. Les œufs durables et leur importance dans le rajeunissement du cycle évolutif." *Ann. Inst. Pasteur*, no. 9. Paris, 1929.

Prof. Whitehead's Philosophy.

Process and Reality: an Essay in Cosmology. (Gifford Lectures delivered in the University of Edinburgh during the Session 1927–28.) By Prof. Alfred North Whitehead. Pp. xxiii + 509. (Cambridge: At the University Press, 1929.) 18*s*. net.

IT does not fall within our scope to attempt a detailed or technical examination of the volume of Gifford Lectures in which Prof. A. N. Whitehead has expounded at greater length than elsewhere his system of metaphysics. This has been done in many other notices, and we would be understood here only to give a general impression from rather a lay point of view, comparing it with other newly published syntheses of similar scope—for example, that of Profs. Alexander and Haldane, Pringle Pattison and Hobson, and Sir Arthur Eddington.

Gifford lectures always open up a prospect of such fresh attempts to bring together the conclusions of science and put them into some sort of living relation with religion. It is an increasingly difficult task, and one should be grateful to the valiant men who essay it and the foundation which encourages them. It is doubtful, however, whether much has yet been achieved in the direction which most of the lecturers have had in view, mainly for two reasons: either they restate their old religious and metaphysical preconceptions side by side with a summary of certain aspects of recent science—this was the method, among others, of two eminent Gifford lecturers, Eddington and Haldane—or they undertake quite a new construction of their own, with a new phraseology and new ideas very difficult to accommodate to accustomed usage; Prof. Whitehead is the greatest example of this type, Prof. Alexander inclining towards him, but with much more tenderness to our traditional language and ways of thought, and also—the most important point—a much more thorough and accurate psychological analysis.

In Prof. Whitehead's work, whether in this volume or in the better-known "Science and the Modern World", we are constantly enlightened by some inspired phrase or conducted to a new vista of unity between the thinkers of the past and the opening realms of thought in the future. In this sense Prof. Whitehead is himself one of the builders of unity, a potent force in the new renascence of "the universe which is thus a creative advance into novelty". But when we turn to the system itself which he has elaborated with so much patience and ingenuity, we are overwhelmed by a cloud of perplexities and doubt.

The first and most obvious cause of this embarrassment is the extraordinary obscurity and redundance of the language. Here is a comparatively simple sentence, selected rather for that reason out of a multitude of others which on every page have confounded the wits of the most practised readers: "The depositions of Plato, Aristotle, Thomas Aquinas, Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, Kant, Hegel, merely mean that ideas which these men introduced into the philosophic tradition must be construed with limitations, adaptations, and inversions either unknown to them or even explicitly repudiated by them." What does this sentence tell us except that "No philosopher's words can be taken as final"? This, however, is a simple case. The greatest difficulty arises when the author adds to this redundancy of ordinary expressions the whole apparatus of a new terminology which he has himself invented and he himself remains the only writer to employ. No doubt an author is justified in introducing words carefully framed to express ideas which he cannot find adequately expressed in accepted phraseology. But clearly he must, if he wishes to be read and understood, do this with the utmost care and moderation.

Now, Prof. Whitehead, thinking that he has a great new idea to expound which dominates all his thought, has not only transformed one familiar word to express this new thought, but has added to it a whole string of others which constantly recur in the midst of long and complicated sentences. The leading word transformed is, of course, 'organism', and with this come entity, superject, prehension, concrescence, and many more. Some are new coinage, others are old words used in a novel and not always strictly consistent sense.

This coinage of new words goes further than merely verbal explicitness—which, in fact, it does not secure. The deeper difficulty is that having set up the one great idea with its new denomination of 'organism' and 'organic', the author is apt to proceed and to move in a completely new world of thought, more and more detached from the world of familiar fact from which he sets out.

This starting-point for the new philosophy is given in an early passage as follows: the "doctrine of the philosophy of organism is that, however far the sphere of efficient causation be pushed in determination of components of a concrescence—its data, its emotions, its appreciations, its purposes, its phases of subjective aim—beyond the determination of these components there always remains the final reaction of the self-creative unity of the universe. This final reaction completes the self-creative act by putting the decisive stamp of creative emphasis upon the determinations of efficient cause." This final 'self-creative unity' is what the author means by 'God', who is elsewhere defined, more briefly in the same direction, as "the principle of concretion".

One understands in a vague sense what this aims at. It has close affinities with other large general ideas current at the moment, especially Gen. Smuts's 'holism'. It has a value, no doubt, in raising the mind above the complexities of particular events: above all, in connecting the idea of creation with that of increasing order and unity in the world. But when applied *ab extra*, as it were, overriding the known distinctions, for example, of the living and not-living, the conscious and the unconscious, it confuses and does not enlighten us. For one reader at least, full of admiration for the author and sympathy with his general aim, more light comes from the less ambitious but more faithful psychological analysis of the school of Bradley and Alexander.

F. S. MARVIN.

Our Bookshelf.

Air Ministry: Meteorological Office. The Weather Map: an Introduction to Modern Meteorology. (M.O. 225i.) Second edition, entirely rewritten. Published by the authority of the Meteorological Committee. Pp. iv + 83 + 24 plates. (London: H.M. Stationery Office, 1930.) 3*s*. net.

THE first issue of "The Weather Map" was published in 1915, primarily in response to military requirements, and was in considerable demand for the succeeding ten years, as is shown by the fact that six reprints were made during that period. Mr. J. S. Dines, while superintendent of the forecast branch of the Meteorological Office, rewrote the work and brought it up-to-date.

There are numerous improvements in the new volume, the most obvious of which are visible at a glance in its better finish throughout, and especially in the cover and in the reproduction of the weather maps. It may be noted, however, that in order to exhibit the weather at individual stations clearly, the area covered by the maps is about the same as for those published in such morning newspapers as reproduce the map for 6 P.M. of the previous day. This area is very small compared with that of the 'working chart' of the official forecasters—a fact which should be borne in mind when considering the process of preparation of the forecasts. There must be a great many people who would follow with interest the changes depicted in these maps, could they master the meaning of all the symbols and figures that appear on them, and their requirements are well met in the full and clear exposition given of the make-up of a modern synoptic weather map.

To those whose interest carries them further, and who require some insight into the kind of reasoning followed by the official forecaster in making his diagnosis of a particular situation, the same attention has been paid, and there is little doubt that present-day technical methods of prediction have been made comprehensible to anyone with an elementary knowledge of physics, and not wholly unintelligible to those without such knowledge. It is good to see also that the history of the subject has not been neglected, and that a careful account has been given of the new ideas that have come to us in recent years from Norway owing to the analytical methods worked out by J. Bjerknes with the aid of a closer network of stations than is normally employed in synoptic meteorology. The amount of information and the clearness of its exposition are remarkable for the size of the volume. The teaching profession should derive especial benefit from its appearance.

In a Persian Oil Field: a Study in Scientific and Industrial Development. By J. W. Williamson. Second edition, revised and enlarged. Pp. 192 + 25 plates. (London: Ernest Benn, Ltd., 1930.) 7*s*. 6*d*. net.

IT is quite evident from the call for a second edition of this book that public interest in the oil industry extends beyond markets. Written originally for the non-technical reader to convey "a judicious

appreciation" of the work of a British oil company, apparently sales and certainly reviews commended the volume to the technologist, a source of gratification to its author, who modestly reiterates in his second preface its real purpose: to serve the general reader.

Probably one of the chief reasons for the success of this essay is the fact that it is unique of its kind. At first glance one might wonder, and with every reason, what there was in the business of oilfield exploitation to appeal to anybody outside those directly concerned, outside the technical circle. But the story of a self-contained British community operating in alien country, contending not only with a difficult people, but also with Nature in her sternest mood, every individual and collective effort directed to one goal, the winning of petroleum and all that this to-day stands for, provides an author with a wealth of material, technical, human, psychological, social, out of which, if he be worthy of his pen, he cannot fail to make abundant literary capital.

The chief departure from the first edition is the inclusion of a chapter on "Oil and Ethics", which, designed to portray the achievement of the company concerned in correct perspective of international industry, throws into sharp relief the other part of the book. Otherwise the alterations are mainly those of righting mistakes, revising sections which clearly wanted attention in the original, and extending the information on those particular operations, for example, geophysical, which have been prominent in the interim. To criticisms made to the reviewer, that the title is an intended parody on a popular song, and that the book is an excellent form of publicity for a commercial undertaking, we reply that, even if either or both are justified, anything which brings home to the general reader what a wonderful substance is petroleum, what praiseworthy enterprise and high standard of human attainment are involved in its exploitation, deserves the fullest approval. H. B. M.

Rudi Schneider: a Scientific Examination of his Mediumship. By Harry Price. Pp. xv + 239 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

THIS volume gives an account of two series of sittings held under the auspices of the National Laboratory of Psychical Research, of which the author is the honorary director. The medium in whose presence alleged psychic phenomena are said to have taken place was a young Austrian, by name Rudi Schneider, who with his brother Willi have for some years held the position of the principal European mediums for the so-called physical phenomena.

The present series of sittings is said to have been held primarily in order to interest as many scientific men as possible, although the list of sitters scarcely lends support to this statement.

The control of the medium and observers was mainly exercised by an electrical device whereby any movements which resulted in breaking the circle were registered by the extinction of certain lights, and thus both medium and sitters were immobilised and (it is claimed) prevented from indulging in any trickery. Under these conditions a number of manifestations are recorded, such as the movements of objects without contact and the appearance of hands seemingly endowed with life. Notes were taken by a lady secretary, who dictated them into a dictaphone as the events occurred, but the few independent accounts that Mr. Price prints show that these notes should be regarded with some caution.

Generally speaking, the book is an interesting addition to the studies of the Schneider phenomena, although the treatment of past history is scarcely ingenuous. From its perusal the uninformed reader would scarcely gather that a formidable mass of evidence exists to justify suspicion regarding phenomena identical, or nearly so, with those now said to occur with the electrical control.

A History of Medicine. By R. McNair Wilson. (Benn's Sixpenny Library, No. 148.) Pp. 80. (London: Ernest Benn, Ltd., 1930.) 6*d.*

IN a very small compass, the author gives an excellent survey of medical history. Beginning with the medicine of the Greeks, he emphasises the influence of Hippocratic humoral conceptions and the later Roman 'methodist' theory and the Galenic theory of the pneuma upon the development of medical science. An admirable plea for recognition of the value of earlier English medicine is made, with special reference to the works of Harvey and Sydenham. Jenner's discovery of the use of vaccines is also well described, and this is followed by a good analysis of the work of Pasteur. From 1880, great strides have been made in antiseptic surgery and the application of antitoxic sera, and the author gives his readers a glimpse into this revolutionary period in medical history.

The book terminates with a brief review of the development of preventive medicine which has resulted in the establishment of the Ministry of Health and the Medical Research Council, the study of mental sickness, and cancer research. The work is altogether a splendid effort, and may be read with interest, both by medicals and laymen.

Plant Biology: an Outline of the Principles underlying Plant Activity and Structure. By Dr. H. Godwin. Pp. x + 265. (Cambridge: At the University Press, 1930.) 8*s.* 6*d.* net.

ELEMENTARY text-books of botany usually bear a strong family resemblance, and it is therefore a pleasure to notice one bearing the hall-mark of individuality. This book treats the plant as an active unit, and at the same time emphasises the physico-chemical bases on which it works. Particularly useful are the schemes showing the types of metabolism and energy relations of the yeasts and bacteria. We may welcome also the illustration of the tissue elements as solid objects, and also the developmental treatment given to the morphology of flowering plants.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Crystal Structure of Parahydrogen.

WE have made two Debye-Scherrer films of parahydrogen cooled by helium boiling under normal pressure, yielding rather faint and granular lines. A much better intensity was obtained when the solid was irradiated at a temperature less than 2° K. The spacings which were deduced from these films cannot be explained by a simple space lattice of cubic symmetry.

A hexagonal close-packing of molecules, with $a = 3 \cdot 75$ A. and $c/a = 1 \cdot 63$, gives a satisfactory agreement between observed and calculated spacings. For the density we compute then 0·088.

A more detailed account of these experiments is being published in the *Proceedings* of the Royal Academy of Amsterdam.

W. H. KEESOM.
J. DE SMEDT.
H. H. MOOY.

Leyden, Oct. 30.

A Sex-linked Character in Ducks.

ALTHOUGH sex-linked characters are known in fowls, pigeons, doves, and canaries, none has hitherto been recorded in ducks. From the industrial point of view, a sex-linked character affecting the down of the newly hatched duckling, enabling the sexes to be distinguished at this stage, would be of considerable importance; for the runner duck, though a magnificent layer, is comparatively valueless for table purposes. It is true that the sexes can be distinguished by a careful examination of the cloaca even at hatching, but this as a rule demands more skill on the part of the operator than the average duck farmer possesses.

Some experiments carried out this year have revealed the existence of a sex-linked character which will probably provide the industry with what it desires. Reciprocal crosses were made between the common mallard and the Indian runner, a race with rather blurred markings on a buffish ground. From the mating between runner duck and mallard drake, 19 birds were produced, all with a dark type of down resembling that found in the mallard. Of these, 10 were drakes and 9 were ducks. From the mating between mallard duck and runner drake, 47 young were produced, of which 27 were drakes and 20 were ducks. The down of the drakes was similar to the down of all the ducklings from the reciprocal cross, but the down of the ducks was much lighter, and nearer in ground colour to that of the runner. The colours of the two types of down cannot be matched exactly in Ridgway's "Colour Standards", but the lighter one is close to the "light brownish olive" on Plate XXX., while the darker is not far removed from the "dark olive" of Plate XL. All the downs, whether light or dark, were yellowish on the ventral surface, and showed yellow rump patches dorsally. Such pale markings are not characteristic of the runner, and are probably due to a dominant factor brought into the cross by the mallard.

On reaching maturity, the birds with the dark downs exhibited a type of plumage closely resembling that of the mallard, whether male or female; but the ducks from the mallard ♀ × runner ♂ developed a distinct and paler type of plumage, which was noticeable also for the marked reduction of the characteristic bright 'speculum' on the wing.

In its general features the case recalls that of the 'cinnamon' canary, and it is interesting that in this species also the inheritance is sex-linked. Finally, it may be added that Werner (*Anat. Rec.*, 1925) has shown that the female runner, like all other birds adequately investigated, possesses only one X-chromosome.

R. C. PUNNETT.

Science and Philosophy.

THE suggestion by Prof. F. G. Donnan (NATURE, June 7, 1930) that an international conference of scientists and philosophers, and perhaps others, might help toward clarifying the present confused state of men's thinking on most of the major problems of Nature and human life, has received considerable notice in America, at least.

A later communication to NATURE (June 21) by Mr. Wilfred Trotter directs attention to the extent to which the biological sciences have "lost prestige in the intellectual world" in the last thirty years, and "ceased to influence philosophic thought". No one who to-day views the field of human interest broadly and thoughtfully can fail to recognise the general truth of the point made by Mr. Trotter. If one desires an illustration of this truth in relation to philosophy, let him compare such writings as Prof. John Dewey's "The Influence of Darwin on Philosophy" (1909) and his "The Quest for Certainty", published just twenty years later. Or if one wants an illustration of the present standing of biology in the realm of ethics, he may reflect on the insignificant and hopeless creature man is from the "particular point of view which the biologist adopts" (Walter Lippmann, "A Preface to Morals", p. 150).

I venture to direct attention to a matter which, though far less than the whole problem of the relation between science and philosophy, yet has long appeared to me to have an important bearing on that problem. The point concerns the now widely adopted classification of the sciences into 'exact science' and 'natural science'. A brief historic reference illustrates what is in mind.

In the "History of Scientific Ideas" (2nd ed.; London, 1847) William Whewell wrote, quoting from his previously published "Philosophy of the Inductive Sciences": ". . . the mathematical and mathematico-physical sciences have, in a great degree, determined men's views of the general nature and form of scientific truth; while natural history has not yet had time or opportunity to exert its due influence upon the current habits of philosophizing".

That Whewell was greatly impressed by this idea is clear from his recurring to it under various heads and in others of his writings. Thus in his "Novum Organum Renovatum" (London, 1858) we read: "Natural history ought to form a part of intellectual education, in order to correct certain prejudices which arise from cultivating the intellect by means of mathematics alone; and in order to lead the student to see that the division of things into kinds, and the attribution and use of names, are processes susceptible of great precision".

These views were expressed by Whewell, it will be noticed, before the publication of "The Origin of Species" and Darwin's other works, which laid a solid foundation for the theory that man himself with all his attributes is a natural product and so holds a definitely ascertainable place in the world of living organisms. But Whewell's appraisal of natural

history referred only to its general educational and logical bearings. Natural history as dealing with that domain of Nature to which man himself belongs had received no serious consideration by him. Only since his time, and to the extent that man has accepted the theory of 'descent with modification' as applying to his own origin and nature, has it been possible for anybody to see that if ever man is to attain that measure of self-knowledge after which the wisest ones of all races have longed and striven, that knowledge must partake much more of the character of 'natural science' than of 'exact science', using these terms as they are now largely understood.

The following then is suggested as one opportune subject for treatment at such a conference as that proposed by Prof. Donnan: The ancient injunction, Know Thyself, may be placed on a scientific-philosophic basis by developing to its fullness the partial insight gained by William Whewell of a natural history mode of philosophising. W. E. RITTER.

University of California,
Berkeley, California,
Oct. 9.

Ancient Metallurgy in Rhodesia.

MY attention has been directed to an article on "Early Man in N. Rhodesia", by Prof. Raymond Dart, which appeared in the *Times* of Aug. 22 and was noticed in NATURE of Aug. 30. Echoes of the statements made in the article are finding their way into our local Press, and the unprotected public is being told that iron was being fabricated "3000 to 4000 years" ago by a people of Palæolithic culture dwelling in central Africa.

On the face of it, such an accomplishment is highly improbable, because the oldest man-made iron of known date is that of the discovery made by Sir Flinders Petrie at Gerar, in Palestine, in 1927. The date of this iron, as determined by associated scarabs and amulets, is 1350 B.C. It is probable that the smelting of iron was begun a little earlier, say, 1400 B.C., in the Hittite uplands, between the Taurus and the Caucasus, a region to which classical tradition points as the cradle of metallurgy. All iron earlier than 1400 B.C. is probably of meteoric origin; many older relics have been tested for their nickel content (which is the criterion) and have proved to be of celestial metal. It is unlikely that the smelting of iron was known long before 1350 B.C., because the knowledge of the art would have been of supreme importance, in trade and war, to any primitive people; it would have sufficed to give them instant dominance over their contemporaries.

We must meet Prof. Dart's conclusion, therefore, with justifiable scepticism. He says: "These facts reveal the extreme age (3000 to 4000 years) of the knowledge of smelting and the working of metals in Northern Rhodesia". This dictum is based upon the finding, by an Italian scientific expedition, of a foundry, slag, and ashes at a depth of six feet in a deposit containing implements characteristic of the Stone Age. The deposit lies within a limestone cave at Mumbwa, near the Kafue river, a tributary of the Zambezi. The find is said to prove that "the smelting is coeval with the later phases of the Palæolithic period in Northern Rhodesia", and shows that "the knowledge of metallurgy was introduced by a superior race into an Africa still in the throes of the Stone Age". This is true enough, but it does not prove an antiquity of 3000 or 4000 years, that is, so long ago as 2070 B.C. What it does prove, I submit, is that foreigners, versed in iron-making, established themselves for a time in the cave, possibly for self-defence, and during their sojourn they made iron weapons for use against the natives, who then were using the "quartz flakes and quartz implements of the Late Stone Age type"—in short, were the savages that Livingstone, Cameron, and Stanley found in that part of the world seventy years ago.

The invaders probably were slave-hunting Arabs, and the date of their incursion may be anything from A.D. 1200 to A.D. 1900, but no B.C. chronology is permissible. The Italian expedition has not finished its exploratory research; perhaps when all the information available is collected we shall be given a more convincing interpretation of the facts.

Apropos of early iron-making, I may mention that sundry writers have imputed the ancient Egyptians' knowledge of the art to a borrowing from their southern neighbours, the Ethiopians, this idea being lent some colour by the fact that the natives in central Africa, more particularly the Kenya and Congo regions, know how to make iron in a crude manner. Crudity of method, however, does not prove antiquity of origin. The denial to any such supposition is found in the description by Herodotus of the weapons used by the Ethiopian contingent in the army of Xerxes. Their armament consisted of "long bows, on which they placed short arrows made of cane, not tipped with iron, but with stone that was made sharp, and of the kind of which we engrave seals. Besides these they had javelins, tipped with antelope's horn that had been made sharp, like a lance. They had also knotted clubs." All of which indicates a complete ignorance of metallurgy. T. A. RICKARD.

Berkeley, California,
Oct. 6.

The Nature of the Vacuome and the Golgi Apparatus in Oogenesis.

I HAVE read with great interest the recent communications of Miss M. O'Brien and Prof. Gatenby (NATURE, June 14, 1930) and of Prof Bhattacharya and Dr. Das (NATURE, Nov. 2, 1929) on the *Lumbricus* and the pigeon ovary respectively For the first time these authors have demonstrated that in the egg cells also the vacuolar system (vacuome) and the classical Golgi apparatus are independent cell-components. A similar conclusion has already been arrived at in plant cells by Bowen (*Z. Zellf.*, 1928) and by Patten, Scott, and Gatenby (*Quar. Jour. Roy. Mic. Soc.*, 1928), in animal male germ cells, by Hirschler, Monné, Voinov, and Gatenby (for references see Gatenby, *Proc. Roy. Soc*, 1929), and most recently in animal somatic cells also by Beams (*Anat. Rec.*, 1930), and by Gatenby and O'Brien.

Now both in the case of the earthworm and the pigeon ovary the use of neutral red has been found necessary to demonstrate the vacuolar system. Prof. Gatenby and his collaborator, therefore, have been naturally careful in stating that "it does not seem possible entirely to dismiss the idea that these globules might be segregation vacuoles and not pre-existing structures".

On the other hand, in the eggs of *Rana tigrina* (Nath, in press) and the teleostean fishes *Ophiocephalus punctatus* and *Rita rita* (Nath and M. D. Nangia, in press), not only the mitochondria and the Golgi elements but also the vacuoles can be seen *intra vitam* side by side separately *without the aid of neutral red or osmic acid*. This is due to the greater density and the larger size of the vacuoles of these three species. In *Ophiocephalus punctatus* the vacuoles begin condensing inside them protein material from a very early stage in oogenesis and actually form the albuminous yolk of the egg, as has been very rightly claimed for *Perca* and *Pygosteus* by Hibbard and Parat

(*Bull. d'Hist.*, 1928) and by Hibbard for *Discoglossus* (*Jour. Morph. Physiol.*, 1928).

In their chemistry the vacuoles of the eggs of *Rana*, *Ophiocephalus*, and *Rita* are diametrically different from the Golgi elements. Whereas the latter consistently go jet-black in either Da Fano or Mann-Kopsch or Kolatschev, and cannot be stained with neutral red, the former do not show the slightest amount of blackening however heavy the impregnations, and are stainable with that vital dye. The Golgi elements are certainly lipoidal (fat-like), whereas the vacuoles represent an aqueous material of a non-lipoidal and non-fatty nature.

I desire to pay tribute to the brilliant researches of Prof. Parat and his collaborators who have focused attention on a hitherto neglected cytoplasmic component, the vacuome, which in oogenesis may give rise to albuminous yolk as in *Perca*, *Pygosteus*, and *Ophiocephalus*. But the vacuome is not the Golgi apparatus as claimed by the Parat school. The classical Golgi apparatus may often be vesicular or vacuolar in form as in so many eggs (Nath, Gresson, etc., etc.) and even in other cells, for example, Protozoa (Hirschler, *Z. Zellf.*, 1927), but chemically and functionally it is a fundamentally different material from the vacuome. The Golgi vesicle is not a mere vacuole, but is surrounded by a thick lipoidal cortex which is characteristically argentophile and osmiophile.

VISHWA NATH.

Department of Zoology,
Government College, Lahore, India,
Aug. 2.

Manner in which Flaps of various Materials fracture along their Bases.

WHILE studying the various methods in which osteoplastic flaps for exposing the brain and its membranous coverings may be formed from the human skull, my attention has been directed to the way in which fracture takes place along the bases of bone

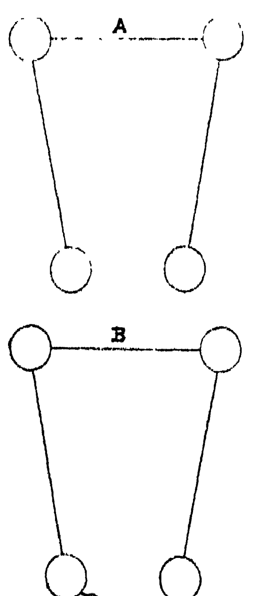


FIG. 1.

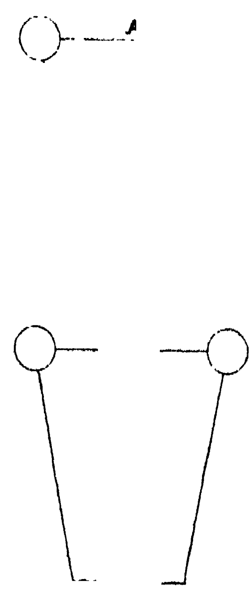


FIG. 2.

flaps. The type of fracture appears to depend upon the manner in which the limits of the proposed base line are cut.

If, by cutting three sides, a flap is fashioned so that the base lies between two trephine holes (Fig. 1, A), and the flap so formed is then bent outwards until fracture occurs along the base line, this line will be found to be jagged and irregular (Fig. 1, B). If, however, by cutting three sides, the flap is fashioned so that the base lies between saw cuts (Fig. 2, A), and the flap so formed is bent outwards until fracture occurs along the base line, this line will be found to be even and regular (Fig. 2, B). I have verified this on numerous occasions, and have also fashioned flaps from, and performed the same experiments with, other materials, such as three-ply wood, dried bone, and cardboard, and find that the results are constant in each case. The difference in the type of fracture of the base line no doubt depends upon the difference in concentration of stress at its limits.

In an article on osteoplastic craniotomy in the current number of the *British Journal of Surgery*, I have directed attention to the facts outlined here, but I believe that they may have a wider application than cranial surgery, and hence this letter.

LAMBERT ROGERS.

Welsh National School of Medicine,
The Royal Infirmary, Cardiff,
Oct. 20.

Autosyndesis among *Crepis setosa* Chromosomes.

IN a paper [1] dealing with the connexion between cytology and taxonomy, Prof. Tischler makes a statement to the effect that the four haploid chromosomes of *Crepis setosa* conjugate to form two pairs at the time of meiosis in the species hybrid *Crepis biennis* (n 20) $\times$ *C. setosa* ($n=4$). This he credits to us in a paper [2] in which we described a constant fertile form, *C. artificialis*, derived from these two species. Prof. Tischler also expresses doubt as to the occurrence of such a phenomenon. He says (p. 48): "Nicht dur die 20 Chromosomen der ersten Art schlossen sich autosyndetisch zu Paaren zusammen, sondern auch die 4 der zweiten. Wir erhalten so 12 Gemini. Und es ist doch die Zerlegung der vier Chromosomen in zwei einander 'homologe' Paare mehr als unwahrscheinlich."

The purpose of this letter is to direct attention to the fact that Prof. Tischler has misread our description of the origin of *Crepis artificialis*. This new species arose from a fourth generation plant of the cross between the two species *C. setosa* ($n=4$) and *C. biennis* ($n=20$). In the F_1 the 20 *biennis* chromosomes conjugate to form ten pairs while the *setosa* chromosomes remain as univalents and are distributed at random to the gametes. Thus all the F_2 progeny receive 20 *biennis* chromosomes (10 pairs) and a random number from *setosa*. *C. artificialis* arose from the union of two gametes, each of which had received 10 *biennis* chromosomes and the same two *setosa* chromosomes, thus producing a diploid complex having 20 *biennis* chromosomes (10 pairs) and 4 *setosa* chromosomes (2 pairs). Only two of the four types of *setosa* chromosomes are present in the fertile form called *Crepis artificialis*. This fact was repeatedly pointed out in the paper to which Prof. Tischler refers.

The following quotations from our original paper should be sufficient to correct the statement quoted above. "The two *setosa* chromosomes in the *artificialis* complex are quite readily recognized by their morphological characters and each is present twice. These are the first and fourth types mentioned above" (p. 309). "*Crepis biennis*, a species with 20 pairs of chromosomes, has been crossed successfully with two other species of *Crepis*, namely, *C. parviflora* Desf. and *C. rubra* L. During gamete formation in these F_1 hybrids, Mrs. Lesley found that, as in the *biennis-setosa* F_1, the 20 *biennis* chromosomes conjugate to form 10 pairs, while the chromosomes from the other

species remained as univalents and were distributed at random. We have also observed this phenomenon in a more recently made hybrid of *biennis* and *setosa*" (p. 305).

J. L. COLLINS.
LILLIAN HOLLINGSHEAD.
PRISCILLA AVERY.

[1] Tischler, G. "Verknüpfungsversuche von Zytologie und Systematik bei den Blutenpflanzen." *Bericht. Deutsch. Bot. Gesell.*, **47**, 31-49; 1929.
[2] Collins, J. L., L. Hollingshead, and P. Avery. "Interspecific hybrids in *Crepis* III. Constant fertile forms containing chromosomes derived from two species." *Genetics*, **14**, 305-320; 1929.

The Mechanism of Formation of the Latent Photographic Image.

IN 1925, with S. E. Sheppard and R. P. Loveland, I proposed the concentration speck theory of the latent image.[1] According to this hypothesis the action, during exposure, of pre-existing silver sulphide-containing specks (discovered by S. E. Sheppard [2]) on the surface of the silver halide grains of photographic emulsions, is confined to increasing their size by accretion of photochemically reduced silver atoms to form a nucleus large enough to induce developability. A mechanism of the formation of the latent image was proposed by me [3] on the basis of the experimental results of G. B. Gudden and R. Pohl on photoconductance.[4] It was supposed that the speck contains silver and silver sulphide, which, adsorbed on the surface of the silver halide crystal, form the electrodes of an elementary voltaic cell of the type $Ag/AgBr/Ag_2S$ having silver halide as the electrolyte, the external circuit being completed by contact between the silver and the silver sulphide. The growth of the speck is due to the electrolytic deposition of silver from the electrolyte.

In a recent criticism F. C. Toy and G. B. Harrison [5] regard such a theory as difficult to accept in the light of their experimental results. They point to the fact that exposure to light for a fraction of a second will normally make a photographic emulsion developable. They think that it would require an enormous increase in the voltage of the cell or a corresponding increase in the electrolytic conduction of the electrolyte to produce in this way a developable centre. This is not necessary. It is evident that the larger the speck is, below a certain limit giving spontaneous developability, the less the added number of silver atoms necessary to make the grain developable. Hence the less the exposure required for this and the greater the apparent sensitivity of the grain. They also consider that the variation of the photographic sensitivity with temperature presents a further difficulty. The sensitivity at the temperature of boiling liquid oxygen is apparently still too high to agree with an electrolytic photoconductance effect which may be expected to be vanishingly small at this temperature. This objection again ignores the effect of the size of the pre-existing speck. Only if sensitivity specks were totally absent would the temperature coefficient of photographic sensitivity be comparable with that of electrolytic photoconductance.

A. P. H. TRIVELLI.

Research Laboratories, Eastman Kodak Co.,
Rochester, N.Y., Oct. 10.

[1] *J. Franklin Inst.*, **200**, 51; 1925.
[2] "Colloid Symposium Monograph", **3**, 76; 1925. *Phot. J.*, **65**, 380; 1925.
[3] *J. Franklin Inst.*, **204**, 649; 1927. **205**, 111; 1928. NATURE, Nov. 19, 1927, **120**, p. 728.
[4] *Physik. Zeitschr.*, **22**, 529; 1921. *Zeitschr. f. Physik*, **6**, 248; 1921. **7**, 65; 1921.
[5] *Proc. Roy. Soc.*, A, **127**, 613; 1930.

Molecular Weight Determination in Camphor Solution.

IN view of the increasing use of a certain excellent and convenient procedure for the determination of molecular weights of substances cryoscopically in camphor solution, the observation should be made that the usual manner of reference to the method in our chemical journals scarcely bestows credit where it is most due.

In the year 1912 Jouniaux,[1] as a result of his "Étude de quelques mélanges binaires contenant du camphre", pointed out that "le camphre présente donc les qualités requises d'un bon solvant cryoscopique". Soon afterwards he published a paper,[2] entitled "Sur l'utilisation du camphre comme solvant cryoscopique", in which he noted the advantage that "un thermomètre ordinaire gradué en degrés" was quite satisfactory for the determinations of the necessary melting points.

In 1922 Rast,[3] without reference to previous work, suggested that the determination of melting points of solutions in camphor of about 10 per cent strength (which, unlike stronger solutions, are seen from Jouniaux's results to exhibit sharp melting points) could conveniently be made in capillary tubes in the ordinary way. This was his only essential innovation.

Rast further (without discussion) adopted 400 as the molecular lowering of freezing point for camphor, calculating this value from melting points of salol-camphor mixtures given in Landolt-Börnstein-Roth (4th edn., p. 556) which themselves are taken from a paper by Caille.[4] Jouniaux (loc. cit.) had previously deduced a higher value, namely, 498. The latter figure seems preferable, not only because camphor is known sometimes to combine with phenols,[5] but also because it is subject to an independent confirmation.[6] From van 't Hoff's relation the latent heat of fusion is seen to be 8·24 cal. Calculated from vapour pressure determinations of camphor by Ramsay and Young, Allen, and Vanstone, combined with a knowledge of the specific volumes of camphor in the liquid and solid states, a value of the latent heat of fusion is obtained actually *identical* with that deduced from van 't Hoff's equation. Better verification could not be desired.

R. J. W. LE FÈVRE.

University College, London, W.C.2.

[1] *Bull. Soc. Chim.* (4), **11**, 546; 1912.
[2] *Ibid.*, p. 722.
[3] *Ber.*, **55**, 1051, 3727; 1922.
[4] *Compt. rend.*, **148**, 1461; 1909.
[5] Léger: *Bl.* (3), **4**, 725; Caille: loc. cit.; Wood and Scott: *J.C.S.*, **97**, 1573; 1910.
[6] Jouniaux: *Compt. rend.*, **154**, 1593; 1912.

Chemistry and Plant Protection.

To remedy the inadequacy of present-day insecticides and fungicides in the control of crop pests and diseases, two courses are open—the discovery of new insecticidal and fungicidal substances, and better utilisation of existing materials. In this second alternative the chemist has assisted, for example, in determining the one or more active constituents of complex mixtures such as tar oils, lime sulphur, and pyrethrum extract, and particularly in evolving methods of standardisation. The biologist, however, whilst continuing to look to the chemist for the provision of fresh materials, is inclined to forget what knowledge of existing fungicides and insecticides the chemist has already provided. With painful frequency, reports of trials appear in which the materials tested are inadequately described, though knowledge of the probable active constituents and their estimation is available. By failing to employ this knowledge in his field work the biologist obtains results which, lacking

in essential details, cannot be reproduced or turned to use by other workers.

To describe a spray as "ammonium polysulphide (0·5 per cent)" without giving the composition of the ammonium polysulphide solution which was diluted 1 in 200; to give "lead arsenate, 4 lb. per 100 gallons" without particulars of the arsenic content of the paste or powder used; to state "1 per cent White oil emulsion" without giving the characteristics of the oil, are examples of this indifference on the part of the biologist. Such cases of inadequate description are to be met in almost every horticultural periodical, and even in research station reports. As the materials examined are of variable composition, the results are about as valuable as an estimate of size by the familiar method of comparison with a lump of chalk.

It is true that in some cases it is impossible to give sufficient details of composition because analytical methods are not available or our knowledge of the active constituents is insufficient. May not this be due in turn to an absence of demand on the part of the biologist for more accurate knowledge of the materials he finds of use?

H. MARTIN.

South-Eastern Agricultural College,
Wye, Kent.

Synthesis of Munjisthin.

MUNJISTHIN, a dihydroxyanthraquinone carboxylic acid occurring in *Rubia tinctorum*, *Rubia sikkimensis*, and *Rubia munjistha*, has been synthesised by us in the following way:

2 chloro-6-methoxy toluene (Ullmann and Panchaud; *Annalen*, 350, 108; 1906) is condensed with phthalic anhydride in presence of aluminium chloride giving 2′ chloro-3′ methyl-4′ methoxy-benzoyl-2-benzoic acid (M.P. 202° C.), which on treatment with sulphuric acid gives 2 chloro-3 methyl-4 methoxy anthraquinone (M.P. 197° C.). On demethylation with anhydrous aluminium chloride this gives 2 chloro-3 methyl-4 hydroxy anthraquinone (M.P. 324°-325° C.). On oxidation with nitrous acid in presence of boric and sulphuric acids according to the method of Farbenfabriken vorm. F. Baeyer and Co. (D.R.P. 273341) the chloro-hydroxy-methyl-anthraquinone is converted into dioxyanthraquinone carboxylic acid (M.P. 231°) (cf. Ullmann and Schmidt: *Ber.*, **52**, 2111; 1919), the melting point of which is not depressed by admixture with natural munjisthin obtained from *Rubia munjistha*.

The paper is being communicated to the *Journal of the Indian Chemical Society*.

Three years ago one of us (P. C. M.) had the pleasure of communicating to NATURE (Nov. 19, 1927, **120**, 729) the "Synthesis of Rubiadin".

P. C. MITTER.
HAROGOPAL BISWAS.

University College of Science,
92 Upper Circular Road,
Calcutta, Sept. 18.

Experiments on Binaural Sensations.

IN experiments carried out in this Institute we have investigated some of the points raised by Mr. Humby in his letter published in NATURE of Nov. 1.

Differences either of intensity or of phase (time) may be concerned in binaural localisation of sound. It is true, as Mr. Humby says, that it is difficult to design apparatus for phase variation in which intensity changes are completely eliminated; on the other hand, it is possible to determine these changes, and even to balance the effect of a phase shift against that of a difference of intensity.

We have carried out experiments of this kind and find that the variation of intensity required to counterbalance the effect of a given phase (time) shift is very much larger than that which is unavoidably associated experimentally with that shift.

J. H. SHAXBY.
F. H. GAGE.

Physiology Institute,
University College of South Wales,
Newport Road, Cardiff, Nov. 4.

Liquid Drops on the Same Liquid Surface.

IN two previous papers,[1] I have mentioned that water at ordinary temperature is not a suitable liquid for forming "liquid drops floating on the same liquid surface". In August 1930, however, I observed at Den Kund (Dalhousie hills), at a height of about 1000 ft. above the sea-level, that water is quite a suitable liquid for easy formation of either primary[2] or secondary drops. The life of these drops is also found to be longer. The splashing gives easy formation of secondary drops of quite a long life. The temperature of the water was about 34° F. The surface tension of water at this temperature is 76·53 dynes per cm., and viscosity 0·0179 c.g.s. units.

L. D. MAHAJAN.

Physics Laboratory, Mohindra College,
Patiala, India, Oct. 4.

[1] (*a*) "Liquid Drops floating on the Same Liquid Surface", J. B. Seth, C. Anand, and L. D. Mahajan, *Phil. Mag.*, Feb 1929. (*b*) "The Effect of the Surrounding Medium on the Life of Liquid Drops floating on the Same Liquid Surface", L. D. Mahajan, *Phil. Mag.*, London, 1930 (in the press).

[2] See *Phil. Mag.*, London, Seventh Series, No. 42, Feb. 1929, page 248.

Upper and Lower Palæolithic Man at Kirmington, North Lincolnshire.

AS the result of recent investigations carried out by me at Kirmington, I am able to state that the uppermost or 'Brown' Boulder Clay contains flint artefacts of Upper Palæolithic types, whilst from the immediately underlying Glacial (cannon-shot) Gravels I have recovered a series of derived flint implements of Early Mousterian type. Similar implements, in a still more derived condition, I found in the shingle gravel which overlies the estuarine warp.

These observations, which I propose to describe in full at a later date, confirm the conclusions arrived at by Lamplugh and by me with regard to the sections at Danes' Dyke on Flamborough Head. The variableness of the "Brown Boulder Clay" at Kirmington might profitably be studied by geologists.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2.

Traces of Metals in Animal Tissues.

To the various elements referred to by Messrs. H. M. Fox and Hugh Ramage in their interesting letter published in NATURE of Nov. 1, there are three which may still be added.

Vanadium is stated to occur in considerable quantities in certain Ascidians; arsenic—sometimes in not inconsiderable amounts—is almost ubiquitous; and I have myself recently observed the unexpected presence of antimony. With regard to this last-mentioned element, I hope to publish a communication as soon as the work is completed.

A. CHASTON CHAPMAN.

Chemical Laboratories,
8 Duke Street, E.C.3.

The Synthetic Activities of the Cell.*

By Prof. H. S. RAPER, C.B.E., F.R.S.

UNLIKE the chemist, the animal cell has a very limited choice of raw materials from which synthesis must start. These are the components of the common foodstuffs. When they have undergone the preliminary processes of digestion they provide in all about thirty substances which may be regarded as available for the building up of new compounds by the cell. Given these raw materials, can we in every instance indicate which is the likely starting-point for the synthesis of substances the constitution of which is known or partly known? This question must still be answered in the negative for such well-known products as cholesterol and the unconjugated acids of bile.

With the purine bases, which are components of nuclear material and therefore present in all cells, this question of indicating the probable raw material for their synthesis must also be answered in the negative, but with less emphasis than in the case of cholesterol and the bile acids. The amino acid histidine, which contains a five-membered ring similar to that found in the purine bases, is their most likely precursor on structural grounds. But we have as yet no experimental evidence that indicates clearly their origin from this amino acid in the body. Until this has been proved, it is perhaps useless to speculate as to the chemical processes involved in the transformation.

An example of a synthetic product which bears a fairly close structural relationship to two of the amino acids which are found in proteins is adrenaline. These two amino acids, phenylalanine and tyrosine, have practically the same carbon skeleton as adrenaline. Either of them might give rise to adrenaline by successive oxidation, methylation of the amino group, and loss of carbon dioxide. That a part of the necessary oxidation process can be brought about by means of an oxidising enzyme, tyrosinase, has already been demonstrated.

If, however, we consider whether a process of this kind, operating in the cells of the adrenal gland under specific conditions, gives rise to adrenaline, difficulties appear. When we remember that the oxidation of one substance may only take place if another is reduced; that a reaction taking place in one compound may only be possible when some other reaction takes place alongside it—in other words, that in the living cell there is a continuous and complex interplay of chemical reactions—then it is not surprising that the discovery of the mechanisms by which adrenaline is formed, although a simple problem at first sight, is probably in reality very complicated.

The case of thyroxine is comparable with that of adrenaline. Thyroxine is a relatively simple chemical substance which could conceivably be produced by the oxidation of diiodotyrosine. The last-named compound has recently been shown to be present in the thyroid gland and this makes the presumption that it is the mother substance of thyroxine all the stronger. Yet it has not been demonstrated either *in vitro* or *in vivo* that thyroxine may be produced from diiodotyrosine.

We may now pass on to consider a process in which the raw material is known with certainty but the chemical reactions by which the synthesis takes place are relatively obscure. I refer to the production of fat from carbohydrate. Lawes and Gilbert, in their classical experiments at Rothamsted on the fattening of farm stock, showed indubitably that animals can produce fat from starch. Since the starch is converted into glucose in the alimentary canal prior to absorption, we may consider glucose as the starting-point of the synthesis.

The most likely chemical explanation of the origin of the fatty acids is that they are built up, two carbon atoms at a time, from some simple reactive substance which is first produced by degradation of glucose. Acetaldehyde and pyruvic acid have both been suggested as probable participants in a reaction of this kind, the former condensing with itself as in the well-known aldol condensation, the latter either with acetaldehyde or with some higher aldehyde containing an even number of carbon atoms produced in the earlier stages of the reaction. By both of these methods it has been shown that *in vitro* aldehydes with an even number of carbon atoms in a straight chain can be built up step by step and these by oxidation can be readily converted into the corresponding fatty acids. Unsaturated linkages in the chain may be produced by either method, so that this requirement in the hypothetical synthetic method is also satisfied. Further, the condensation takes place in weakly alkaline solution or under the catalytic influence of certain organic bases, so that drastic treatment is not necessary to bring out the reaction. So far, this evidence for the mechanism of synthesis of the fatty acids is purely chemical and the grounds on which it can be put forward are largely chemical ones. It is known also that acetaldehyde and pyruvic acid, the intermediates postulated in this hypothesis, can be produced in the body. But there the question rests for the present so far as higher animals are concerned. When we know what the conditions are which set the process of fat synthesis going, and when we are able to reproduce them at will in animals, it may be possible to determine what are the intermediate substances concerned.

More success has been achieved by a study of the formation of fatty acids in micro-organisms. Bacteria which form butyric acid from glucose have been found to produce in addition both lactic acid and acetaldehyde. These same bacteria will also produce butyric acid from pyruvic aldol though not from aldehyde ammonia, aldol, or pyruvic acid itself. Neuberg and Arinstein, who investigated this type of fermentation, conclude that pyruvic aldol is the precursor of the butyric

* From the presidential address to Section I (Physiology) of the British Association, delivered at Bristol on Sept. 4.

acid when it is formed from carbohydrate. But it has also been shown that in this so-called butyric fermentation fatty acids containing an even number of carbon atoms higher in the series than butyric are formed, namely, hexoic and octoic acids. This makes it appear probable that the processes by which these lower members of the series of fatty acids are formed in bacterial fermentation may be the same as those by which higher members of the series are formed in animals.

The intensive study during the last few years of the processes of alcoholic fermentation and the chemical events which occur in muscular contraction has revealed such close similarities that we are becoming forced to accept the view that certain fundamental activities of the living cell, whether animal or vegetable, may be carried out by an almost identical mechanism. It may therefore be that we shall eventually discover the reactions responsible for the synthesis of fat in animals by investigating the processes by which it occurs in vegetable forms, such as bacteria or moulds.

Even if these reactions be the right ones, the problem still remains as to how they are accurately controlled within the cell. Some of the substances concerned in them are diffusible and very reactive, and we should have to explain how diffusion away from the site of reaction is prevented. To overcome difficulties of this kind it is becoming common to invoke the intervention of surface forces. There is, however, not much experimental evidence as yet which helps us to explain by such intervention the mechanism of synthetic processes even of such a simple kind as the reversal of an enzyme action.

Freundlich in his Liversidge Lecture to the Chemical Society last year described experiments on the influence of charcoal in modifying the velocity of certain reactions. These showed that the stability of a substance on a surface may be greater than in homogeneous solution under similar conditions. It must be borne in mind, however, that in these experiments very large quantities of charcoal were used compared with the amounts of the substances the equilibria of which were being studied. So much so that in the reaction in alkaline solution the bromoethylamine was practically completely adsorbed and the reaction was taking place entirely on the charcoal surface. Can one postulate such conditions during the continuous synthesis of substances in the cell, glycogen from glucose, for example? It seems to me that to explain the rapid accumulation of synthetic products such as fat or glycogen which we observe in cells, something more than a shift in the equilibrium of the reactions due to surface forces is necessary. Such a condition favouring synthesis could only operate for a time until the surface became saturated. We must therefore postulate some additional mechanism whereby the synthesised product is removed from the sphere of action, for if it diffused off the surface again it would be subject to the equilibrium conditions which are present in the solution. It may be that the arrangements in the cell are such that only small amounts of the substrate are dealt with at a time, so that complete synthesis is achieved and the synthetic product removed.

We have also to consider how the synthetic product is protected in the cell from the disruptive agencies which exist there. Arrangements for this purpose must be present, since we know that substances may accumulate in cells which contain enzymes that hydrolyse them. Whatever these arrangements are, they appear in certain instances to be closely associated with the life of the cell, for after death they cease to operate and the synthetic product is again broken down. However difficult it is to form a conception of them, it may be necessary to do so, since they must form a part of any system which is put forward to explain synthesis as a result of the intervention of surface phenomena.

We may now consider two syntheses in which there is little or no doubt about the raw materials or some of the chemical reactions involved. These are the production of glycogen and of proteins.

It has been proved that when glycogen breaks down in the liver it gives rise to glucose. Lohmann and also Barbour have succeeded in obtaining glycerol extracts of liver and muscle which hydrolyse it, but the product appears to be a trisaccharide and not glucose. No enzyme which by itself hydrolyses glycogen to glucose has yet been obtained from animal tissues. It is of interest that pancreatic and salivary amylase produce isomaltose from glycogen. These results suggest that there may be some configurational difference between glycogen and starch which accounts for their difference in behaviour with diastatic enzymes. Be that as it may, it appears natural to assume that the synthesis of glycogen from glucose in the cell is brought about by the simple reversal of a hydrolysis which may be catalysed by enzymes under appropriate conditions. These conditions have, however, not yet been realised *in vitro*. Barbour was unable to demonstrate any synthesis of glycogen from the trisaccharide produced by the muscle enzyme even in highly concentrated solutions.

This failure to obtain evidence of the synthesis of glycogen from the products of its hydrolysis makes it legitimate to consider whether we are right in adopting the orthodox view that the synthesis of glycogen from glucose in the living cell is brought about by a reversal of action of the enzyme or enzymes which hydrolyse it. There are other facts which merit consideration in any discussion of its mode of synthesis in the body. When an animal is fed liberally with glucose or fructose, it converts a part of them into glycogen in the liver. The evidence for this is indubitable. It implies, therefore, either a conversion of fructose into glucose before the condensation to glycogen occurs, or a conversion of both into some common form of hexose which then undergoes the condensation. Further, there is a considerable amount of accredited evidence that many substances not belonging to the sugar group can be converted into glucose in the animal body. Such substances, therefore, must be regarded as potential glycogen formers. Whatever the processes

may be which eventually result in the production of a hexose from these diverse substances, the most remarkable thing about them, to my mind, is that the hexose is always *d*-glucose. We have no satisfactory explanation for this striking stereochemical performance, but the facts suggest that the condensation of the two—or three—carbon units to a hexose is brought about under such specific conditions of strain that only the *d*-glucose configuration can result, much as coins must be minted in a definite mould to become currency.

A consideration of all the data which have been accumulated regarding the synthesis of glycogen makes it probable that more than the mere reversal of enzyme action is concerned. It is certain that the cells in which it occurs must be supplied with oxygen. Fletcher and Hopkins showed with muscle that its structure must be maintained, and with liver the synthesis certainly only takes place in the intact organ. Do not these facts point to the conclusion that it is only the living cell that can bring about this synthesis ? And if this be so, cannot we go further and suggest that the substances from which glycogen is produced, or bodies derived from them, must first become bound up with, or at some stage form an integral part of, the living structure before they are converted into glycogen ? The evidence at least suggests that some such conception of the process may not be far from the truth.

We may now pass to the consideration of the synthesis of proteins. In the early part of this century, due largely to the elegant methods introduced by Emil Fischer, rapid advances were made in our knowledge of the structure of proteins. These advances led to a picture of protein structure which has become generally accepted, namely, that the protein molecule is formed by the union of amino acids through an amide linkage.

The investigation of the structure of proteins, which are closely allied in origin, composition, and general chemical behaviour by immunological and in part by chemical methods, has taught us how intricate the mechanism must be by which they are built up. The facts brought out by the classical work of Dakin and Dale on the albumin of the duck's and hen's egg serve to exemplify this. The only chemical difference that could be shown between these two proteins was concerned with the disposition in the molecule of some of the leucine, aspartic acid, and histidine. But when used as antigens in the anaphylactic reaction they were markedly specific.

These results indicate that the chemical structure of the molecule is different in proteins which are very similar both in general chemical properties and in biological origin. They suggest that the protein molecule produced by a particular type of cell is always built up in a distinctive and, so far as we can determine, an unvarying pattern. We may deduce from this that although the general method of protein synthesis—that is to say, the mechanism by which amino acids are joined up —may be the same in all cells, yet there must be arrangements in the cell which enable only one particular, final pattern to result from the synthesis.

What are the methods by which the amino acids are caused to combine ? The use of proteolytic enzymes in an attempt to bring about synthesis under conditions which have been partially successful with other substances has often been tried and nearly as often has failed. Two examples of protein synthesis by enzyme action have been described. The most acceptable of these is Taylor's production of a protamine by a glycerol extract of clam liver from the products of its complete hydrolysis. The other is the preparation of so-called plasteins from the products of the partial hydrolysis of certain proteins by pepsin. A comprehensive review of the subject of plastein formation by Wasteneys and Borsook, who have themselves made notable contributions to this problem, has led them to the belief that in this phenomenon we have a true resynthesis of protein from some of the more complex of its hydrolytic products.

Even if this be accepted as a possible explanation, it still leaves many questions regarding protein synthesis unanswered, and not the least difficult of these is the problem of how the separate amino acids are brought together to form the specific proteose substrates which one must postulate as combining—and in a definite order—to produce the particular protein which is characteristic of the cell which synthesises it.

The process by which the substance of the cell is increased, the building up of protoplasm, is one which must be closely allied to protein synthesis, since the material we call protoplasm is constituted for the greater part of amino acids, united, so far as can be ascertained, by the same sort of linkage that we find in proteins. The protoplasm of the dead cell responds to all the tests by which we identify protein, it is subject to the action of hydrolytic agents in the same way, and yields identical products when hydrolysed.

Ought we not therefore to look for some of the mechanisms of protein synthesis in the processes which operate when the living cell grows, and can we by any stretch of imagination account for this by a reversal of the action of one or more hydrolytic enzymes ? It appears inconceivably difficult to do so. The extreme specificity of the reaction, which necessitates that at a given phase of the synthesis one particular amino acid and that one alone can be added as the next link in the molecule, requires such a multiplicity of enzymes and such a remarkable degree of control of their action as to be almost outside the range of probability. When we remember, however, that one of the prime attributes of life is that it is a dynamic condition, it does become possible to form a conception of protein synthesis in relation to that fact. The experiments of Willstätter and others have shown that to some extent the specificity of enzymes is accounted for by the 'carrier' with which they are associated. It is not inconceivable that a catalyst capable of bringing about the union of amino acids in the living cell and ultimately fashioning its protoplasm may be attached to or associated with a

'carrier' which, instead of having a fixed configuration, as with the enzymes that we can extract from the dead cell, has one which is continually varying, this dynamic state being characteristic of the living material of the cell.

If, further, we could assume that the variations in the configuration of the carrier were cyclic, always going through a definite series of phases, it might be possible to account for the fact that at any particular phase of the cycle the configuration would be such as to favour the synthetic union of one particular amino acid rather than any other because of its spatial arrangement. The assumption of cyclic changes in simple or complex living organisms is not new in physiology, and it is not unlikely that they occur in parts even of the cell itself.

The possibility that protein synthesis is associated with some part of the cell which is undergoing cyclic changes, and is thus alive, raises the interesting question of the site of this and possibly other syntheses, such as those of fat and glycogen. Are all parts of the cell, that is to say, both nucleus and protoplasm, to be regarded as alive in the sense I have indicated, and therefore to be considered as regions in which syntheses depending on life can be brought about?

It is necessary not to confuse the terms irritability and life. It is true that what we term irritability is usually taken to imply that the tissue which shows it is living; but taking the nerve fibre as an example, it would appear that the maintenance, for a time at least, of the irritability of protoplasm and its restoration when it has disappeared—but not irreversibly—does not require the presence of the nucleus. It may require oxygen or the presence of certain ions, but this may merely mean that the labile state of the protoplasm has been upset by the products of the cell's activity, and removal of these will restore it to its irritable condition.

We have no evidence that irritability as a manifestation of what we call life is more than the possession of extremely labile structures, sensitive to minute environmental changes. The nucleus, on the other hand, is essential to the continuous life of the cell and its growth. It appears also to determine very largely the magnitude of the respiratory processes which occur in it at rest, though not necessarily the excessive respiration observed in the recovery from functional activity. Can we therefore go so far as to say that the nucleus is the seat of those synthetic activities of the cell which appear to depend on its living character rather than on its irritability, or have we to regard the protoplasm as equally living, so that it is able to reproduce itself and in addition bring about such syntheses as those of fat and glycogen?

There is something to be said in favour of the idea that the protoplasm is not living in the sense in which the nucleus is, and therefore is less likely to be the seat of certain synthetic processes. It is, I think, quite a tenable view that protoplasm is made up, largely but not entirely, of combinations of amino acids such as we find in the proteins, and that it is synthesised by the nucleus to serve special as well as certain general requirements. These special requirements must and do vary greatly with each type of cell.

Consider the mammalian erthroblast. The principal substance in its protoplasm is the protein hæmoglobin. It is doubtful whether this cell exists except to produce hæmoglobin. When it has matured, the nucleus degenerates and disappears, leaving the red blood corpuscle. Along with this the respiratory activity of the cell practically disappears too, and there is not much discoverable in it except hæmoglobin. It is certainly now not living in the sense in which its progenitor, the erythroblast, was. Is it not reasonable to suggest, therefore, that the production of hæmoglobin as the erythroblast grows and matures is a function of the nucleus and not of the protoplasm of this cell? All semblance of further synthesis of hæmoglobin certainly disappears when the nucleus goes. The adoption of such a view does not imply that having produced the protoplasm of a cell the nucleus has nothing more to do with it. We know that in some indefinable way the nucleus in most cells controls the structure of the protoplasm and maintains its lability, but we have no knowledge as yet of the mechanism by which this is brought about.

One property of proteins, which may account in a general way for the presence of protein-like structure in protoplasm, is their buffering power. The nucleus is probably the most labile part of the cell. The chemical reactions proceeding in it may demand an environment that has to be finely controlled as regards changes in reaction or the concentration of certain ions. The protoplasm may thus serve as a protective layer between the nucleus and the external world, guarding it from changes which would otherwise terminate its existence. The known properties of the proteins, both chemical and physical, may be useful to this end, to which they are almost ideally suited.

Even if we can accept as possible the unorthodox view that the nucleus is the only living part of the cell, and is therefore the only part that can bring about syntheses which depend upon life, it does not solve our difficulties in explaining how they are achieved. It merely narrows down the possible sites in the cell in which they occur. The nucleus itself is a complex structure, and we have as yet few experimental methods for elucidating it. Most biologists would, I think, agree that the cell has arisen by a process of evolution from something simpler and eventually from non-living materials. It cannot have come as a 'bolt from the blue'. If we regard the nucleus as the only living part of the cell, then we may justly regard the protoplasm as something that has been acquired or developed in the process of evolution and is now necessary to its existence. We do not know definitely, however, of nuclear material which is living and devoid of its protoplasmic envelope unless such an arrangement is present in the bacteria. But the investigation of filterable viruses has given an indication that material possessing the

prime attribute of life, namely, the power of reproducing itself, exists possibly in simpler forms than we find in the smallest visible organisms.

If we agree that the cell has evolved from something simpler, then we might expect to find such elementary forms of life coexisting with it, did we but know how to look for them. The filterable viruses may represent such forms, and their chemical characters may resemble those that we find in the nucleus of the cell. The ability to synthesise protein may be a property which living material only acquired at a late stage of its evolution, and that property may be one which in the process of time has come to be essential for the maintenance of the complex structure of the nucleus as we see it to-day.

An Anthropometric Investigation on Twins.

THE latest contribution to the now considerable mass of literature bearing on the resemblances and differences between twins is a valuable memoir by Dr. Percy Stocks ("A Biometric Investigation of Twins and their Brothers and Sisters", *Annals of Eugenics*, vol. 4, April 1930). The tests and measurements were made during 1925-27 on twin children and their brothers and sisters in elementary and central schools of the London County Council, the ages of the children ranging from three to fifteen years. The characters considered in the present memoir—others will be dealt with later—include height; weight; length, breadth, and horizontal circumference of head; interpupillary distance; blood pressure; pulse rate; respiration rate; eye colour; hair colour; facial resemblance on an arbitrary scale of four classes; and finger-prints. The total number of children examined was 832 (392 boys and 440 girls), of whom 563 were members of twin pairs, 7 were surviving members of triplets, a few were odd twins who had a brother or sister at school, and the remainder were either siblings of twins, or pairs of siblings unconnected with twins, the latter being necessary to form a comparative group.

An investigation on such data is obviously not a simple matter. It is desired to compare (1) monozygotic twins, (2) dizygotic twins, (3) other siblings, with regard both to individual measurements (means, standard deviations, etc.) and correlations or differences between pairs. As was first pointed out recently by Dr. R. A. Fisher, the proportions of monozygotic and dizygotic twins amongst pairs of the same sex may, *if a character is normally distributed*, be estimated from the available data and the frequency distribution of differences analysed, but this does not give wholly what is wanted. Separation of monozygotic from dizygotic pairs on the basis of facial resemblance only is by no means so satisfactory as the unpractised observer might suppose: Dr. Stocks concludes (p. 81) that only about two-thirds of like-sexed twins can be at once separated by facial resemblance into two groups labelled 'identical' and 'fraternal', and even for these groups other evidence suggests that the diagnosis is really incorrect in a small proportion. The final conclusion reached is that finger-prints form the best fundamental test, with anthropometric measurements (height and head measurements) to decide doubtful cases, and definite rules are laid down for the purpose.

Assuming this analysis made, there is a further trouble due to the great range of age amongst the children observed, and differences of sex. Were the data subdivided into age and sex groups, the numbers in each group would be too few for valid comparison. This difficulty is surmounted by converting all measurements to standard age and sex, and only these converted or 'corrected' measurements are used. Further to increase the virtual numbers on which a comparison is based, by using relative deviations different measurements may be pooled together; for example, all the 'static characters', as Dr. Stocks terms them—height, the three head measurements, and interpupillary distance.

Finally, in an investigation of this kind, errors of measurement, and the errors involved in the fact that only single measurements were taken of such fluctuating characteristics as pulse and respiration rates, are of much more importance than they would be in most anthropometric investigations. To obtain information on these points and enable correction to be made, repeated observations were carried out on five individuals for fifty days. How important is this correction for errors and day-to-day variation may be seen from the fact that correlations between siblings are raised by about 90 per cent for pulse rate, 40 per cent for respiration rate, 20 to 30 per cent for blood pressure, though only by much smaller amounts of 0·25 to 2 per cent for the dimensional measures.

Making these corrections, mean correlations for the three groups work out as follows (Table XI., p. 103):

	Non-twin siblings.	Dizygotic twins.	Monozygotic twins.
Height	0·49	0·56	0·95
Head dimensions	0·45	0·45	0·83
Weight	0·38	0·46	0·94
Blood pressure	0·46	0·39	0·81
Pulse and respiration	0·27	0·39	0·86
Aggregate of 10 characters	0·42	0·47	0·85

The results suggest that correlations for non-twin siblings do not differ appreciably from those for dizygotic twins. Hereditary constitution appears to be more important in comparison with environment in regard to height and weight, rather less so in regard to head measurements, still less in regard to blood pressure, and least of all in pulse and respiration rates. Dizygotic twins are, in these data, on the whole inferior to their brothers and sisters in the physical measurements, but this is certainly not the case with monozygotic twins, except perhaps as regards weight.

Supplement to NATURE

No. 3185 NOVEMBER 15, 1930

Science Medals of Great Britain, Ireland, and the Dominions.

THE absence of any connected and inclusive account of the terms of the trusts and foundations under which the science medals of Great Britain, Ireland, and the Dominions are allotted, whether also of yearly, biennial, triennial, or of longer interval of distribution, forms sufficient reason for an attempt to fill this gap by bringing together information upon the different awards. While various academies and societies, incorporated and other, have from time to time instituted gifts of this description, information regarding them is often scanty, and, moreover, is not well known. It is proposed to divide the awards in three classes: (1) General; (2) Physical and Mathematical Sciences; and (3) Biological Sciences (including Geology and Geography).

For many years, in countries where scientific studies have been pursued, the award of gold, silver, or bronze medals, at varying intervals, in recognition of notable researches, has been accepted as an honourable and tangible expression of contemporary opinion regarding their character and worth. In addition, the practice is very generally observed of allocating gifts of money—in other words, *prizes*—for work in identical fields, a course which it would be mere affectation to deny is substantially parallel in purpose with the custom of awarding medals. In any event, both methods have been practised by world-known academies and societies.

In Great Britain, compared with other countries, the award of medals for past and current achievements in science finds fuller favour, it must be confessed, than that of monetary prizes, though, it is true, medals are frequently accompanied by the gift of balances of funds associated with the respective foundations. But here, such allotments are very moderate in amount, scarcely to be considered as prizes. The British tendency is mostly in the direction of the establishment of fellowships and post-graduate endowment, whereby the pursuit of various branches of natural knowledge may be provided for, or definite research work promoted. However, no rule exists, and societies and individuals are free to consult their own dictates, and form their own opinion regarding the kind of stimulation and the quality of effort it is desired to continue or inaugurate.

Certain considerations respecting types of science medals may be referred to, though at the risk of being didactical. A well-proportioned artistic medal appeals to persons of good taste and discrimination, especially if, in appropriate manner, it denotes its aim and purpose. An example complying with this standard, executed in silver or bronze, is preferable to a medal of poor interest and intent produced in the gold medium. In one case design is paid for from available funds; in the other, gold value. What might prove a legitimate source of pleasure and pride to the recipient may be sacrificed for a gift-horse in metal, weak, or frankly ugly. There are, however, limiting difficulties which cannot be overlooked. Mixed committees charged to discuss and decide upon the institution of medals not infrequently display a regrettable lack of judgment. At the end some compromise is inevitable. Yet in the service of science, medallic art may find surviving compensations, notwithstanding these pains and penalties.

Generally it is incumbent on the artist-designer of a modern science medal to portray on his obverse the lineaments of some person whose achievements are connected with the *raison d'être* of foundation. If, in regard to the reverse, his hands are not unduly tied, symbolism, imagination, and poetic fancy have scope for exercise. The reverses of medals of earlier centuries present an infinite variety of design and device. Most of them drew inspiration, in some form or other, from Greek and Roman coins, where the figures of deities with their attributes were symbolised. They serve the designer of the science medal in that he may associate pagan derivatives with modern developments of philosophy and natural knowledge. On the reverse of the Nobel gold medals awarded for physics and chemistry, we see Nature personified as the goddess Isis. But the reverse of the gold medal struck in 1907 by the Royal Swedish Academy of Sciences to commemorate the two hundredth anniversary of the birth of Linnæus depicts a student dissecting a flower; the art here is wholly pictorial in conception.

An authoritative critic has remarked that "more than anything else, the medal in its restrained limits, proves that art has nothing to do with mere quantities, and that within the small circle of a disc of metal the great artist can make his appeal as unerringly and as powerfully as upon square yards of canvas". It is in chief to French artists, working during the period since 1870, that we owe much that is in agreement with the foregoing comment. The medals of David, Chaplain, Dubois, and Roty commemorate men and women and signalise great events after the fashion of the traditions of the early Italian and German designers, and over and above is fancy and charm of detail. The late M. Roty stood at the head of

these artists. In a letter which the writer received from him in 1898 he says: " The rectangular form of medal was only adopted a few years ago. I was the first to re-employ this form, and it was so successful that my colleagues in France and in other countries followed my example. The habits of sheep are very much the same in all countries." The well-known rectangular plaquette of Pasteur was by M. Roty.

Medals of satirical implication, designed to provoke ridicule, were in circulation at the end of the sixteenth and throughout the seventeenth centuries. In the most part they bore reference to current and acute political and religious controversies, and hence do not concern us here. But it is worthy of note that science does not appear to have suffered from the satire of the die-sinker. Even at the time of Jenner's discoveries, though many lampoons and caricatures deriding the smallpox preventative were published, no satirical medal was issued.

In the preparation of modern medals the usual procedure of the artist-designer is to make a model in modelling wax on slate, to scale. From this a cast in plaster is taken, which may be worked over and serve as the final model. Bronze casts can now be obtained by the expert founders. If a struck medal is required, a cast in steel is made from the plaster model, and from it convex dies in soft steel are produced by the ' reducing machine ' ; after hardening, they serve then their mission, which is to punch out the concave dies for striking the medal.

Reference was made recently in this journal (Oct. 5, 1929, p. 557) to the observation of Gurwitsch that when the tip of one actively growing onion is brought near to the tip of another growing onion, whether end-on or broadside-on, mitosis is stimulated in the latter in the neighbourhood of the growing tip of the former; from which is deduced or foreshadowed an attractive hypothesis of biological rays and fields of force, a counterpart of the fields of force of physical science. Can it be that the medallic art of a distant future will have to consider the onion seriously; that whereas we already have *Primula* and *Nepenthes* (Darwin medal, Royal Society), a future designer may have to include *Allium* in his list of possible delineations?

I. General.

Royal Society of London.

Copley Gold Medal.—Founded in 1736, arising from a legacy derived in 1709 from Sir Godfrey Copley, Bart., F.R.S., and for some time used otherwise than in medallic gifts. Bestowed annually upon the living author of such philosophical research, either published or communicated to the Society, as may appear to the council to be deserving of that honour. No distinction of nationality governs allotment.

Royal Medals.—Two gold medals were founded by King George IV., the grants being continued by successive sovereigns. They are awarded annually (subject to royal approval) for the two most important contributions to the advancement of natural knowledge, published originally in His Majesty's dominions within a period of not more than ten years, and of not less than one year of the date of the award. The obverse of each medal bears the head of the reigning sovereign.

See, for other medals awarded by the Society, Physical and Mathematical Sciences and Biological Sciences sections.

British Association for the Advancement of Science.

Montreal Medal.—During the Montreal meeting (1884), the decision was taken to commemorate the visit by founding a bronze medal for annual award by McGill University for proficiency in applied sciences. The obverse bears the head of James Watt.

Toronto Medal.—From the income of a fund raised by members who attended the meeting (1924), two bronze medals and gifts of books are awarded annually to selected students of the University of Toronto.

South Africa Medal.—To commemorate the visit (1905), a fund was raised among the members who made the journey for the provision and endowment of a medal or studentship for South African students. The medal was struck in bronze from designs by Mr. Frank Bowcher The symbolical figure on the reverse has since served the Association as a badge.

Following upon the meeting in South Africa in 1929, a medal for scientific workers in South Africa not exceeding thirty years of age has been instituted, under an arrangement between the British and South African Associations.

Asiatic Society of Bengal.

Sir William Jones Memorial Medal.—Awarded biennially for Asiatic researches in science. The next award falls due in 1931.

See also Biological Sciences section.

Royal Society of Canada, Ottawa.

Flavelle Gold Medal.—The gift of Sir Joseph Flavelle of Toronto, and first awarded in 1925. It is allotted to fellows of the Society or others for original work in science or literature of especial merit. The medal is not necessarily bestowed annually. Since 1927 it has been awarded only for work in science.

Royal Society of Edinburgh.

Keith Gold Medal.—Instituted in 1820, and awarded biennially, together with a sum of money from the fund, for the most important discoveries in science made in any part of the world, but communicated by their author to the Society, and published first in its *Transactions*. In 1833 provision was made, during any biennial period, for a substantive mode in adjudication. The medal bears the bust of John Napier on the obverse.

Makdougall-Brisbane Gold Medal.—Instituted in 1855 by Sir Thomas Makdougall, Bart., president, 1832–60, and awarded biennially, together with a sum of money from the fund, to such person, for such purposes, for such objects, and in such manner as shall appear to the council most conducive to the promotion of the interests of science. For 1930–31 the medal (and prize) will be awarded for an essay, paper, or other work having reference to any branch of scientific inquiry, either material or mental. Open to all men of science. The obverse of the medal bears the head of the founder.

See also Biological Sciences section.

Royal Irish Academy

Cunningham Gold Medal.—Instituted under the bequest (1789) of Timothy Cunningham, of Gray's Inn, and first awarded in 1796. Medals have not been allotted since 1885, the interest of the fund having been devoted to the publication of memoirs. The head of Lord Charlemont, first president of the Royal Irish Academy, appears on the obverse of the medal.

Royal Society of Tasmania.

Society's Medal.—Founded in 1927 for the recognition of eminence in research, and for work of outstanding merit on behalf of the Society and the State. Awarded at intervals (irrespective of sex). The regulations are restrictive as regards residence in Tasmania and membership of the Society. The medal is oval in shape, and is struck in bronze.

African Society.

Society's Gold Medal.—Founded in 1920 by Mr. Henry S. Wellcome, a member of council, for annual award, in respect of eminent services rendered to Africa. A silver medal was also instituted by him at the same time in recognition of kindred services. The medals are in memorial of Mary Kingsley. The first recipient was Sir Harry Johnston.

Royal Institute of British Architects.

Grissell Gold Medal.—Awarded annually for meritorious work in constructive architecture.

The Institute has a series of medals at its disposal for the encouragement of various branches of architecture. We select one which bears relation to questions mutually concerning the architect and man of science.

Royal Society of Arts.

Albert Medal.—Instituted in 1862 as a memorial of H.R.H. the Prince Consort. Struck in gold, it is awarded for "distinguished merit in promoting Arts, Manufactures, and Commerce". The first bestowal was made in 1864 to Sir Rowland Hill, and annually since, irrespective of the nationality of the recipient. The obverse bears the head of the Prince Consort.

The Society also awards annually ten or twelve silver medals for the best papers read during the session.

Royal Scottish Society of Arts.

Keith Medal.—The Keith Prize was founded in 1833 by Alexander Keith, to be applied in sums of money or medals in rewarding inventions, improvements, or discoveries in the useful arts. The award frequently consists of a medal together with a sum of money.

Brisbane Medal.—The Brisbane Prize was instituted in 1856 by Sir Thomas Makdougall-Brisbane, Bart., to be awarded either in a medal or a medal along with plate, books, or money, to the authors (or inventors) of communications of merit.

Hepburn Medal.—The Hepburn Prize was founded in 1862 by John Stewart Hepburn, for inventions and communications approved by the Society. The award (annual or biennial) frequently consists of a medal together with a sum of money.

Society's Medal.—Awarded at the discretion of the council as a means of recognising special services rendered to the Society, or in such other manner as the Society may approve. The medals may be struck either in gold, silver, or bronze.

Royal Asiatic Society of Great Britain and Ireland.

Society's Gold Medal.—Instituted in 1897 to commemorate the sixtieth year of reign of Queen Victoria. Awarded triennially in recognition of distinguished services in Oriental research.

Burton Memorial Medal.—Instituted in 1925 to celebrate the birth centenary of Sir Richard F. Burton. Awarded triennially in connexion with a lecture dealing with the life of Burton, and his contributions to Oriental literature and studies of Eastern life and character. Also in respect of his explorations and travels and geographical achievements, or those of other famous explorers whose travels have led to an increase of geographical and ethnological knowledge. The medal is struck in silver; the obverse bears the head of Burton.

Royal Empire Society (formerly Royal Colonial Institute).

Society's Gold Medal.—First awarded in 1914 for a monograph on an Imperial subject. After 1915 the gift fell into abeyance during the remaining period of the War. On its revival in 1925, it was decided to award the medal for the work adjudged to be the best recent book on a subject of Imperial interest.

Royal Society of Literature.

Society's Gold Medal.—The Society was founded by George IV. in 1823, and incorporated in 1825. The first award of a medal was made in 1825 and bestowed upon James Rennell, F.R.S., the geographer. Awards are made at varying intervals. The obverse of the medal bears the head of George IV.

Royal United Service Institution.

Institution Gold Medal.—Founded in 1874, and awarded annually for the best essay on a naval and military subject alternately. The obverse bears the head of Athena.

Chesney Memorial Gold Medal.—Founded in

1900, and awarded at intervals to "the author of any specially eminent work calculated to advance military science or knowledge in the Empire". The medal was instituted to commemorate the services of General Sir George T. Chesney, K.C.B., R.E.

Chester Society of Natural Science, Literature, and Art.

Kingsley Memorial Medal.—Founded in 1877, and awarded "for having contributed materially to the promotion and advancement of some branch or department of Natural Science". The medal commemorates the Rev. Charles Kingsley, founder of the Society. The medal is struck in bronze, and bestowed annually. The obverse bears the head of Kingsley.

Victoria Institute, or Philosophical Society of Great Britain.

Langhorne Orchard Prize.—A silver medal for a prize essay on a subject bearing on science and religion. First given in 1925 and again in 1929. An open Bible is inscribed on one side of the medal.

II. Physical and Mathematical Sciences.

Royal Society of London.

Rumford Gold Medal.—Founded in 1796 by Count Rumford, F.R.S., and first awarded in 1800. Bestowed biennially upon the author of the most important discovery or useful improvement in heat or light during the preceding two years. The medal is also struck in silver; the obverse bears the head of Rumford.

Davy Gold Medal.—Founded in 1869 under the will of Dr. John Davy, a brother of Sir Humphry Davy. Awarded annually for the most important discovery in chemistry made in Europe or Anglo-America. The obverse bears the bust of Davy.

Sylvester Medal.—Awarded triennially for the encouragement of mathematical research, irrespective of nationality, and in honour of the life-work of Prof. J. J. Sylvester, F.R.S. First allotted in 1901. The medal is struck in bronze; the obverse bears the bust of Sylvester.

Hughes Gold Medal.—Founded under the will of Prof. D. E. Hughes, F.R.S., who died in 1900. Awarded annually for original discovery in the physical sciences, particularly electricity and magnetism, or their applications. The medal is allotted without restriction of sex or nationality; the obverse bears the head of Hughes.

See also General and Biological Sciences sections.

Royal Dublin Society.

Boyle Medals.—Founded in 1895, and awarded on the recommendation of the Committee of Science and its Industrial Applications in recognition of scientific work of outstanding merit done by Irishmen, or in Ireland, and not restricted to members. The medals are struck in bronze; the obverse bears the head of Robert Boyle from a bust of him in the possession of the Society. Two medals may be awarded annually, but in practice bestowals occur at irregular intervals.

New Zealand Institute, Wellington.

Hector Memorial Medal.—Founded in 1912 in honour of Sir James Hector, F.R.S., in association with a Hector Research Fund. The medal is struck in bronze, and bestowed annually in rotation for the following subjects: botany, chemistry, ethnology, geology, physics (including mathematics and astronomy), zoology (including animal physiology). Awarded to that investigator who, working within the Dominion of New Zealand, shall have done most towards the advancement of that (allotted) branch of science. In 1916, Sir Ernest Rutherford received the medal for researches in physics.

Royal Aeronautical Society.

Simms Gold Medal.—Awarded annually for the best paper read in any year before the Society on any science allied to aeronautics, for example, meteorology, wireless telegraphy, instruments. Allotted to a member or non-member.

Taylor Gold Medal.—Awarded annually for the most valuable paper submitted or read during the previous session before the Society. Allotted to a member or non-member.

Sir Charles Wakefield Gold Medal.—Awarded annually to the designer of any invention or apparatus tending towards safety in flying.

Society's Silver Medal.—Awarded at the discretion of the council, for some advance in aeronautical design. Allotted to a member or non-member.

Society's Bronze Medal.—Awarded under the same conditions as those for the silver medal, but for some less important advance in aeronautical design.

Royal Astronomical Society.

Society's Gold Medal.—Instituted in 1823, it was first awarded in 1824 to Babbage in respect of his calculating machine; also to Encke for his determination of the elliptic orbit of Encke's comet. Awarded annually, as may be expedient, for discovery in astronomy or research in the science. The obverse bears the bust of Newton.

Jackson-Gwilt Medal.—Arising from a personal fund established in 1861, the first award came up for allotment in 1897. Struck in bronze, it is bestowed at intervals of not less than three nor more than seven years, and for the promotion of astronomy. The obverse bears the bust of William Herschel.

Institution of Naval Architects.

Institution's Gold Medal.—Awarded annually by the council to any person (not being a member of

that body) who communicates a paper deemed to be of exceptional merit. The gift was established in 1877.

Chemical Society.

Faraday Medal.—Instituted in 1868 in connexion with the establishment of a Faraday lectureship, and usually awarded to foreigners. Struck in bronze, and bestowed at varying intervals. The obverse bears the head of Michael Faraday. The first award was made to Dumas in 1869.

Longstaff Medal.—Instituted in 1881 in connexion with a donation for research work in chemistry, provided by Dr. G. D. Longstaff. Awarded triennially. It is struck in bronze, and the obverse bears a portrait of Longstaff.

Harrison Memorial Prize.—In 1922 the Society established a memorial fund derived from friends and colleagues of Colonel Edward Frank Harrison, Deputy Controller of the Chemical Warfare Department during the War, having for application a triennial prize for the most meritorious and promising original investigations in chemistry by a natural-born British subject of either sex. A bronze medal allotted with the gift reproduces in scale the Society's War Memorial plaque.

Institution of Chemical Engineers.

Osborne Reynolds Medal.—Founded in 1928, the gift of Mr. F. A. Green. Awarded annually for meritorious work accomplished for the advancement of the Institution. The medal is struck in silver.

Moulton Gold Medal.—Founded in 1929. Awarded annually for the best chemical engineering paper of the year "of a mature character", read before the Institution and published in the *Transactions*. Awards may be made to non-members. The obverse bears the head of Lord Moulton.

Society of Chemical Industry.

Society's Gold Medal.—Awarded biennially by the Society for conspicuous services to applied chemistry, by research, discovery, invention, or improvements, or to the Society in the furtherance of its objects. The recipient may be of any nationality, and not necessarily a member. The medal was first presented in 1896.

Messel Memorial Medal.—A gold medal (with an honorarium) is awarded biennially, and commemorates Dr. Rudolph Messel, F.R.S., an original member and benefactor of the Society. The medal is allotted for special distinction in science, literature, or public affairs. The obverse bears the head of Dr. Messel. The first award was made in 1922.

Institute of Chemistry of Great Britain and Ireland.

Meldola Medal.—Founded in 1921, the gift of the Society of Maccabæans. Awarded annually to the chemist "whose published chemical work, issued within the year prior to bestowal, shows the most promise". The recipient must be a British subject not more than thirty years of age at the time of the completion of the work. The medal is struck in bronze: the obverse bears the bust of Raphael Meldola, F.R.S.

Frankland Medal.—Founded in 1927, on the occasion of the jubilee of the Institute, as a memorial to the first president, Sir Edward Frankland, F.R.S. The medal is awarded annually, and is struck in bronze; the obverse bears the bust of Frankland.

Society of Dyers and Colourists, Bradford.

Perkin Gold Medal.—Instituted in 1908 in honour of Sir William Perkin, president in 1907, and awarded at intervals of two or three years for discoveries or work of outstanding importance in connexion with the tinctorial arts. The obverse bears the bust of Perkin, which was modelled by F. W. Pomeroy, R.A.

Dyers' Company's Gold Research Medal.—Instituted in 1908 and awarded annually for a paper submitted to and published by the Society of Dyers and Colourists in the year, embodying the results of scientific research or technical investigations connected with the tinctorial art.

The Society's Medal.—Instituted in 1908, and awarded occasionally in recognition of work of exceptional merit carried out under the Society's Research Scheme. It may be struck either in gold, silver, or bronze.

Manchester Association of Engineers.

Constantine Gold Medal.—First awarded for the year 1903-4, and annually since then. The gift was established by Mr. E. G. Constantine, a past president of the Association, with the object of encouraging papers containing original or other matter conveying the most useful information to the Association upon the practice and theory of engineering. The medal may be allotted to non-members of the Association.

Society of Engineers.

President's Gold Medal.—Awarded annually by the president, through the council, for a paper on a subject of general interest connected with engineering. Instituted in 1886. The obverse bears the Society's seal; the reverse is engraved with particulars of the paper which secured the gift, the names of the author and the president who awarded the medal, with the date.

Institution of Engineers and Shipbuilders in Scotland.

Railway Engineering Gold Medal.—Founded in 1865, and awarded annually for communications in railway engineering and practice.

Marine Engineering Gold Medal.—Instituted in 1865, and awarded annually for communications on subjects in marine engineering.

Institution Gold Medal.—Founded in 1865, and awarded annually for subjects not within the scope of the railway and marine engineering medals.

The obverses of these medals bear the bust of James Watt.

Engineering Institute of Canada.

The Institute awards four medals, named respectively the *Gzowski*, *Kennedy*, *Leonard*, and *Plummer*, each concerned with some aspect of engineering science.

Institution of Civil Engineers.

Telford Gold Medal.—The question of instituting a medal to be awarded for meritorious memoirs was considered in 1827. Thomas Telford, F.R.S., the first president, died in 1834, and through a bequest made by him for the provision of annual premiums, the Institution's Telford medal was bestowed in 1837, and annually since. The award is not limited to papers on any particular subject or subjects. The obverse of the medal bears the head of Telford.

James Watt Gold Medal.—Founded in 1858 and awarded to the author or authors of a paper on any engineering subject, usually one dealing with mechanical engineering. The obverse bears the bust of Watt.

George Stephenson Gold Medal.—Founded in 1881 for award to the author or authors of a paper on any engineering subject. The obverse bears the head of Stephenson.

Kelvin Gold Medal.—In 1913 a memorial window was placed in Westminster Abbey on behalf of the engineers of the British Empire and of the United States of America. A portion of the memorial fund was made available for the founding of a Kelvin gold medal for triennial award for distinction in engineering work or investigation of the character with which Lord Kelvin was especially identified. The first bestowal was made in 1920. The obverse bears the bust of Lord Kelvin.

N.B.—The Institution of Civil Engineers acts as an administrative body, the award of the medal being in the hands of a committee, consisting of the presidents for the time being of eight of the leading engineering institutions in Great Britain, which considers recommendations.

Coopers Hill War Memorial Medal.—Founded in 1921 by the Coopers Hill Society, in memory of its members and relatives of members who fell in the War. In the annual award of the Institution of Civil Engineers, and allotted to the author of the best paper for a selected professional subject. The medal is struck in bronze.

Howard Gold Medal.—Founded in 1927. For quinquennial award to the author of a treatise on any of the uses or properties of iron, or to the inventor of some new and valuable process relating thereto. The first bestowal was made in 1927 as part of the Howard Quinquennial Prize awarded since.

Institution of Electrical Engineers.

Faraday Medal.—Founded in 1921 to commemorate the fiftieth anniversary of the first ordinary meeting of the Society of Telegraph Engineers (now the Institution of Electrical Engineers). Awarded annually, either for notable scientific or industrial achievement in electrical engineering, or for conspicuous service rendered to the advancement of electrical science, without restrictions as regards nationality, domicile, or membership of the Institution. Struck in bronze, the obverse bears the head of Michael Faraday.

Coopers Hill War Memorial Medal.—Founded in 1921 by members of the Royal Indian Engineering College, Coopers Hill, and awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. The medal is struck in bronze.

Willans Gold Medal.—Founded in 1895 by subscription, and awarded triennially alternately by the Institution and the Institution of Mechanical Engineers, for the best paper dealing with the utilisation and transformation of energy, treated especially from the point of view of efficiency or economy. The obverse of the medal bears the head of Peter William Willans. The first award was made in 1897, and by the Institution of Electrical Engineers.

Institution of Gas Engineers.

Birmingham Gold Medal.—Founded in 1881 by funds received from the gas undertakings and companies, gas engineers and managers, and constructors of gas plant in the Birmingham area. It is awarded at the discretion of the council for " Originality in connection with the manufacture and application of gas ", such qualification to be interpreted in its widest possible sense. Allotted at intervals of not less than two years, without distinction of nationality.

H. E. Jones, London, Gold Medal.—Founded in 1905 by the late Mr. H. E. Jones, a past president of the Institution, and bestowed annually. It is awarded for the best contribution dealing with " The principles involved in the construction of works or plant for the manufacture or distribution of gas. . . . The points of good management of a gas undertaking considered in relation to the management of labour, and popularising the use of gas for general purposes, or improvement in carbonising and purifying processes, or in the development of residuals."

Institution Gold Medal.—Awarded at the discretion of the council, at varying intervals, to the author of a paper read at a meeting of the Institution which is considered worthy of such recognition.

Institute of Marine Engineers.

Denny Gold Medal.—Founded in 1891 and offered annually for a paper of merit by a member. The head of the founder, Mr. Peter Denny, appears on the obverse.

Institute's Silver Medal.—Founded in 1922, and is awarded annually for a paper of merit read by a non-member.

Institution of Mechanical Engineers.

Thomas Hawksley Gold Medal.—Founded in 1914, arising from a fund established by Mr. Thomas Hawksley, to perpetuate the memory of Thomas Hawksley, F.R.S., twice president of the Institu-

tion. Awarded annually for the best original paper read at a general meeting of the Institution or printed in the *Proceedings* during the preceding year.

Willans Gold Medal.—Founded in 1895 by subscription and awarded triennially by the Institution and the Institution of Electrical Engineers for the best paper dealing with the utilisation and transformation of energy, treated especially from the point of view of efficiency or economy. The obverse of the medal bears the head of Peter William Willans. The first award was made in 1897, and by the Institution of Electrical Engineers.

Institution of Water Engineers.

Whitaker Medal.—Founded in 1927, through a fund placed at the disposal of the Institution by a member (desiring to remain anonymous), the interest on which to be used for a bronze medal to be given annually to the author of the best paper each year dealing with the application of geology to water engineering. The donor intended that the gift should be not only a stimulus and encouragement to research, but should also tend to memorialise the late William Whitaker, F.R.S., the eminent geologist. The obverse bears the head of Whitaker, from the rendering of Mr. Frank Bowcher. The first award was made in 1930 for a paper by Mr. R. C. S. Walters on "The Hydrogeology of the Chalk of England".

Institute of British Foundrymen.

Oliver Stubbs Gold Medal.—Established in 1921 by the National Ironfounding Employers' Federation and presented to the Institute to encourage and reward efforts made by its members to impart knowledge on the practice and theory of founding. Awarded annually. The obverse bears the head of Oliver Stubbs.

Iron and Steel Institute.

Bessemer Gold Medal.—Founded in 1873 by Mr. (afterwards Sir Henry) Bessemer, and awarded annually for distinguished merit in promoting the metallurgy of iron and steel.

Andrew Carnegie Gold Medal.—Founded in 1901 by Mr. Carnegie. It is awarded to the author of the paper considered to be the most meritorious of those presented in any one year. The award of this medal remained in abeyance during the War, and for some years afterwards; in 1927 the reports of research work submitted within the previous thirteen years were considered, and three awards were made. Since 1927 no further award has been made. The obverse of the medal bears the bust of Andrew Carnegie.

Gold Medal of the Blacksmiths' Company, City of London.—An offer by the Court to award annually a gold medal bearing the arms of the Company was accepted in 1919. It was agreed that the council of the Iron and Steel Institute should recommend every year the name of a member for the award, preference being given (other things being equal) to members who were or had been students or apprentices practically engaged in the working or the manufacturing of iron or steel, or had achieved work of merit or importance in connexion with the manufacture of iron and steel. The first award was made in 1920.

London Mathematical Society.

De Morgan Gold Medal.—Following the death of Prof. A. De Morgan, in 1871, it was decided to establish a medal in trust for the advancement of mathematical science, and as a memorial of the Society's first president. The gift is of triennial allocation, open to mathematicians of all countries, and is not restricted to any particular branch of mathematical study. The die was entrusted to Thomas Woolner, R.A., and the bust of De Morgan appears on the obverse of the medal. The first award was made in 1884 to Prof. A. Cayley.

Royal Meteorological Society.

Symons Gold Medal.—Founded in 1901, and awarded biennially for distinguished work done in connexion with meteorological science, irrespective of sex or nationality. The obverse of this memorial medal bears the head of G. J. Symons, F.R.S., founder of the British Rainfall Organization.

Institution of Mining and Metallurgy.

Institution Gold Medal.—Founded in 1902, and awarded annually for conspicuous services in the advancement of the science and practice of mining or metallurgy.

Canadian Institute of Mining and Metallurgy.

Leonard Gold Medal.—Awarded annually, through a fund established by Lieut.-Col. R. W. Leonard, for the best paper on a mining subject, communicated either to the Engineering Institute of Canada or to the Canadian Institute, and open to all classes of members of either body.

Randolph Bruce Gold Medal.—An annual award for the most notable contribution in the field of practical mining, metallurgy, or geology, to the advance of the mining industry of Canada. Provision has been made (1929) by His Honour R. Randolph Bruce, Lieutenant-Governor of British Columbia, for the successive award to members of the Institute of ten gold medals.

North of England Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne.

Greenwell Medal.—Awarded either in gold, silver, or bronze, at the option of the council of the Institute, to the writer of a paper recording the results of experience of interest in mining, and especially where deductions and practical suggestions are made by the writer for the avoidance of accidents in mines. The medal is provided out of a fund of £100 given by the late Mr. G. C. Greenwell in 1900. The head of the donor appears on the obverse of the medal.

Institution of Petroleum Technologists.

Boverton Redwood Medal.—In 1921, Mr. A. Duckham expressed a wish to establish such gift

to commemorate the late Sir Boverton Redwood, founder of the Institution, and its first president. The award is biennial, and for a paper or papers deemed to advance knowledge of the technology of petroleum. The council decided in 1924 that in the first instance papers should be considered from so far back as 1919, the year following the War. Accordingly the first award, as for 1919–21, was made to M. Paul Chambrier, who described the revised method of working the petroleum deposits at Pechelbronn, Alsace. The medal is struck in bronze, and allotted irrespective of nationality. The head of Redwood appears on the obverse.

Manchester Literary and Philosophical Society.

Dalton Medal.—Founded in 1864, but the first award was not made until 1898, the medal being adopted "for presentation on such occasions as the Society may determine". The last recipient (1919) was Sir Ernest Rutherford. The obverse bears the head of John Dalton. The medal is struck in bronze.

Royal Philosophical Society of Glasgow.

Graham Gold Medal.—Founded in 1878. Candidates for the award are required to enter a paper giving an account of an unpublished original research in any branch of chemical science, pure or applied. The medal is allotted for the particular research considered of the highest merit and most likely to aid in the advancement of chemical science. The award may take the form, as desired, of (1) the medal in gold; (2) the medal in bronze and scientific instruments or books; (3) the medal in bronze and the balance of the fund for application in chemical research. The obverse of the medal bears the bust of Thomas Graham, with the date of his birth and death. (This medal has not been allotted for some years. The original fund provided also for special lectures in chemistry, and the whole income is now made available mainly for the purpose of the "Graham Lectures".)

Royal Photographic Society of Great Britain.

Exhibition Medal.—First awarded in 1877, twenty-four years after the Society's Exhibition was inaugurated. The medal is struck in bronze. The obverse bears the head of H.R.H. the Prince Consort.

Progress Medal.—Founded in 1878. Awarded in recognition of any invention, research, publication, or exhibition which, in the opinion of the council, shall have resulted in any important advance in the development of photography. The medal is struck in silver.

John Traill Taylor Memorial Medal.—Instituted in 1898, and struck in bronze, the medal is bestowed in association with a memorial lecture. The obverse bears the bust of Taylor.

Hunter and Driffield Memorial Medal.—Instituted in 1920, and struck in silver, the medal is bestowed in association with a memorial lecture.

Physical Society of London.

Duddell Medal.—Founded in 1922 as a memorial of William Duddell, F.R.S., and awarded annually, irrespective of nationality and sex, for contributions to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of material used in their construction. The medal is struck in bronze; the obverse bears the bust of Duddell.

Institution of the Rubber Industry.

Colwyn Gold Medal.—Established through a gift made by Lord Colwyn, and first awarded in 1928. It is allotted annually for conspicuous services of a scientific or technical character, bearing on the improvement or development of rubber manufacture or production. The recipient must be a British subject. The obverse of the medal bears the bust of Lord Colwyn.

Royal Statistical Society.

Howard Medal.—Instituted in 1873, and bestowed upon the author of an essay on some branch of social statistics, selected by the council. The medal is struck in bronze, and competition is not limited to fellows of the Society. The obverse bears the bust of John Howard, F.R.S.

Guy Medal.—Instituted in 1891 in honour of Dr. William A. Guy, F.R.S. Awards are confined to fellows of the Society, and to those who are adjudged to merit distinction on account of original contributions to the theory or practical applications of statistics. The medal may be of gold, silver, or bronze. The obverse bears the bust of Guy.

III. Biological Sciences (including Geology and Geography).

Royal Society of London.

Darwin Medal.—Arising from the transfer in 1885 of an International Darwin Memorial Fund, a silver medal is awarded biennially in recognition of work of acknowledged distinction (especially in biology) in the field in which Charles Darwin himself laboured. The obverse bears the bust of Darwin. Bestowal may be made without distinction of nationality or sex. First awarded in 1890.

Buchanan Gold Medal.—Awarded quinquennially in respect of distinguished services to hygienic science or practice in the direction either of original research or of professional, administrative, or constructive work. Bestowal may be made without distinction of nationality or sex. First awarded in 1897. The obverse bears the head of Sir George Buchanan, F.R.S.

See also General and Physical and Mathematical Sciences sections.

Asiatic Society of Bengal.

Barclay Memorial Medal.—Awarded biennially for conspicuously important contributions to medical

or biological science with reference to India. The next award falls due in 1931.

Annandale Memorial Medal.—Awarded triennially for important contributions to the study of anthropology in Asia. The next award falls due in 1931.

Joy Gobind Law Memorial Medal.—Founded in 1929 by Dr. Satya Churn Law, and for triennial award for conspicuously important work on zoology in Asia. The first award was made in February 1930.

Paul Brühl Memorial Medal.—Instituted in 1929 through funds provided by the "Brühl Farewell Committee". To be bestowed triennially for meritorious researches in Indian botany, in commemoration of the life-work of Prof. Paul J. Brühl, a teacher of botany in India, chiefly in Calcutta. The first award will be made in 1932.

See also General section.

Australian Association for the Advancement of Science.

Mueller Memorial Medal.—In 1902 the Association accepted a fund in the hands of the Mueller National Memorial Committee with the view of founding a medal in memory of Baron Sir Ferdinand von Mueller, long identified with research work in natural science in Australia. The interest of the fund is allocated for a bronze medal, awarded biennially to the author of important contributions to anthropological, botanical, geological, or zoological science, published originally within His Majesty's dominions, preference being always given to work having special reference to Australasia. A money gift may be allotted with the medal. Rectangular in shape, the obverse bears a quarter-length presentment of von Mueller.

Royal Society of Edinburgh.

Neill Gold Medal.—Instituted in 1851, and awarded biennially or triennially, together with a sum of money from the fund, for a paper of distinguished merit on a subject of natural history, by a Scottish naturalist, presented to the Society during the period; or it may be awarded for a work or publication by some distinguished Scottish naturalist in some branch of natural history, bearing date within five years of the time of award. The obverse of the medal bears the head of Patrick Neill, LL.D.

Bruce Medal.—Instituted in 1923 to commemorate the work of Dr. W. S. Bruce as an explorer and scientific investigator in polar regions. Open to workers of all nationalities, with a preference for those of Scottish birth or origin. Awarded biennially, in bronze, with a sum of money, for some notable contribution to the natural sciences; to be in the nature of new knowledge, the outcome of a personal visit to polar regions on the part of the recipient. The Royal Physical Society, Edinburgh, and the Royal Scottish Geographical Society assist in the allotment.

See also General section.

Royal Society of New South Wales, Sydney.

Clarke Medal.—The Society was inaugurated in 1867 by the Rev. W. Branwhite Clarke (F.R.S., 1876). On his death in 1878 a medal in his honour was founded, which is awarded annually for researches in natural science, and struck in bronze. The obverse bears the bust of Clarke.

New Zealand Institute, Wellington.

Hutton Memorial Medal.—Founded in 1909 in honour of Capt. Frederick Wollaston Hutton, F.R.S., in association with a Hutton Research Fund. The medal is struck in bronze, and bestowed not oftener than once in every three years upon persons who have made "some noticeable contribution" in connexion with the zoology, botany, or geology of New Zealand. The awards are made only to those who have received the greater part of their education in New Zealand, or who have resided in New Zealand for not less than ten years.

Royal Society of Tasmania.

Johnston Memorial Medal.—In association with a lecture, this medal, struck in bronze, was established by public subscription to commemorate Mr. R. M. Johnston, a pioneer geologist (deceased 1918), author of "The Geology of Tasmania". Awarded at intervals, the first recipient (1923) was Sir T. Edgeworth David, F.R.S. The obverse bears the bust of Johnston.

Royal Anthropological Institute.

Huxley Memorial Medal.—Awarded annually in association with a memorial lecture given by some distinguished anthropologist, either British or foreign. The medal is struck in bronze; the obverse bears the bust of Thomas Henry Huxley.

Rivers Memorial Medal.—Founded in 1923, and awarded for specially meritorious field work in physical or cultural anthropology, preference being given to the claims of British subjects or fellows of the Institute. The medal is struck in bronze; the obverse bears the bust of Dr. W. H. R. Rivers, F.R.S.

British School of Archæology in Egypt.

Petrie Memorial Medal.—Founded in 1923, and awarded every five years for archæological work by English-speaking workers. The obverse bears the bust of Sir Flinders Petrie, F.R.S., long concerned in exploration and research in Egyptian archæology. The medal is struck in bronze.

Society of Apothecaries of London.

Society's Gold Medal.—Instituted in 1925, and awarded, usually annually, for services rendered to the science of therapeutics. The obverse bears the effigy of Galen, by T. H. Paget, after William Wyon, R.A.

Royal Botanical Society of London.

Society's Gold Medal.—Founded in 1840, and awarded for excellence in applied botany or flori-

culture. The Society was incorporated in 1839 for the promotion of botany and its application to manufactures, medicine, and the arts. Silver and bronze medals are also bestowed.

Institute of Brewing.

Horace Brown Gold Medal.—Founded in 1925 and awarded triennially for eminent services on the scientific or technical side of the fermentation industries, there being no disqualification in respect of nationality or sex in bestowal. The obverse of this memorial medal bears a replica of a crayon portrait of H. T. Brown, F.R.S., by Sargent.

Chadwick Trust.

Chadwick Gold Medal.—Founded under the testament of Sir Edwin Chadwick, K.C.B., in association with a prize, and awarded to such officer of the medical services of the Army, Navy, or Air Force as shall during the preceding five years have specially assisted in promoting the health of the men of the force to which he is attached through medical and sanitary work, or other scientific researches.

Royal Geographical Society.

Founder's Gold Medal.—At the foundation of the Society in 1830, its Royal Patron, King William IV., granted an annual premium of fifty guineas for the encouragement and promotion of geographical science and discovery. The fifth recipient received it in the form of a gold medal, and awards have been from that date, though not invariably, medallic. On the accession of Queen Victoria, the annual grant was continued, and it was resolved that for the future two gold medals should be awarded in each year: (*a*) the Founder's medal, to bear on the obverse the portrait of the founder; (*b*) the Patron's medal, to bear the portrait of the reigning sovereign. The two medals are equal in value and in honour.

Patron's Gold Medal.—(See above.)

Victoria Medal.—On the death of Queen Victoria in 1901, the council instituted the Victoria Medal, to be awarded from time to time for conspicuous merit in scientific research in geography. The medal bears on the obverse the portrait of the Queen (as in youth).

Royal Scottish Geographical Society.

Society's Gold Medal.—Instituted in 1890, and conferred by the council on distinguished geographers and travellers, irrespective of nationality, in consideration of special services to geographical science. Awarded at suitable periods, as also silver and bronze replicas in the same type.

Livingstone Gold Medal.—Instituted in 1901 by Mrs. A. L. Bruce in memory of her father, Dr. Livingstone. Awarded annually, irrespective of nationality, for distinguished service to geographical exploration or research. The obverse of the medal bears the bust of David Livingstone.

Bruce Medal.—See Royal Society of Edinburgh, Biological Sciences section.

Geological Society of London.

Wollaston Gold Medal.—First awarded in 1831, and established through the will (1828) of Dr. William Hyde Wollaston, F.R.S. The obverse bears the bust of Wollaston. The medal is bestowed annually.

Murchison Medal.—Founded in 1871, under the conditions of a geological fund established through the will of Sir Roderick I. Murchison, Bart., F.R.S. Awarded annually in bronze. The obverse bears the bust of Murchison.

Lyell Medal.—Founded in 1873 through the will (1875) of Sir Charles Lyell, Bart., F.R.S., and first awarded in 1876. The obverse of the medal, which is struck in bronze, bears the head of Lyell. It is bestowed annually without restriction of country or sex.

Bigsby Gold Medal.—Founded in 1876 by Dr. John J. Bigsby, F.R.S. Awarded biennially, without restriction of country. The obverse bears the bust of Bigsby.

Prestwich Gold Medal.—Founded in 1896 through the will of Sir Joseph Prestwich, F.R.S. Awarded triennially without restriction of country or sex. The obverse bears the bust of Prestwich.

Royal Horticultural Society.

The Society was founded in 1804; it aims at spreading a knowledge of the science of horticulture. Various medals applicable to different branches of the science are awarded. We select those associated with the early history of the Society, and of historic interest.

Banksian Medal.—Instituted in 1820 in commemoration of Sir Joseph Banks, F.R.S., one of the founders of the Society. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Banks.

Knightian Medal.—Instituted in 1836 in commemoration of Thomas Andrew Knight, F.R.S., president 1811-38. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Knight.

Lindley Medal.—Instituted in 1866 in commemoration of Dr. John Lindley, F.R.S., sometime secretary. Struck in bronze, silver, and silver-gilt; the obverse bears the head of Lindley.

Victoria Gold Medal of Honour.—Instituted in 1897 in commemoration of the sixtieth year of reign of Queen Victoria, and awarded to British horticulturists selected as deserving of special honour at the hands of the Society.

Linnean Society of London.

Linnean Gold Medal.—Founded in 1888, and awarded annually to a biologist of eminence, usually to a botanist and zoologist in alternate years. The obverse bears the bust of Linnæus.

Trail Medal.—Founded in 1910 in association with a fund established by Prof. J. W. H. Trail, F.R.S., "to encourage study that throws light upon the substance known as protoplasm, or the physical basis of life". The medal is struck in bronze and bestowed at intervals of not less than five years. The obverse bears the bust of Linnæus.

Crisp Medal.—Founded in 1912 and awarded in

association with a fund established by Sir Frank Crisp, Bart., in recognition of the best paper dealing with microscopical research by a fellow and published by the Society since the previous award. The medal is struck in bronze and bestowed at intervals of not less than five years. The obverse bears the bust of Linnæus.

Medical Society of London.

Fothergill Gold Medal.—Awarded triennially for significant advances in medical science. The Fothergillian medal was first awarded in 1787; in 1803 it was awarded to Edward Jenner. From 1893 the administration of the trust has been in conformity with a scheme of the Charity Commissioners. The most recent award (1929) was to Sir Thomas Lewis, F.R.S. The obverse of the medal bears the bust of Anthony Fothergill, M.D.

Royal Society of Medicine.

Society's Gold Medal.—Awarded triennially to a man of science (or a woman) who has made valuable contributions to the science and art of medicine. Established in 1920 through funds provided by the late Dr. R. Murray Leslie.

Jenner Memorial Medal.—Founded in 1896 by the Epidemiological Society (now merged in the above society) "in recognition of the greatest medical service ever done to man". Awarded, struck in bronze, for services in the prevention and control of epidemic disease. The obverse bears the bust of Jenner.

British Medical Association.

Association Gold Medal.—Founded in 1877 and bestowed annually "For Distinguished Merit". Awards are made to those who shall have conspicuously raised the character of the medical profession by scientific work, by extraordinary professional services, or by special services rendered to the Association.

British Medical Association, Australia Branch.

Association Gold Medal.—The Federal Committee in Australia instituted a medal in 1924 for distinguished service, and for the purpose of "perpetuating the appreciation of the Federal Committee of signal services rendered by members of the British Medical Association in Australia".

British Medical Association, South Africa Branch.

The institution of a medal has been decided on; regulations for award are under consideration.

Liverpool School of Tropical Medicine.

Mary Kingsley Medal.—Commemorates the work of Mary Kingsley in West Africa, and bestowed in recognition of distinguished scientific achievement. There is no restriction as to nationality in the award. The medal is struck in bronze, and the obverse bears the bust of Miss Kingsley.

Pharmaceutical Society of Great Britain.

Hanbury Memorial Gold Medal.—Founded in 1875, and awarded biennially for "high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs". The medal commemorates Daniel Bell Hanbury, remembered for his researches in materia medica; the obverse bears his head.

Harrison Lectureship Medal.—Founded in 1921, and associated with a biennial lecture on a subject relating to the science and practice of pharmacy. The medal, struck in silver, commemorates Lieut.-Col. E. F. Harrison, deputy controller of the Chemical Warfare Department during the War. The obverse bears the head of Harrison.

The Society also bestows annually the silver Pereira Medal, as the result of examination, to a pharmaceutical chemist. The medal (founded in 1860) commemorates Jonathan Pereira, the classic teacher of materia medica.

Royal College of Physicians, London.

Baly Gold Medal.—Founded in 1866, arising from a trust fund established by Dr. F. D. Dyster, "in memoriam Gulielmi Baly, M.D.". Awarded biennially to the person who shall be deemed to have most distinguished himself in the science of physiology, especially during the two years immediately preceding, and is not restricted to British subjects. The obverse bears the bust of Baly.

Moxon Gold Medal.—Founded in 1886 through a trust fund established as a memorial of Dr. Walter Moxon. Awarded triennially to the person who is deemed to have most distinguished himself by observation and research in clinical medicine. Bestowal is not restricted to British subjects. The obverse bears the bust of Moxon.

Weber-Parkes Medal and Prize.—Provision is made under the terms of a trust established in 1895 by Dr. (afterwards Sir) Hermann Weber in memory of Dr. E. A. Parkes, for a prize of one hundred and fifty guineas, accompanied by a silver medal. The subject scheme of the prize relates to tuberculosis. The allotment is triennial, and is not restricted in nationality. The obverse bears the bust of Weber.

Bisset Hawkins Gold Medal.—Instituted in 1896 as a memorial to Dr. Francis Bisset Hawkins, and bestowed triennially on some duly qualified medical practitioner, who is a British subject, and has, during the preceding ten years, specially advanced sanitary science or promoted public health. The obverse bears the bust of Bisset Hawkins.

Royal Sanitary Institute.

Rogers Field Medal.—Founded in 1901, and awarded in silver for the first time in 1903. It commemorates the work of Mr. Rogers Field, a pioneer of sanitation, and is bestowed in connexion with the annual congress of the Institute for an exhibit of special merit from a hygienic point of view. The obverse bears the head of Field.

Royal College of Surgeons of England.

Honorary (Gold) Medal.—Instituted in 1802, and bestowed at varying intervals. In awarding, the leading considerations are liberal acts or distinguished labours, researches, and discoveries,

eminently conducive to the improvement of natural knowledge and of the healing art.

John Hunter Medal and *Triennial Prize.*—The medal itself, executed in bronze, was founded in 1867, and is allocated with the (older) triennial prize. From 1925 the terms of this joint gift provide for award to some fellow or member of the College who has, during the preceding ten years, done such work in anatomy, physiology, histology, embryology, or pathological anatomy, as deserves special recognition. The obverse bears the bust of Hunter.

Lister Medal.—In 1920 the College became trustees of the Lister Memorial Fund, and the following provision is in operation: That out of the General Fund a sum of £500, together with a bronze medal, be awarded every three years, irrespective of nationality, in recognition of distinguished contributions to surgical science, the recipient being required to give a lecture in London under the auspices of the College. The obverse of the medal bears the head of Lord Lister.

Cartwright Medal.—Awarded quinquennially in bronze, with an honorarium, to the author of the best essay upon a subject relating to dental surgery, and selected by the council upon the recommendation of a committee. The medal was bestowed for the first time in 1911, and bears on the obverse the head of Samuel Cartwright, F.R.C.S.

Royal College of Surgeons of Edinburgh.

Caird Medal.—Founded in 1927, in association with a money gift, as a memorial to Francis Mitchell Caird, Regius professor of clinical surgery, University of Edinburgh, 1908-1919. It is to be awarded triennially in bronze for an essay on a subject in surgery or surgical pathology, based on personal observation and research, and open to graduates of Edinburgh and to licentiates and fellows of the Royal College of Surgeons who have studied in Edinburgh for a period of at least two years, and have been qualified as practitioners for not more than seven years. The precise design of the medal has not yet been settled, but an award under the scheme will be made shortly.

Royal College of Veterinary Surgeons.

Steel Memorial Medal.—Instituted in 1891 in memory of John Henry Steel, Army Veterinary Department, principal of the Bombay Veterinary College, and awarded by the council triennially as a reward for scientific or literary work of merit connected with the veterinary profession. The medal is struck in silver, and fellows and members of the College are alone eligible. The obverse bears the head of Steel.

Zoological Society of London.

Society's Medal.—In 1837 the council decided to "offer six medals annually, by way of premiums, for subjects connected with zoology". In 1847 two medals (the first), struck in silver, were awarded, in 1859 nine. "Silver medals have continued to be awarded at irregular intervals, and for very different reasons, and it may be an important duty of the Council at some future time to revert more to the original intention of the Society and present medals annually for specific contributions to zoology, in the form of the introduction of very rare animals, or for direct contribution to knowledge" ("Centenary History of the Zoological Society of London", 1929). The Society's medal struck in bronze has usually been given to keepers for special services.

Royal Zoological Society of Ireland.

Animal Photography Medals.—The council allots a silver and bronze medal respectively for sets of photographs taken in its gardens by amateurs.

Royal Geological Society of Cornwall.

Bolitho Gold Medal.—Instituted under the will (1895) of Mr. William Bolitho, and awarded annually for such member whose attainments, labour, and discoveries in geology or mineralogy shall best deserve recognition. This, the senior scientific society of Cornwall, was founded in 1814. The first bestowal of the medal (1896) was made to Prof. R. Etheridge, F.R.S.

Royal Institution of Cornwall.

Henwood Gold Medal.—Awarded triennially for the best treatise or paper in the subjects of geology, mineralogy, mining operations, botany, ornithology, ichthyology, conchology, or antiquities of Cornwall. The gift arises under the will of William Jory Henwood, F.R.S., who died in 1875. Bestowal is not confined to members. The obverse bears the head of Henwood.

Printed in Great Britain by R. & R. Clark, Limited, Edinburgh.

Obituary.

DR. W. M. W. HAFFKINE.

THE death of Waldemar Haffkine on Oct. 26 last will recall an era in bacteriology of which few of the active participators still survive.

The discovery in 1880 by Pasteur, that fowl cholera can be prevented by the inoculation of living attenuated cultures, and his success with this disease, as also with swine erysipelas, anthrax, and hydrophobia, seemed to open up a field of endless possibilities. One of the early workers to transfer this activity to human beings was Haffkine, who was enabled to go to India and inoculate vast numbers of people against Asiatic cholera and bubonic plague. Following the Pasteurian tradition, he first used living cultures, as Ferran y Clua (1852–1929) had done before him in Spain. The results were not satisfactory; and later, Haffkine turned to the use of killed cultures, the value of which had previously been shown (1884–1886) by D. E. Salmon and Theobald Smith in America in the case of prophylactic inoculation against hog cholera.

Waldemar Mordecai Wolff Haffkine was born in Odessa on Mar. 16 (3), 1860, the son of Aaron Haffkine. He received a classical education at Berdiansk (South Russia) and studied science in the University of Odessa (1879–83). He afterwards worked at the Zoological Museum in Odessa (1883–88) and then came west as assistant professor of physiology in the Medical School of Geneva. Ultimately, he made his way to Paris in the wake of Metchnikoff, met Pasteur, and was appointed (1889) *préparateur* at the Pasteur Institute, which had been inaugurated the previous year. He remained in this post until 1893, when he went to India full of ideas of stamping out cholera by prophylactic inoculation. Here he found a great field for his efforts and in the midst of his work he turned aside to combat another scourge—bubonic plague—which was beginning to get a firm hold of Bombay. Under his directions vast quantities of the protective vaccines were made and inoculated on a wholesale scale. In the course of his labours he received great publicity and fame, partly on account of the enthusiasm of his personality and partly on account of the uncritical attitude towards some of his results.

Haffkine was regarded as a kind of second Jenner, but when a study of his plague results was made by the English Plague Commission in India, the report was, on the whole, adverse to his claims. None the less, he was regarded as a bacteriological wizard. He retired from the India service in 1915 and returned to Europe, where he lived for a time in Paris and afterwards at Boulogne-sur-Seine. He wrote relatively little of a scientific character in bacteriology. W. B.

WE regret to announce the following deaths:

Dr. J. V. Elsden, joint editor of the *Colliery Guardian* and author or part author of several well-known geological works, and treasurer from 1916 until 1921 of the Geological Society of London, aged seventy-four years.

Mr. C. J. B. Macdonald, an honorary life governor of the Royal Agricultural Society of England and editor since 1927 of the Society's *Journal*, on Nov. 10, aged sixty-six years.

Prof. E. R. Matthews, chief drainage engineer to H.M. Office of Works, and formerly Chadwick professor of municipal engineering in the University of London, on Nov. 6, aged fifty-seven years.

News and Views.

HIS Majesty the King has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal Medals: Royal Medal to Prof. O. W. Richardson, for his work on thermionics and spectroscopy; Royal Medal to Prof. J. E. Marr, for his pioneer work in the accurate zoning of the palæozoic rocks. The following awards of medals have also been made by the president and council: Copley Medal to Sir William Bragg, for his distinguished contributions to crystallography and radioactivity; Rumford Medal to Prof. Peter Debye, of Leipzig, for his work relating to specific heats and X-ray spectroscopy; Davy Medal to Prof. R. Robinson, for his work on the constitution and synthesis of natural products, and for his contributions to the theory of organic reactions; Darwin Medal to Prof. Johannes Schmidt, of Copenhagen, for his work on extended oceanographical expeditions, and for his genetic studies in animals and plants; Hughes Medal to Sir Venkata Raman, of Calcutta, for his studies on the abnormal scattering of light.

THE following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on Dec. 1: *President*: Sir F. Gowland Hopkins; *Treasurer*: Sir Henry Lyons; *Secretaries*: Dr. H. H. Dale and Dr. F. E. Smith; *Foreign Secretary*: Lord Rayleigh; *Other Members of Council*: Prof. E. V. Appleton, Prof. G. Barger, Prof. A. E. Boycott, Prof. E. P. Cathcart, Sir Alfred Ewing, Prof. E. S. Goodrich, Prof. G. H. Hardy, Sir Harold Hartley, Sir Thomas Lewis, Dr. W. H. Mills, Prof. E. A. Milne, Dr. A. B. Rendle, Prof. R. V. Southwell, Prof. G. I. Taylor, Prof. D. M. S. Watson, and Prof. W. W. Watts.

SIR ARTHUR KEITH was elected Rector of the University of Aberdeen on Nov. 8 in succession to the late Lord Birkenhead. Sir Arthur, who was a non-political candidate, was opposed by Col. John Buchan, M.P. (Unionist), and obtained a majority of votes in each of the 'nations', Mar, Buchan, Angus, and Moray, the total numbers being 310 as against 231. Although not unprecedented, the election of a non-political candidate is rare. Sir Arthur was formerly a student of Aberdeen and as one of the most distinguished of its *alumni* now living had a strong claim on the suffrages of the members of his University. His studies in the comparative morphology of the Simiidæ—in particular of the anthropoids—and

of early types of man have served to support as well as to elucidate the Darwinian hypothesis of the descent of man. His gift of lucid and graceful exposition has won him an unrivalled place as a public lecturer, as is testified by the fact that he has held all the lectureships open to members of the medical profession. By his more popular writings and lectures he has done much to stimulate the interest of the general public in the problems of anthropological science. In his official capacity as Curator and then Director of the Royal College of Surgeons, he has indeed deserved well of the members of the medical profession. Among the many positions of honour to which he has been called, it will suffice to mention the presidential chair of the Anatomical Society, of the Royal Anthropological Institute, and of the British Association at its Leeds meeting in 1927. We offer Sir Arthur our congratulations on this latest and perhaps most welcome of his honours.

THE pamphlet "How to Tackle Unemployment", published last week by the Liberal party, contains no strikingly new ideas. The policy advocated by its authors, Mr. Lloyd George, Lord Lothian, and Mr. Seebohm Rowntree, differs little from that outlined in "Labour and the Nation", which has been the inspiration of the Labour party for the past three years. Neither the analysis of the causes of the present world-depression and the decline of British basic industries, nor the suggested remedies for unemployment, bears the stamp of originality. It is indeed unlikely that the Labour Government's Economic Advisory Council, among the members of which are Sir Daniel Hall, Mr. J. M. Keynes, and Mr. G. D. H. Cole, had not already reached much the same conclusions as to causes and submitted similar remedial schemes in even more detail than those put forward in the pamphlet. Nevertheless, the task of industrial reconstruction will undoubtedly be made easier by the publication of the Liberal leaders' selective synthesis, not the least noteworthy part of which is the recognition given to the part which scientific and technical knowledge should play in the future development of the British Empire.

THE Liberal pamphlet contrasts the position of the scientific and technical experts in Germany with their position in Great Britain. In Germany the Credit Banks are equipped with expert staffs "capable of investigating both the efficiency of going concerns and the soundness of proposed industrial ventures", and in consequence even small concerns have often been enabled to raise necessary capital from the public. In Great Britain the "bankers are masters but have so far not felt it proper to accept responsibility for enforcing reorganisation or greater efficiency" in industry, largely due to the fact that they have not appropriate experts on their staffs or scientific or technical experts on their boards of directors. The pamphlet also deals with the important part which science has to play in the development of those parts of the world where the standard of living is very low, and particularly of the British Colonial Empire. The proper investment of capital would enable agriculture, the basic industry of our colonies, to be developed scientifically and inevitably raise the standards of life of the backward races; this, over a period of time, would play an extremely important part in the solution of the unemployment problem. Both at home and overseas "enterprise . . . will increasingly take the form of the exploitation of new scientific development and new inventions". It is not suggested that it is the business of governments to be responsible for invention, but it is asserted that governments should assist in every way to create the conditions whereby the pursuit of industrial research and the discovering and wise application of invention are encouraged to the utmost.

IN a pamphlet entitled "The Agricultural Crisis and the Way Out" (Messrs. Jarrold and Sons, Ltd., Norwich, 3*d*.), Dr. Cloudesley Brereton points out that agriculture is still the basic industry of Great Britain and still employs the largest number of hands, though a million acres have gone out of cultivation and 100,000 agriculturists have left the land. Since 1922, the great majority of farmers have been losing money year by year and there has been a progressive drop in the prices of wheat, barley, and oats. Prices, indeed, for most kinds of agricultural products are unnaturally low, according to Dr. Brereton, partly because farmers have not organised their marketing and partly because of the unrestricted competition of foreign produce. Traders in meat, bread, and vegetables have become highly organised as a result of the impetus given by War-time organisation for the distribution of food, and they have been able to force a lower price on the producer and to raise prices against the consumer. They have ceased to interest themselves in helping the farmer to get rid of any surplus during a glut, preferring to buy a more or less fixed amount, regardless of the supply available, and to retail it at more or less fixed prices according to the season. Dr. Brereton looks for a solution of the agricultural problem in the development of some form of organised marketing, though he holds that until this is developed nothing but a guaranteed price for wheat, with a duty on foreign malting barley and the prevention of 'dumping', can tide the farmer over the interval. The cost to the Government would gradually decrease as marketing schemes were developed. The German plan of compelling all millers to grind a fixed quota of home-grown wheat might also be adopted.

A USEFUL pamphlet by P. Good describing the organisation of the electrical industry in Great Britain has just been published by the Institution of Electrical Engineers. About sixty organisations are described, beginning with the Institution of Electrical Engineers and finishing with the British National Committee of the World Power Conference. The Electrical Research Association (E.R.A.) co-operates with those responsible for the laboratories in the universities, technical colleges, and schools throughout the country. This forms a valuable link between the colleges and industry. The value of the work done by this Association is known to be far in

excess of the expenditure incurred. The research carried out on overhead transmission lines at a comparatively trifling cost has been shown to represent a saving of 10 per cent on the three million pounds per annum expended on constructing these lines. The Electricity Commissioners Department also, which has been entrusted with supervising the supply of electricity throughout Great Britain, has done an immense amount of work. The country has been divided into eight areas, and very complete statistics regarding the number and nature of the undertakings in these districts have been collected. The Commissioners have paved the way for the centralisation of the supply, which is at present proceeding rapidly. The Institute of Transport is linked up with the electrical industry owing to the many important developments in the application of industry to transport which have recently taken place. It is a little disappointing to read that the total route mileage electrified in England is only 615·8, of which 307·7 miles, or nearly half, has been done by the Southern Railway.

"HEREDITY and Predestination" was the subject of the Lloyd Roberts Lecture delivered by Dr. Barnes, the Bishop of Birmingham, at Manchester Royal Infirmary on Nov. 7. It is an effort to mould upon some of the biological theories of the day an interpretation of the relationship of man to God, or, perhaps more accurately, it may be said to be an attempt to support certain widely held beliefs by particular appeal to the notion of genes as the repositories of unit characters. The general progress of the inorganic and organic worlds, culminating in civilised man, leads Dr. Barnes to a belief in the purpose and intelligent will of God. He does not believe in the inheritance of acquired characters, nor will he risk being called a vitalist, but he is a thorough-going believer in the gene. "Tennyson's words, 'Man is man and master of his fate', must be altered to 'The genes are genes and masters of man's fate'." Now changes in the genes appear to be the raw material of evolution, and through them the creative process works; that is to say, if ethical theism be accepted, that in modifications of the genes the activity of God is expressed. Yet modifications of the genes, expressed in visible mutations, seem to be devoid of any ethical character whatever, so that, as Dr. Barnes sees the matter, good and evil arise with equal frequency in the variations associated with heredity, but the Divinely guided creative process of which we are products is active through the environment. The determinism which is implied in inheritance does not necessarily mean that we have no freedom of choice.

DR. BARNES goes on to say that "the notion that evil is due to a fall, to some act of spiritual rebellion against God, must be abandoned", since we have learned that evil and good are equally likely to arise at every stage of the evolutionary process. The 'evil and good' of his argument are simply adjustment or maladjustment to environment: the good are the survivors, the evil the individuals smothered by circumstances. Man has so modified circumstances that now ill-adjusted individuals of humanity are constrained to survive, and this survival of 'evil' is one of the great problems of social progress. We are entirely with Dr. Barnes in his plea for further research into the inheritance of feeble-mindedness, but we cannot see that his appeal to the gene has furthered the problems with which he deals. If genes are realities, it is impossible to say that they are the ultimate sources of variation; it is equally difficult to believe that the action of environment is less deterministic than the variation of the ultimate units of life; but and this lies at the foundation of the argument—there is no certainty in the statement that mutations are equally good and evil, or in the notion that they are causeless in the sense of being entirely fortuitous.

"SCIENCE and Modern Industry" was the subject taken by Sir William Pope for his Norman Lockyer lecture to the British Science Guild on Nov. 13. Modern man, he said in the course of the lecture, is to no appreciable degree the intellectual superior of his predecessor who lived in the far fringe of historic time. The invention of expressive and flexible languages, the existence of great literatures, the execution of gems of art, and the development of moral philosophy thousands of years ago, when compared with man's powers to-day, suggest that some forms of intellectual expression have long since been worked out to the utmost limit of the capacity of the human intelligence. In the study of the natural sciences, on the other hand, there finds expression a new faculty; the application of deductive reasoning to experimental observations carried out in accordance with a connected scheme and leading to an understanding of the ways of inanimate Nature is a new phase in man's intellectual history. The scientific age has provided us with a liberal supply of creature comforts, with more freedom from toil and more leisure than could have been dreamt of a century ago; moreover, it has seen the foundation of great industries. Modern industry, consisting in the application of science to industry, can serve national or international needs with economy and efficiency only when legislative or other control is exerted scientifically. Sir William Pope developed his argument by reference to the rise, decline, re-birth, and protected development of the coal-tar dyestuff industry in Great Britain, explaining the principal factors controlling the situation and the form of legislative assistance which has been accorded to the industry during the past ten years. The building up of a virile dyestuff industry in Great Britain has necessarily been accompanied by advantage to every branch of chemical industry and science, so that uncertainty whether the Government proposes or not to renew the relevant Act causes widespread embarrassment.

So much information concerning the manufacture and consumption of dyestuffs in Great Britain is available as to afford the practical certainty that the issue of national interest could be decided on questions of fact by a judicial body. "Scientifically-minded people," said Sir William Pope, "whether academic or industrial, have no convictions; they frame their conclusions and actions on the facts." Some of the great

industries of Great Britain, particularly the agricultural industry, are archaic in their methods and outlook; it is significant that in Germany agriculture is by far the largest domestic consumer of chemical products, whilst in England far too little advantage is being taken of artificial manures. Turning to the consideration of preparation for an industrial career, Sir William insisted on the profound distinction between education and instruction. The attainment of a mastery over general principles is a slow process, because it involves education, and the learning of experimental methods calls for long and laborious laboratory training, whilst theoretical organic chemistry, for example, offers an easy task to the youthful trained memory. It is common to find that the young man's handwriting and spelling are execrable, his knowledge of leading facts and ideas imperfect, and his knowledge of foreign languages quite inadequate, while he is stuffed with facts relating to highly specialised branches of science. Sir William Pope did not advocate a return to the classical and mathematical education of former days, but he asked that the schools should provide an education in the broad principles of the natural sciences and methods, supplemented by liberal and simple courses of practical work in the laboratory. Business men who had received a broad scientific education would find themselves capable of assessing at their true value many of the fantastic proposals which are continually being laid before financiers.

THE discovery of an unusual type of implement in the Swanscombe gravel pit at Northfleet, Kent, is announced in the *Times* of Nov. 6. Its interest lies in the fact that this type is unlike anything previously known in England or on the Continent, with the exception of certain implements found at Clacton-on-Sea by Mr. Hazzledine Warren, and others somewhat similar, also found by Mr. Warren, at Stoke Newington. The Abbé Breuil has therefore suggested the name 'Clactonian' for the new industry. The discovery was made by Mr. R. H. Chandler in the bottom gravels of the pit ten feet below the middle gravels in which St. Acheul hand-axes were found in excavations in 1913, of which characteristic examples are now in the British Museum. In these previous excavations some flakes only were found in the bottom gravels. The predominant tool in the present discovery is a species of chopper, of which the cutting edge has been produced by flaking a flint nodule with alternate strokes from right and left. Some of the flints are striated. The tools are associated with a warm fauna, the straight-tusked elephant, rhinoceros, and deer. Hence it is suggested that the striated tools may have been made before the Mindel glaciation, while those without striation and associated with the warm fauna may have belonged to the Mindel-Riss interglaciation. They would thus come between Chellean and Acheulean and might be classified as Early Acheulean.

THE October issue of *Man* is a special number devoted to India, embodying some of the results of the work of the Indian Research Committee of the Royal Anthropological Institute. For some time a special committee has been engaged in the investigation of Indian beads. It was with the assistance of this committee that Miss Caton-Thompson was enabled to arrive at a dating for the Rhodesian ruins at Zimbabwe. The number opens with a brief account of the work of the committee by Prof. J. L. Myres, president of the Royal Anthropological Institute, which is followed by a contribution by Mr. H. C. Beck, "Notes on Sundry Asiatic Beads," illustrated by two plates, of which one is a beautiful reproduction in colours of some of the more striking and important types. Mr Beck deals with beads from burial sites—megalithic, cairn, and urn burials—in India, the Malay Peninsula, and Sarawak. Some of the beads are of considerable antiquity, and Mr. Beck by comparative study traces them to their probable origin. Some of the beads show affinities with Crete, while others are of Roman origin. A series of articles by Mr. L. A. Cammiade describes the excavation of urn burial sites in Southern India, and particularly the Madras Presidency, from which some of the beads described by Mr. Beck were derived. The area of these urn burial sites was sometimes considerable, running to as much as a quarter of an acre. The urns were of various types, and inside the large urns were smaller urns, in one case as many as twenty-two in number. There were no signs of cremation.

THE custom of urn burial revealed by the excavations described by Mr. Cammiade is extremely interesting. In certain cases it is highly artificial, as Mr. Cammiade points out. While some of the large urns contained a body entire, in others—those in which the smaller urns were contained—the small bones, the phalanges and carpals, had been placed in small urns, the skull and some of the other bones were found among the contents of the urn, and the long bones were leaning against the internal sides of the urn. The culture of the cairn and urn burials of Southern India is discussed by Mr. K. de B. Codrington. He is of the opinion that they belong to a single culture complex in Southern India, presenting affinities with Northern India which it is not yet possible to work out. The date approaches somewhere about the borders of the historic period; it may be about 600 A.D. The burial customs appear to link up with modern practice; but the interesting feature is that they appear to be the final stage of the burial rite and to be communal, the bodies having been reserved until the time of interment came. The rich were interred entire; but of the poor, some of the bones only were interred symbolically.

DURING the naval review off Portland on Nov. 1, three battleships, the *Warspite*, *Barham*, and *Malaya*, were engaged from 3 P.M. to 3.20 P.M. in concentration firing from 15-inch guns. According to the *Times* correspondent on board the *Nelson*, which was little more than a mile from the firing ships, the reports did not seem unduly loud. They were heard, however, according to letters in recent issues of that paper, at considerable distances from Portland, the farthest place being Towcester in Northamptonshire (130

miles) and the nearest Littlehampton in Sussex (83 miles)—not unusual distances when a silent zone is developed. When plotted on a map, the 25 places are seen to lie within an oval area 113 miles long from north-west to south-east and 56 miles wide, the centre of the area being about one hundred miles north-east of Portland.

THE British Photographic Research Association has gone into voluntary liquidation; this decision has been reached in full accord between the Department of Scientific and Industrial Research and the manufacturer members of the Association. Two main factors have necessitated this decision. The first is that important changes have taken place in the organisation of the industry itself; manufacturing interests have been consolidated and as a result the number of separate firms interested in the work of the Association has been considerably reduced. The second factor is a very marked increase in the research work carried out in the laboratories of the manufacturing firms themselves—an increase which has, to a large extent, been the outcome of the work of the Association. This widening of the outlook of the industry with regard to research is one of the results which it was hoped the Association would achieve, and the development has been much fostered by the policy of the Director of the Association, Dr. T. Slater Price, in keeping the scientific staffs of the manufacturing firms in close touch with the research work carried out in the laboratories of the Association, and also with the latest scientific developments likely to have direct application to problems of the industry.

DR. PHILIP EGGLETON delivered an address before the Royal Society of Edinburgh on Nov. 3, on recent work in the biochemistry of muscle. In studying the muscular engine, two chemical systems which may prove to be quite distinct—have to be sought. One is responsible for the energy of contraction, an anærobic set of processes, and the other is concerned with the 'recharging' phase, oxidative recovery. The view that the formation of lactic acid from carbohydrate is the core of the former system, and its partial oxidation is the essence of the latter, has had to be seriously modified as a result of several recently reported facts, notably the discovery by Lundsgaard that in certain circumstances work may be done anaerobically by a muscle without the formation of any lactic acid. The newer additions to our knowledge do not weaken the hypothesis that the oxidation of lactic acid provides the energy for recuperation, but they necessitate a fresh search for the chemical contractile mechanism. It has been suggested by Meyerhof that the breakdown of phosphagen (which Lundsgaard observed even in the muscles incapable of lactic acid production) is a reaction capable of supplying the necessary energy for this phase. There are difficulties in the way of this suggestion, but the only alternative at present is to place the responsibility on some reaction, or set of reactions, as yet undiscovered.

THE presidential address of Sir George Humphreys to the members of the Institution of Civil Engineers on Nov. 4 was appropriately devoted to a review of the activities of the London County Council during the period of twenty-eight years in which Sir George has been associated with that body, for the later portion as its Chief Engineer and Administrator of Housing. The population of Greater London has increased from 6,600,000 in 1901 to nearly 8,000,000 at the present day, and the problems presented by its growth and redistribution have been of an extremely interesting character. Sir George reviewed the various spheres of administration and development, including the drainage area of 180 square miles, with its main outfalls at Barking and Crossness, pointing out that within the area surrounding the County (117 square miles) to a radial distance of 25 miles from Charing Cross, there are so many as two hundred separate sewage works, the effluents from which find their way into the Thames. The problem of making comprehensive provision for these and additional areas within the catchment basin is now engaging the attention of the Ministry of Health. As regards water supply, the greater part of the water for the 574 square miles served by the Metropolitan Water Board is drawn from the Thames and the remainder from the Lee and from wells. The Board has to-day available storage reservoirs for 19,657 million gallons, and despite some restriction of use in 1929, it has maintained a supply of about 100,000 million gallons of water per annum for a population of about 7½ millions. The Thames bridges, tunnels, and river protection works were alluded to, and the various public services, including transport, briefly surveyed. The address concluded with a reference to housing accommodation for the working classes, and stated that the contributions of the London County Council and the borough councils, since the War, had amounted to about 40,000 and 11,000 dwellings respectively, the former constituting, in a number of cases, small townships, such as the Becontree estate at Dagenham with 25,000 houses and the St. Helier estate near Morden with 10,000.

IN the recent presidential address to the Society for Psychical Research, delivered by Dr. Walter Prince, of Boston, U.S.A., which is printed in the Society's *Proceedings* for October, the speaker laid stress upon the unsatisfactory methods generally employed for the investigation of the so-called physical phenomena of spiritualism, and outlined a number of conditions which it would be desirable to demand. He compared the nature of the evidence as regards these alleged physical phenomena with that of certain of the mental phenomena, such as scrying and clairvoyance. With respect to these, he maintained that so far from explaining away the phenomena, psychical researchers have brought some of them far on the way to factual establishment. Dr. Prince considers that telepathy is proved, and attempts to dispose of many of the mental phenomena have been met with swift rebuttal. Continuing, Dr. Prince referred to a few cases which seem difficult to explain normally, and in conclusion stated that what is needed is more observation until finally the meaning and significance of the phenomena will become clear.

FROM *Věstník*, the publication of the Museum of Czechoslovakia, we learn that at an auspicious inauguration ceremony on May 4, an Agrarian Museum in Bratislava was thrown open to the people. The building of the museum has taken four years, and now ten rooms are devoted to general exhibits and four to a historical section. The aim of the museum is to inculcate in the peasantry a new interest in their own country, in the development of its agriculture, and in the struggles of their ancestors; and through these to promote further progress in agriculture. The care with which the museum has been planned, both as regards the buildings and the collections which they are to house, speaks well for the foresight of its organisers, and it is not surprising to learn that the Slovak peasants welcome the new cultural institution, which gives a feeling of unity and solidity to their industry. The opening of the museum was celebrated as a holiday by the Slovak peasantry and the whole agricultural population in Czechoslovakia.

"IN these times when our traditional human pairings are being so widely criticised and so boldly relaxed, there is a biological warning—Beware of Reversions." In the course of an article in the *Quarterly Review* for October, Sir J. Arthur Thomson recalls, in the light of recent researches, the trend of the evolution of sex in the animal kingdom. His excellent summary of the many-sided progression of sex structures and sex behaviour leads to conclusions which bear upon human affairs, for he is convinced that man, when willing to use science as his torch, has much to gain from a survey of the sub-human world of life. A wide survey of the evolution of sex throughout the animal kingdom shows the gradual enhancement of sex attraction by the addition of the psychological to the physiological, and by the addition of finer sympathies and synergies to the sensory attraction. Where a prolonged courtship is subtle, as Julian Huxley has shown it to be with the great crested grebe, it forges psychical bonds which last and keep the two birds loyal partners long after the sex-fondness has passed into abeyance. The main lesson of the evolution of sex, Sir Arthur concludes, is that fondness should rise into love, and that the earth-covered roots should feed a stem that bears the flowers of the spirit and the seeds of an evolving race.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 P.M. on Thursday, Nov. 20, an oil painting of Ampère will be presented to the Institution on behalf of Mr. E. Garcke. The portrait is by Mr. Edgard Maxence, Member of the Institute of France.

IT is announced in *Science* that the Abbé Henri Breuil, of the Institut de Paléontologie Humaine, Paris; Sir Arthur Keith, of the Royal College of Surgeons, London, and Prof. G. Elliot Smith, of University College, London, have been elected corresponding members of the Field Museum of Natural History, in recognition of services rendered to the museum.

SCIENCE Service announces that Admiral Watson Taylor, U.S.N., retired, has been awarded the John Fritz Medal for his outstanding achievement in marine architecture, particularly in relation to hull design, as Chief Constructor of the United States Navy during the War. The award is made by the four American societies of civil, mining and metallurgical, mechanical, and electrical engineers.

THE third Liversidge lecture of the Chemical Society, which was to have been delivered by Prof. H. B. Dixon, will be given at 5.30 P.M. on Dec. 11 by Prof. W. A. Bone, at the Imperial College of Science and Technology, South Kensington. Prof. Bone will take as his subject, "Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930)".

THE annual meeting of the Institution of Naval Architects will open on Wednesday, Mar. 25. At the invitation of the Association Technique Maritime et Aeronautique, the summer meeting will be held in Paris early in July 1931. The International Exhibition at Vincennes (near Paris) will add to the interest of the meeting, and it is proposed to visit one of the shipbuilding centres in France.

THE following officers for the session 1930–31 of the Philosophical Society, University of Durham, have been elected: *President*: The Hon. Sir Charles A. Parsons; *Hon. Secretary*: Mr. W. M. Madgin, Armstrong College, Newcastle-upon-Tyne; *Hon. Treasurer*: Mr. J. W. Bullerwell, Armstrong College, Newcastle-upon-Tyne; *Editor of Proceedings*: Prof. G. W. Todd; *Librarian*: Dr. F. Bradshaw.

AT a meeting of the Geological Society of London on Nov. 5, Prof. P. Lemoine, Paris, and Prof. G. A. F. Molengraaff, Delft, were elected foreign members of the Society; and Prof. R. S. Bassler, Washington (D.C.); Prof. O. Mügge, Göttingen; Dr. D. I. Mushketov, Leningrad; Madame M. Pavlov, Moscow; Prof. P. D. Quensel, Stockholm; and Prof. E. Stensiö, Stockholm, were elected foreign correspondents of the Society.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. W. G. Higgins, to be agricultural field officer, Federated Malay States. Mr. C. M. Maggs, to be horticultural assistant, Federated Malay States. Mr. V. Liversage, to be agricultural economist, Kenya. Mr. F. B. Notley, to be assistant entomologist, Kenya. Mr. G. M. Roddan, to be provincial superintendent of agriculture, Sierra Leone. Mr. E. Harrison, deputy director of agriculture, Kenya, to be director of agriculture, Tanganyika Territory. Mr. G. W. Lock, to be district agricultural officer, Tanganyika Territory. Mr. R. P. Davidson and Mr. A. J. Kerr, to be agricultural officers, Uganda. Mr. G. Griffith, to be assistant agricultural chemist, Uganda. Mr. W. Small, mycologist, Ceylon, to be director of agriculture, Nyasaland. Mr. E. P. Hodgkin, to be entomologist (Medical Service), Kenya. Mr. M. E. Dommen, to be assistant conservator of forests, Cyprus.

IN the column of "Historic Natural Events" in NATURE of Nov. 8, p. 744, it is stated that Tycho Brahe discovered Nova Cassiopeiæ on Nov. 11, 1572, from Uraniborg. The observation was made, however, at the castle of Herritzvad, near Knudstrup, where Tycho Brahe's maternal uncle, Steno Bolle, had permitted him to instal a laboratory. The first stone of the observatory of Uraniborg was laid on Aug. 8, 1576.

THE *Guide to Current Official Statistics* is a very useful annual publication of H.M. Stationery Office (price 1*s*.). The volume for 1929 has now been issued. There are two main divisions of the guide. The larger part is occupied by a detailed subject index which gives the numbers of the relevant publications. In the second part these are serially listed with titles and contents. This arrangement makes it easy to discover if there is an official publication on any subject.

THE annual report for the year ended Mar. 31 last of the Executive Council of the National Institute for the Blind, 224-6-8 Great Portland Street, London, W.1, has recently been issued. The report gives an account of the work of the Institute, with a general description of its activities. Interesting information is given respecting the reproduction of literature in Braille and in Moon types, with several illustrations. Help is given by voluntary workers in the production of single Braille volumes: for example, a particular text-book for a blind student. It is only by means of an assured income that the splendid work of the Institute can be maintained and extended, and an appeal is made for continuous support, for which purpose the annual subscription is most valuable.

THE eleventh Annual Report of the Ministry of Health, 1929-1930, has recently been issued (London: H.M. Stationery Office. 4*s*. 6*d*. net). The report relates to the year ended on Mar. 31, 1930, and the subjects dealt with come under the main heads of public health, local government and local finance, poor law, national health insurance, and contributory pensions. The report is in the main a record of the more important business transacted by the Ministry during the year, and does not cover matters of routine or detail. In the section dealing with sale of foods and drugs, attention is directed to the considerable contamination by tin that may occur in cheeses wrapped in tin-foil. As in previous years, the Annual Report of the Chief Medical Officer of the Ministry is published separately.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research student at the Institute of Pathology and Research, St. Mary's Hospital—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (Nov. 17). A lecturer in dermatology in the University of Liverpool—The Registrar, The University, Liverpool (Nov. 19). An assistant at the Institute of Metals, for technical abstracting—The Secretary, Institute of Metals, 36 Victoria Street, S.W.1 (Nov. 20). An assistant curator in the Royal Botanic Gardens, Kew, in charge of the Herbaceous and Alpine Department—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Nov. 24). A principal of the Stranmillis Training College, Belfast—The Secretary, Committee for the Training of Teachers, Ministry of Education, Parliament Buildings, Belfast (Dec. 1). A director of the Fuel Research Institute of the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Dec. 15). An advisory entomologist in the University of Reading, under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice to farmers—The Registrar, The University, Reading.

Our Astronomical Column.

Total Solar Eclipse of Oct. 21.—The *Daily Science News Bulletin* of Oct. 24, issued by Science Service, Washington, D.C., gives an account of the results obtained by the American party on the island of Niuafo'ou in the solar eclipse of Oct. 21. There had been rain shortly before totality, but it cleared in time, leaving only a very slight haze, which did not seriously interfere with the coronal photographs: these are stated to be of marvellous beauty; they were taken with the 63-ft. tower telescope and the 65-ft. horizontal one. The corona was of a type intermediate between maximum and minimum; there were streamers both to east and west, and a coronal dome shaped "like a gigantic strawberry" was a prominent feature. Prof. Mitchell secured excellent spectrograms with two concave gratings, extending from λ3200 to λ7800. They show more than thirty hydrogen lines and eight coronal lines. Structure can be traced in the image given by a coronal line in the green; a coronal disturbance is shown that appears to be connected with a prominence. The New Zealand party also secured successful spectrograms with a prismatic camera, but they are on a smaller scale than the American ones.

The Leonid Meteors of 1930.—Mr. W. F. Denning writes: "The shower of November meteors becomes due at the middle of the present month, though no brilliant display is to be anticipated. The group of meteors which originated the abundant exhibition of Nov. 13, 1866, was disturbed by the gravitational influence of the planet Jupiter and apparently drawn outside the earth's orbit, so that in 1899 or 1900 no striking returns were observed. In 1901, however, a somewhat plentiful outburst of meteors was noticed in America, while in 1903 the shower was witnessed in England. The numbers counted, however, fell far below those recorded in 1833 or 1866, and were quite of secondary importance. The part of the stream which may return this year will form the region in advance of the main clusters near the cometary nucleus and should be attentively observed, for it is important to ascertain whether or not the meteors are now more richly distributed along the orbit than in former years. This year the moon will be full nine days before the shower should recur with the greatest activity, and will rise on Nov. 15 at 0.34 A.M. and at 1.59 A.M. on Nov. 16. Observers who will watch the firmament either before or after these times will be certain to see a few fine Leonids, and possibly obtain some valuable data."

Research Items.

The Barren-Land Wolf of Canada.—In a recent instalment of his account of "An Expedition to Sub-arctic Canada" in 1924–25, Capt. J. C. Critchell-Bullock gives a lengthy account of the habits of the barren-land wolf (*Canadian Naturalist*, October 1930). He dismisses as highly exaggerated the stories of the viciousness of these wolves, which, well-fed or starved, always avoid a direct encounter with man. Very few authentic cases are on record of the killing of human beings, and apart from one case of a badly crippled man on the Mackenzie River many years ago, they apply to an occasional Indian or Eskimo child who had become waylaid during a blizzard and had fallen down. In such circumstances, even sleigh dogs at a trading post have been known to maul a woman, with fatal results. The barren-land wolf travels in packs of not more than eight or nine, and it seems reasonable to assume that these packs consist of parent wolves and their own litters. They breed during June, and the pups, generally born in a den amongst loose drift which can be readily tunnelled, are suckled for two months and then fed on meat or partially digested food regurgitated by the mother. At two years they are practically full-grown, and until they take mates, follow their parents. Wolves are not likely to be found breeding in any locality in greater numbers than about one pair to four square miles, and where food was scarcer, dens were found at intervals of about twelve miles. They make great inroads upon the caribou herds, and on the assumption that there are four million caribou in Canada and fifty thousand wolves, the author reckons that the annual kill amounts to some two and a half million caribou.

Control of Moles.—An account of some experiments in the control of moles, carried out by the Department of Agriculture and Horticulture of the University of Bristol, is given in the *Journal of the Ministry of Agriculture*, vol. 37, p. 646. A badly infested area was surrounded by a yard-wide trench, in the inside of which fine wire netting was erected to prevent the escape or re-entry of moles. Certain materials known to be effective in rodent control were used. Baits prepared from red squill, either as a liquid or powder, at the rate of ten parts per hundred of the powder, proved satisfactory, provided that considerable care was taken to avoid handling the soil or disturbing the run, it being found that if the naked hand rubbed the soil of the burrow, or the run was much disturbed, the moles escaped near this point. Gassing with 'cyano-gas' or 'horo-gas' was also effective in driving the moles from the runs; but for satisfactory results the process should also be carried out in the retreats of the moles under banks or in woods, for although the actual runs do not become re-infested after being gassed, the moles will tend to carry on their activities around the treated area. Trapping is considered quite satisfactory in the hands of an experienced person, and is recommended for large estates where there is sufficient work to justify the employment of a professional mole-catcher.

The Butterfly *Pieris rapæ* in New Zealand.—In the *Entomologists' Monthly Magazine* for October (p. 224), Mr. E. S. West records the capture of two examples of this common and destructive butterfly in New Zealand. They were taken in Napier, Hawke's Bay, and the record is one of considerable importance. Under a new and highly favourable environment there is a possibility of the insect establishing itself and becoming as great a pest as in Europe and North America. Doubtlessly the Department of Agriculture and the Cawthron Institute will take any steps desirable to ascertain whether the species has secured a footing or not, and will give advice as to any repression measures, should such prove necessary. The two examples recorded may prove to be merely odd specimens from a small batch that possibly got introduced in the egg stage. It is not unlikely that eggs of this species were present on Cruciferous vegetables in cold store on steamers plying between New Zealand and Honolulu or northern America, where this insect is common. On reaching a New Zealand port, vegetable debris discarded from steamers might provide the means of entry of the insect in question. *Pieris rapæ*, it may be added, has so far been unknown in Australasia. It became established in the Hawaiian Islands less than thirty years ago, where it most likely got introduced from California on cabbages or allied vegetables.

Northern Ostracods.—An account of the Ostracoda of the North Sea and Baltic forms a recent part of "Die Tierwelt der Nord- und Ostsee" (Begründet von G. Grimpe und E. Wagler. Lief. 16, 10 b. Ostracoda von Walter Klie, Bremerhaven. Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1929), numerous species being recorded, but not all differentiated. The systematic part, which takes up rather more than half the memoir, contains diagnoses of the main groups and keys to the genera, with figures, chiefly after G. O. Sars, of representative forms or of their characteristic appendages, 45 genera and 172 species being included. The remaining portion, besides dealing briefly with methods of collecting and technique, is taken up by descriptions of the morphology, physiology, life-histories, and general bionomics of these animals, with notes on habitat and distribution. No mention is made of Prof. H. Graham Cannon's work dealing with important points both of anatomy and feeding mechanisms. Much more is known about freshwater ostracods than of the marine forms, information being very scanty, especially as to the life-histories of the latter. All those in the district described are bottom forms except the Conchœcidæ and *Philomedes globosus* in the Cypridinidæ, which are pelagic. More workers are much wanted to further our knowledge of the marine ostracods, and they would probably be amply repaid by taking up the subject in detail.

Resistance of Statoblasts to Unfavourable Conditions.—In the course of observations on the statoblasts of the largest of the colonial freshwater Polyzoa, *Pectinatella magnifica*, Chandler M. Brooks made several tests to determine their resistance to unfavourable conditions of temperature and of drought (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 81, p. 427, 1930). It has been generally supposed that the statoblasts of freshwater Polyzoa must be frozen or at least go through a considerable period of rest before they will hatch. Specimens kept at 22° C. until about ready to hatch, hatched under normal conditions although the temperature fell to freezing point, while those not kept in the warm room failed to hatch. Even the lowest temperature produced by an ice and salt mixture did not kill statoblasts exposed to it for any length of time, but even at 10° C. they developed very slowly. Heating above 40° C. retarded development, and at 55° C. death resulted. It would appear, therefore, that statoblasts develop steadily from the time they are formed, just as buds do, but the speed of development is greatly influenced by the temperature, and the

retardation due to excessive cold explains the lack of hatching in autumn. As regards drought, undried statoblasts hatched in eight days; dried for one week, in twelve days; for three weeks, in nineteen days; for five weeks (when they could be broken and ground to dust), in twenty-three days. The polypids are much more sensitive, enduring 10° C. for a short time only and dying at once at 45° C., so that the statoblasts clearly have a positive protective function.

Fruit Storage.—The home storage of apples and pears is an all-important question at this time of the year, and much waste can be avoided if attention is paid to a few general rules supplied by the Ministry of Agriculture. Care in choosing the right time for picking is essential if storage is to be successful. The fruit should come away from the tree easily on gently lifting, every precaution being taken to avoid bruising, as the careful storage of damaged fruit is only trouble wasted. A cool cellar or shed with a good roof and earthen, concrete, or brick floor is best, since wooden-floored buildings, especially dwelling-houses, are apt to be too dry. Pears, however, can be kept under slightly drier conditions than apples. The atmosphere should be rather moist, and during the first three weeks, at least, considerable ventilation is essential. A cool, even temperature is desirable, and the fruit should be kept in complete or partial darkness. Before placing in store, the fruit should be allowed to cool off in an airy place. Each sound specimen is then wrapped in a separate piece of clean tissue paper and they can be packed several rows deep on shelves or in boxes. Pears, in particular, need frequent inspection, as their ripe period is so short-lived. They are best stored spread out in shallow boxes. Wrappers for fruit storage, cut to a convenient size, can be obtained from most horticultural sales-

Sugar Beet in England.—The financial results of sugar beet growing in the eastern counties of England have been investigated for the three years 1927–29, and are reported on by C. Burgess and P. E. Graves in Report No. 16, Farm Economics Branch, University of Cambridge, Department of Agriculture. Data have been supplied by one hundred and fifty-two farmers, and more than ten thousand completed forms have been supplied and analysed statistically. The report first gives a statistical rendering of the field data, manuring, yield, sugar content, and soil classes, which provide the theoretical basis for the work. Other factors concerned are the influence of time of delivery upon sugar content, weather conditions during growth, and cost of haulage and transport. After a consideration of the over-all costs and the receipts and profits per acre and per ton, the results are grouped for the different soil types. This leads to the practical aspect of the factors influencing costs and returns, such as manuring, rate of seeding, methods of cultivation, etc., together with the difficulties due to the seasonal distribution of labour required for sugar beet. The second reduction in the rate of subsidy comes into operation with the 1931 crop. There has been a considerable extension in the acreage under sugar beet, but it is considered that it would be unwise to press for too great a reduction on the present price of sugar beet on this score, since maximum production is essential to economic factory operation, and lower prices might entail a reduction of acreage and consequent reduction in supply. It is to the interest of the factory to offer a price which will maintain the acreage of beet at a maximum, and in the interest of the farmer to maintain a high production to enable factories to be run economically, so that the interests of the two parties are in reality identical.

Form of the Japan Arc.—Though the term 'Japan arc' has been used by Naumann and others for nearly fifty years, no attempt seems to have been made to determine its exact form until the task was undertaken by Mr. N. Kumagai, of the Geological Institute, Kyoto Imperial University (*Jap. Jour. Ast. and Geophys.*, vol. 8, pp. 1-28; 1930). The boundaries of the four main islands, Kyusyu, Sikoku, Honsyu, and Hokkaido, are taken to be the bathymetric lines of 200 metres on either side, for at this depth there is an abrupt increase in the slope of the ocean-bed. The central axis of Japan is defined as the locus of points midway between the marginal arcs. The means of every three of the points corresponding to each half-degree were calculated and when plotted on a map were found to lie nearly along the arc of a small circle, the pole of which lies in lat. 42° 37′ N., long. 130° 23′ E., the polar distance of the circle being 8° 46′. In the same way, Mr. Kumagai finds the boundaries of the arc to correspond closely with two parallel small circles, the distance between them being 178 miles, while the total length of the Japan arc, from the west end of Kyusyu to the north end of Hokkaido, is 1300 miles. In a second discussion, the island of Hokkaido is excluded, as its boundaries deviate slightly from the above small circles. It is then found that both boundaries and central axis agree much more closely with parallel small circles, the pole of which is in lat. 41° 0′ N., long. 131° 46′ E., the distance between the marginal arcs being the same as before, and the length of the arc not less than 986 miles.

Granite Intrusions of the Adirondacks.—In the *New York State Museum Bull.* No. 281, 1929, Dr. A. F. Buddington presents the results of five years of field work in the foothills of the north-west Adirondacks, south-east of the St. Lawrence and parallel to it. Here there is a belt of Grenville formations invaded by fourteen elongated granite masses. The latter are interpreted as phacoliths resulting from intrusions of magma in the crests of anticlinal folds with subsequent intense deformation before the complete consolidation of the magma. The granite bodies are restricted to the folds, limbs and noses both presenting conformity with the bedding of the invaded rocks. In one case the base of a phacolith is clearly exposed. On the other hand, there is scarcely a trace of cataclastic structure in the granites and such foliation as occurs is shown to have developed before consolidation. The phenomena to be expected at the surfaces of batholiths are absent. Along much of the contact between granite and limestone there is a narrow zone, up to 150 feet in width, that consists of hornblende- or pyroxene-gneiss, accompanied by sills and lenses of granite and pegmatite and sheets of garnet-sillimanite-gneiss. Metasomatic replacement of limestone by residual solutions carrying volatile compounds thus appears to be indicated.

New Jersey Barnacles.—Mr. Horace G. Richards (*Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. 82, 1930) notes the habitat of several barnacles, particularly *Platylepas hexastylos* on the skull of the green turtle *Chelonia mydas*. This is the first time that this species has been seen *in situ* on a turtle although it was known to live attached to them. The more common turtle barnacle *Chelonibia testudinaria*, which lives attached to the shell of turtles, was found on a large specimen, probably the loggerhead (*Caretta caretta*), taken by a fisherman. The rock barnacle *Balanus balanoides* has recently been found where rock jetties have been built along the sandy shores, although previously absent on account of the uncongenial surroundings. *Balanus eburneus* is the commonest barnacle in these districts.

Mollusca of Jasper Park.—The Jasper National Park, Alberta, Canada, save for the birds and mammals, has been biologically a *terra incognita*, so that advantage was taken of expeditions to the Park in 1925–26 to study as many of the animal groups as possible and Mr. Alan Mozley now reports on the mollusca collected in and around certain of its lakes (*Trans. Roy. Soc. Edinb.*, vol. 56). About forty species and varieties are enumerated and described and some are figured in order to show their typical form and variations in the region, while an account of their habitats and other phases of their ecology is promised in a later communication.

Atmospheric Pollution.—The Report of the Atmospheric Pollution Committee of the Department of Scientific and Industrial Research for the year ending March 1929 was published on Oct. 28. It shows that of the principal towns of Great Britain at which observations of the dust particles which fall to the ground from the air in a month are made, only a few have districts in which the deposit is less than 12·7 tons per square mile per month. These are Bournville and West Heath, Birmingham; Garston, Watford; Headingley, Leeds; Western Park, Leicester; Rothamsted; Hesketh Park, Southport; and Clarence Park, Wakefield. The great majority of the stations, for example, London (including Kew), Cardiff, Edinburgh, Glasgow, Rochdale, Stoke-on-Trent, and the central parts of Leeds, Leicester, Birmingham, and Wakefield have deposits from one to three times, Liverpool, St. Helens, and the centre of Rochdale have from three to five times, while City Road, Newcastle-on-Tyne, has more than five times the above. The average amount of suspended sooty impurity in the air of, for example, London or Stoke-on-Trent on a winter day, is about half a milligram per cubic metre, domestic smoke being 2·5 times as much as industrial smoke in London and 3·5 in Glasgow, while towns like Leeds get about 25 per cent more sunshine in the outskirts than in the centre.

The Boiling Point of Water.—Although the boiling points of water under pressures between 68 cm. and 83 cm. of mercury are generally given to 0·001° C., there are discrepancies of the order of 0·01° C. between the values given by different observers. In order to decide between the alternative values, Messrs. A. Zamaczinsky and A. Bonhoure have made a new series of observations, using the glass hypsometer of M. Swietoslawski, in which the boiling process projects the steam and hot water against the thermometer tube. The temperature is measured by platinum thermometers, the pressure of the atmosphere by a standard barometer, and the deviation from it by a water manometer. To prevent superheating of the water, the inside surface of the hypsometer is covered with powdered glass. The results agree to within 0·002° C. with those given by M. Volet as the result of the observations of Chappuis and referred to in the notice of vol. 18 of the *Travaux et mémoires* of the Bureau International des Poids et Mesures (NATURE, 125, p. 948). The authors agree with M. Volet that a trinomial in the pressure is necessary to express the results. They give a table of boiling points between 68 cm. and 83 cm. mercury pressure by steps of 0·1 cm. in the September issue of the *Journal de Physique*.

Determination of Unsaturated Hydrocarbons.—*Technical Paper on Fuel Research*, No. 28 (Department of Scientific and Industrial Research. London: H.M. Stationery Office, 1930, 4*d*.), by A. B. Manning and F. M. E. Shepherd, on the determination of aromatic, unsaturated, and naphthene hydrocarbons in light oils and motor spirits, deals principally with light oils from the carbonisation and hydrogenation of coal, only two examples of motor spirit being metnioned. The principle of the method is absorption from vapours, similar to ordinary gas analysis. Further investigation of the application of the methods to petroleum products would undoubtedly be of interest.

Critical Constants of Fluorine.—The boiling point of fluorine was given by Moissan and Dewar in 1897 as approximately −187°, but no other measurements of the vapour pressure of this element have been made. In the October number of the *Journal of the American Chemical Society*, Cady and Hildebrand describe the preparation of fluorine in quantity and the measurements of its vapour pressure. They calculate the boiling point as −188·2°, and point out that this is in good agreement with Moissan and Dewar's value corrected to the new values for the vapour pressure of oxygen, which gives −188·0°. The critical temperature and pressure are found by direct experiments to be approximately −129·1° and 55 atm., the latent heat of evaporation at the boiling point being 1540 gm. cal. per mol.

An Electrically Driven Sifting Machine.—In the *Chemiker-Zeitung* for Oct. 15 will be found the description of a new electrically driven sifting machine which is likely to be of great use in chemical factories and laboratories. It is made in various sizes and can be adapted to take sieves of different shapes. It can be suspended from above and may be transported along an overhead rail. The vertical motor is enclosed in a dust-proof casing and both it and the container which moves the sieve are mounted on ball-bearings. Shaking is effected by means of an enclosed excentric device, with a special arrangement to guard against transference of any of the vibration to the motor. Any ordinary hand-sieve up to a diameter of 54 cm. can be fixed to the model and readily interchanged. The machine is made by Messrs. A. C. Fraissinet, of Chemnitz.

Furnace Atmospheres and the Production of Scale.—At a joint meeting of the Yorkshire and Fuel Sections of the Society of Chemical Industry held in Leeds on Oct. 27, a paper on the influence of different furnace atmospheres in the heating of metals, particularly steel, by Dr. W. H. Blackburn and Prof. J. W. Cobb, of the Fuel Department, University of Leeds, was read. Typical furnace atmospheres reproduced in the laboratory show that it is of paramount importance that free oxygen should not reach the surface of the hot metal, indicating the necessity of not using more air than is necessary to complete combustion. A fuel rich in carbon and poor in hydrogen, as, for example, dry coke used in a fire or gas-producer blown with air and no steam, produces definitely less scale than a fuel richer in hydrogen, such as oil or bituminous coal. Special experiments showed that the free carbon suspended in the atmosphere of a furnace working with a smoky flame plays little or no part in making that flame protective against scaling, the protection being due to the reducing gases present. There seems thus to be no ground for the common assumption that a smoky flame from bituminous coal is more effective in minimising scale than a clean reducing flame from coke, which latter would, indeed, tend to be more protective on account of its lower content of water vapour. This contention is important in connexion with the possibility of minimising smoke from industrial furnaces.

Furunculosis in Freshwater Fishes.

THE Interim Report issued in March last (Edinburgh: His Majesty's Stationery Office) of the Furunculosis Committee appointed in July 1929, by the Right Hon. William Adamson and the Right Hon. Noel Buxton, contains a large amount of information on the damage done by this disease and the means of its dissemination, with suggestions for its suppression. The Committee was constituted "to investigate the origin, predisposing causes and mode of dissemination of furunculosis and similar infectious diseases among salmon, trout and other freshwater fish in England and Scotland, and to conduct experiments with a view to ascertaining methods of combating the disease, and to report the results of their proceedings".

Previous to the formation of this Committee, much information and experimental data were collected by a smaller and informal committee between the summer of 1928 and July 1929, certain members of which are on the present committee, and the services of Miss I. J. F. Williamson, who has been the research worker throughout, are retained, with a laboratory placed at the disposal of the committee in the Bacteriological Department of the University of Edinburgh, where recently accommodation for live fish has been arranged.

Furunculosis among freshwater fish had been known on the Continent for at least forty years, almost solely on fish farms, later in Bavarian rivers, and in 1910 in France and Switzerland. A severe outbreak in four rivers in the south-west of England in 1911 directed attention to the disease, which had been known in Great Britain, in a much less severe form, probably among trout in the chalk stream, a few years earlier. In 1911 investigations were carried on, and *Bacillus salmonicida*, the same organism as had been found to be the cause in Germany, was identified. Later the disease was recorded from Ireland, Wales, and Scotland and assumed an important aspect.

Furunculosis in the salmon and other freshwater fish is thus caused by the bacterium *Bacillus salmonicida*, which invades the blood stream and is distributed throughout the body. Lesions forming focal areas of necrosis in the skin and underlying muscles are set up, causing death. The bacillus can be isolated and cultivated artificially. It can be present in outwardly healthy fish, these being 'carriers' of the disease. Gobies were infected in the laboratory by these carriers.

The Salmonidæ are chiefly infected, particularly the genus *Salmo*, both *Salmo salar* (salmon) and *Salmo fario* (brown trout) being frequent victims, also other freshwater species to a less degree, but not purely marine forms. The eel, *Anguilla vulgaris*, has been experimentally infected, as have certain other marine fish.

Healthy fish placed in water with infected individuals may contract the disease. Set free in fresh water, the parasite may survive for a sufficient period to allow of its widespread distribution. Outbreaks usually occur from the end of May to October and there is a relative quiescence during winter and spring, but the disease may persist throughout the year in any given area. Thus it is enzootic but may be epizootic. There is no evidence of the passage of the organism through an intermediate host. It may be assumed that infection is spread by contact of infected and healthy fish or by the discharge of the specific organism from the body of infected fish into the water.

Temperature is an important factor, warm dry weather favouring the disease. Overstocking and overcrowding also helps in spreading it to a large extent. All kinds of rivers and streams may harbour it. So far, river pollution seems to be unimportant in favouring its growth.

It is probable that salmon from the sea become rapidly infected in fresh water and the change of environment may increase susceptibility. All evidence favours the theory that infection is introduced into the area concerned by some means other than natural. When once there it may spread by many methods. Possibly infection may come from the introduction of a fish from a farm known to be infected.

It is of immense economic importance for our fisheries to get rid of this disease. In one river when in the ordinary course every fish would spawn, as many as 700 salmon have been picked up dead in a single season, the average annual loss being 400 fish, and the trout fisheries also suffer to a large extent.

The recommendations of the Committee as to means of control are: the collection of further evidence regarding the distribution of the disease; control of all possible sources of infection; eradication of the disease when present in fish farms by destroying the fish and emptying and disinfecting the tank or pond, and the immediate removal of dead and dying fish from the rivers; amelioration of conditions possibly favouring outbreaks when infection is already present, especially overcrowding; the control or prohibition of the importation of live fish from abroad, and the provision of powers to inspect and examine fish from artificial and natural waters, especially fish farms which are the usual sources of stock fish; finally, the maintenance of a central laboratory where routine examination of fish can be carried out and research prosecuted.

Upper Air Investigations in Egypt.

A PUBLICATION entitled "Upper Winds at Cairo and Khartoum", which constitutes Paper No. 27 of the Physical Department of the Ministry of Public Works, Egypt, has been issued. It summarises the results of many thousands of measurements of upper wind made with the aid of pilot balloons at Helwân (25 km. south of Cairo) and Khartoum, the author being L. J. Sutton, director of the Egyptian Meteorological Service. The bulk of the paper is made up of statistical tables showing the frequency of occurrence of winds from the different directions, and the frequency of different speeds from each of the directions at various heights. There are also figures showing the resultant winds in each month at the surface, 500 metres, 1000 metres, and so on up to about 4000 or 5000 metres; and in the case of Khartoum, mean values for the rainy season (May–October) and the dry season (November–April).

The meteorological value of a work of this kind is largely represented by the extent to which it enables a more accurate picture of the general circulation of the atmosphere to be given in standard works on meteorology such as Shaw's recently completed "Manual of Meteorology". The statistics given in this case in regard to the mean wind at 3000 metres and 5000 metres in January at Helwân, agree with a figure in vol. 2 of that manual (Fig. 164, p. 259), in so far as they confirm the existence of a prevailing

westerly wind in northern Egypt at the 4000 metre level, in spite of the dominance of northerly winds from 500 metres to 2000 metres. The resultant at 4000 metres height is not far from due west in any month, and on an average for the whole year must be almost exactly from west.

At Khartoum conditions aloft are complicated by the complete seasonal change occasioned by the northward and southward movements of the equatorial wind circulations in accordance with the varying declination of the sun. In the rainy season the resultant has an easterly component from 3000 to 5000 metres, and is on an average nearly due east between 4000 metres and 5000 metres from July to September. Shaw's "Manual" does not give the mean pressure distribution at 4000 metres in July for the northern hemisphere, so a similar comparison cannot be made for that level. There is, however, a diagram for 8000 metres. If the latter is correct, one would expect light northerly winds to predominate above the easterlies found by Sutton. It is possible that these exist, but it may be noted that Sutton's resultant direction for July backs from nearly north-east to a little south of east, on passing from 4000 metres to 5000 metres, and it appears more probable that the diagram in question (Fig. 167, p. 162 of vol. 2) requires slight modification in view of Sutton's statistics.

In the dry season at Khartoum it appears that westerly or north-westerly winds prevail at about 3000 to 4000 metres, not winds from between west and south-west, as is implied by the figure in Shaw's "Manual" referred to earlier in this notice, which gives the pressure distribution at 4000 metres in January. It may be noted that Teisserenc de Bort is the authority on which Shaw based his diagrams. It is to be hoped that someone will be willing presently to revise our notions of mean air movement at 4000 metres and 8000 metres over Africa in the light of such valuable papers as this, when more of the younger meteorological services have carried on systematic soundings for a long series of years.

Drift Bottle Experiments in the Gulf of Mannar.

MR. A. H. MALPAS, in his work entitled "Preliminary Account of the Results of Drift Bottle Experiments in the Gulf of Mannar" (*Ceylon Journal of Science*—Section C, Fisheries: Bulletin of the Ceylon Fisheries, vol. 4, April 1930), describes the continuation of the experiments initiated by Mr. James Hornell in 1907. The recent researches have been on a much larger scale, drift bottles being liberated, so far as was practicable, throughout the year from 1913 until 1927 (except for the years 1917–19) and the area extended to include the whole of the portion of the Gulf above the Colombo-Tuticorin line, in order to obtain some idea of the monthly current changes.

In the Gulf of Mannar there is a more or less regular cyclic movement of water controlled by the north-east and south-west monsoons. The effect of the south-west monsoon, which has its maximum in July–August, is to force oceanic water of high salinity and low temperature into the Gulf, whilst with the north-east monsoon with its maximum in December–January the surface water is replaced by water of a low salinity. The oceanic current operates chiefly in the southern portion of the Gulf and rarely penetrates so far north as the pearl banks. There is, however, a definite surface drift over the pearl banks area due to the wind, and the banks lack protection from the violence of the south-west monsoon, which at its height makes the waters at the bottom turbid and may cause silting.

Under favourable conditions of south-west monsoon and current in July and August, the pelagic larvæ liberated at Tuticorin might reach Ceylon and settle as spat, and, conversely, Tuticorin might receive spat from Ceylon in December and January during the north-east monsoon.

In analysing the drift for each month of the year, the direction of drift of each bottle recovered is assumed to be from the point of liberation to the point of recovery, and naturally no allowance is made for the various possible changes in direction of drift between liberation and recovery.

The number of recovered bottles during the period of the north-east monsoon was small and these indicate no marked currents in the Gulf opposed to the prevailing north-east winds which would carry the bottles to either the Indian or Ceylon coasts. Many were probably carried out into the ocean and so lost. The period from March to April is transitional between the two monsoons with an average of south-west winds, the returns indicating a change of drift from south-west to north-north-east. In the pearl banks area and up the Ceylon coast the current was northerly with a slight westerly tendency. The 'little monsoon' sets in at the end of April with wind and rain and a pronounced north-east drift. The south-west monsoon from May to October opens with a burst of rain and wind about the middle of May, through June gradually becoming stronger until its full force is reached towards the end of July and beginning of August, then weakens and dies away in October: average wind south-west in May–July, more westerly in August–October. The bottle returns indicate north to north-east drift, becoming more easterly as we proceed north-west across the Gulf.

On the whole, the results of the bottle returns are in agreement with the Admiralty interpretations.

British Archæology.

AMONG the numerous papers on British archæology read before Section H (Anthropology) of the British Association at the recent Bristol meeting, two are of special interest. (1) Mr. C. W. Phillips, in discussing "Earthworks on Walton Common Down, near Clevedon", pointed out the great importance of air photography. On Walton Common Down, 250 feet above sea-level, is a group of earthworks in the form of a roughly circular enclosure 340 feet in diameter, with an entrance on the south-south-west side. An avenue formed by banks of similar construction projects from it 100 yards to the north-east and ends in a cross bank. A disc barrow stands to the north of the avenue and a partially destroyed rhomboidal earthwork to the south.

Until the site had been examined from the air, it was considered that the circle and avenue might be the remains of an ancient sacred place, but air photography proved a wholesome corrective by showing that outlying portions of one of the groups of Celtic fields underlie the earthworks, which are thus subsequent in date. Both air photography and field work show intensive remains of Celtic cultivation on the Common Down, associated with two groups of proved hut circles. It is suggested that the cross bank and avenue might have been devices for marshal-

ling and sorting sheep, similar works in Ireland being known to be thus associated.

(2) Mrs. E. M. Clifford's paper on prehistoric discoveries at Barnwood, Gloucester, opened up possibilities of decisive evidence as to the physical type of the native British who were living in the district when the Roman legions reached Gloucester (Glevum). The site lies by the side of the Roman road leading from Gloucester to Cirencester, It is an extensive flat field two miles distant from the Severn and 80 feet above the level of that river. The field has been excavated to a depth of 8 feet by the Gloucester Stone Company, and the discoveries reported by Mrs. Clifford were made during operations.

A section shows an upper foot of soil, then 2–3 feet of brick-earth, then bedded gravels, upper and lower. The lower gravels are rich in remains of mid-Pleistocene fauna; in the gravels and brick-earths have been found Acheulean, Mousterian, and Aurignacian stone implements. No human remains of Pleistocene date have been discovered as yet, but burials of a later date—of the early bronze age period (a beaker burial), of La Tène II.—and an extensive Roman cemetery (first and second century A.D.) have been carefully examined. In the Roman cemetery more than 100 inhumations and 50 cremations have been studied.

Sir Arthur Keith visited the site after the British Association meetings and considers it to be of great historical importance. He thinks that the evidence points to the people buried in the cemetery as being native British, thus giving a complete picture of the kind of people who lived in the west of Britain when the Romans reached Glevum. Mrs. Clifford acknowledged expert assistance received from Sir Arthur Keith, Mr. J. W. Gray, Prof. L. S. Palmer, the late Dr. C. W. Andrews, and Mr. Reginald A. Smith.

'Serialism.'

THE work entitled "An Experiment with Time", published in 1927, in which numerous remarkable instances were given of dreams that had occurred prior to the occurrence of the events corresponding to them in waking experience, will be familiar to many readers of NATURE. In order to account for these phenomena, the author of the book, Mr. J. W. Dunne, propounded in it a theory, which he designated 'serialism'; and he has recently been giving broadcast talks in further elucidation of his theory.

Mr. Dunne maintains that, so far from being a fallacy, an infinite regress is traceable not only in the nature of physical existence but also in the nature of our awareness of the physical world. The physical world is, he argues, so constituted that it can be viewed as a series of more and more fundamental worlds; and can, in fact, be understood only when examination of it is carried so far as the second term of the series. The process of scientific investigation consists, he urges, essentially of two steps—the search for the truly 'given', or compulsory, elements in our knowledge, and the description of such given knowledge as knowledge of an existing world. The awareness that some of our knowledge is compulsory is itself second-term knowledge. Thus, knowledge of a real external world and knowledge of the self are correlative—both are given in willed activity, primarily the activity of attention. The ultimate will and the ultimate physical entity that is the opposite will belong to the realm of indefinable 'being', which the defined fields of physical and psychical ence are to be extracted.

The second-term field of physics exhibits entities plainly regressive character; moreover, it does not constitute a closed physical system, but discloses gaps in its continuity, and these gaps indicate where there may be voluntary intervention. If the physical world be described in terms of matter, the regress comes to light when matter is derived from a submatter, called space, and this again from a sub-space, and so on.

The most striking confirmation of the theory is, however, afforded, Mr. Dunne thinks, by an analysis of the time regress. If we say of an event that it is happening 'now', we are adding something to the simple notion of a time-order; and the 'now-mark', which characterises the first-term field of physical existence, must itself travel. When, in the series of events *A B C*, *B* is now and later *C* is now, they are earlier and later in a more fundamental time, in which all that is past and future in the lesser time coexists. In modern physics the importance of the 'now-mark' has, it is contended, become readily apparent; for the probable structure of *B* depends very largely upon *B*'s position with regard to a 'now'. Many paths which a particle may take when *A* is 'now' are no longer open when *C* has become 'now'.

University and Educational Intelligence.

CAMBRIDGE.—The Adam Smith Prize has been awarded to Miss R. L. Cohen, of Newnham College, for an essay entitled "Factors affecting the Price of Potatoes in Great Britain".

At St. John's College the following have been elected into fellowships: W. D. V. Hodge, Wrangler with distinction, Part II. Mathematical Tripos 1925, Smith's Prize 1927; J. G. Semple, Wrangler with distinction, Part II. Mathematical Tripos 1927, Rayleigh Prize 1929; P. E. Vernon, Natural Sciences Tripos Part I., 1926, Class 1, Moral Sciences Tripos Part II., 1927, Class 1, Rockefeller Foundation Fellowship in Social Sciences at Yale University 1929.

The Henry Sidgwick Memorial Lecture at Newnham College will be given by Prof. A. V. Hill, professor of physiology in the University of London, on Saturday, Nov. 22, at 5 P.M. The title of the lecture is "Biology in Education".

LEEDS.—Under the will of the late Lord Brotherton, who died on Oct. 21 last, the University is to receive £100,000 for general purposes. This benefaction will be additional to the gift of the University Library, his collection of books, and an endowment for upkeep.

OXFORD.—At the meeting of Congregation on Nov. 4, a decree was passed providing that £2000 of an anonymous gift to the University of £5000 should be invested and the income used for the purchase of scientific books and periodicals. Another decree was passed giving power to the Vice-Chancellor to make provision for carrying on the duties of the Savilian professorship of astronomy during the vacancy caused by the death of Prof. H. H. Turner.

THE Prince of Wales has consented to become president of the fourth Congress of Universities of the Empire to be held in Edinburgh next summer, and, circumstances permitting, to welcome and address the delegates and representatives in London on July 3.

PROF. L. M. DENNIS, of the Department of Chemistry, Cornell University, informs us that the following have accepted appointment to the George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University for the next two years: first term, 1930–1931, Prof. G. Hevesy, Freiburg in Breisgau; second

term, 1930–1931, Dr. N. V. Sidgwick, Lincoln College, Oxford; first term, 1931–32, Prof. W. L. Bragg, Manchester; second term, 1931–32, Prof. Alfred Stock, Technische Hochschule, Karlsruhe; first term, 1932–33, Prof. Cecil H. Desch, Sheffield; second term, 1932–33, Prof. Otto Hahn, Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem; first term, 1933–34, Prof. V. M. Goldschmidt, Göttingen; second term, 1933–34, Prof. Robert Robinson, Oxford.

Historic Natural Events.

Nov. 16-18, 1928. Storms over British Isles.—This was a very stormy period over the British Isles and neighbouring parts of Europe. A deep barometric depression lay north of Scotland and a series of intense secondaries crossed England and the southern North Sea, bringing winds of nearly 90 miles per hour in gusts. This storm caused much damage, especially to shipping, in Germany and Holland, with some loss of life. In Holland and Schleswig-Holstein the dykes burst in several places, with flooding.

Nov. 17, 1218. Storm Flood in North Sea.—Several parishes were overwhelmed by the sea, and many thousands of persons lost their lives. This storm broke through the West Frisian Islands, and formed the beginning of the Zuyder Zee.

Nov. 17-18, 1852. "Duke of Wellington's Flood".—During one of the highest Thames floods on record, on the occasion of the Duke of Wellington's funeral, the hearse and horses were upset in the flooded Bath Road at Maidenhead. At Putney the towing path was six feet under water, and the Great Western Railway line was flooded for four miles between Hanwell and Paddington. At Windsor part of the Home Park was four feet under water. Oxford was described as standing in a sea of water, the whole of the surrounding country being flooded, and the Evenlode Valley was for more than a week like an immense lake.

Nov. 17, 1882. Sunspot, Magnetic Storm, and Aurora.—A remarkable sunspot, visible to the naked eye, was reported on Nov. 17 and the following days. It was the largest spot hitherto photographed at Greenwich, its area being 2470 millionths of the sun's visible surface, and was exceptionally brilliant. Simultaneously both Europe and North America were visited by a violent magnetic storm, which began on Nov. 11 and reached its climax between 10 h. 30 m. on Nov. 17 and 5 h. 30 m. on Nov. 18. The magnetic declination oscillated rapidly through almost 2°, and the changes of force were correspondingly great and sudden. The whole telegraphic system was disturbed to an extent far exceeding anything previously recorded. Equally remarkable was the display of aurora on the evening of Nov. 17. As observed at the Royal Observatory, Greenwich, it commenced with a bright glow of red light extending from the north and west beyond the zenith, interspersed with pale green phosphorescent light and streamers. At 18 h. 40 m. a very brilliant streak of greenish light about 20° long appeared in the east-north-east and travelled rapidly towards the west. This streak was very widely observed over the British Isles; it passed from horizon to horizon in about six seconds, its height was of the order of 200 miles, and its velocity over a path of 200 miles about 15 miles per second. In North America the aurora was also very brilliant, and about midnight, in Michigan, all the visible heavens, to within 20° of the southern horizon, were covered by straight streamers extending from all parts of the horizon to the zenith, where they formed a boreal crown of blood-red colour.

Nov. 17, 1910. Heavy Rain in Sicily.—As a result of a violent thunderstorm and 'cloudburst', 18·3 in. of rain fell in 24 hours at Riposto, Sicily. This is the heaviest known fall in a day in Europe.

Nov. 18, 1912. Hurricane in Jamaica.—The western part of Jamaica was devastated by a hurricane of remarkable intensity, especially when the lateness of the season is considered. At Negril Point lighthouse the wind reached 120 miles per hour at 2 A.M., after which the anemometer was destroyed; the storm continued to increase in violence for four hours, but no estimate was made of the highest velocity. The rainfall was very heavy, and, where gullies opened on to the coast, many houses were washed away and a number of lives were lost; elsewhere, as at Savanna-la-Mar, the sea swept over the land and destroyed everything, wrecked ships being stranded in the streets.

Nov. 19, 1421. Storm Flood in North Sea.—An extraordinarily great storm flood in the North Sea affected the coasts of Friesland, Holland, and England. Seventy-two towns were submerged and it is said that 100,000 men were killed. As a result of this storm the Zuyder Zee finally reached its present form.

Nov. 19, 1822. Earthquake in Chile.—By this earthquake the greater part of Valparaiso was ruined, while the shock was felt over an area 1200 miles long from north to south. A large tract of the coast, it is said 100 miles in length, was permanently upraised, at Valparaiso by about 3 feet, at Quintero by about 4 feet. Three weeks later, the old bed of the sea was still bare, with beds of oysters and other shell-fish adhering to the rocks. An old wreck near Quintero that before the earthquake could not be reached was afterwards accessible from the land.

Nov. 19, 1824. Inundation at St. Petersburg.—As a result of a violent westerly wind which heaped up the waters of the Baltic in the Gulf of Finland and impeded the flow of the Neva, St. Petersburg suffered from the greatest inundation since the foundation of the city. The waters of the Neva rose 13 ft. 7 in. above the ordinary level, and the whole city except some suburbs was submerged. The damage was aggravated by a frost which followed the flood.

Nov. 19, 1928. Cloud formed by Aeroplane.—A Swiss aviator reached a height of about 33,000 feet in clear air near a thin sheet of cirrus cloud. A definite streak of cirrus formed behind the aeroplane, and persisted from 3.45 P.M. until 4.15 P.M., gradually being distorted by the wind. It was successfully photographed from the ground.

Nov. 19, 1928. High Solar Prominence.—An eruptive solar prominence, the highest on record, was observed at the Kodaikanal Solar Observatory, India, to reach the height of 20′·9 (that is, two-thirds of the sun's diameter or about 570,000 miles) above the sun's chromosphere, when cloud intervened. The brightness of the prominence at so great a height was also remarkable. Comparison of several spectroheliograms taken in calcium light gave the greatest outward velocity of the prominence as nearly 145 miles a second.

Nov. 20, 1242. Floods in England.—Miss Ormerod quotes that "there happened a marvellous tempest of thunder and lightning, and therewith followed such an exceeding rain (which continued many days together) that rivers rose on marvellous heights, and the Thames itself, which seldom riseth or is increased by land floods, passing over the banks, drowned all the country for the space of six miles about Lambeth, so that none might get into Westminster Hall, except they were set on horseback".

Societies and Academies.

LONDON.

Royal Society, Nov. 6.—**W. A. Bone** and **S. G. Hill**: The slow combustion of ethane. The slow interaction of ethane and oxygen in various proportions at 290°-320° C. and pressures between 420 mm. and 780 mm. involves essentially 'chain reactions', preceded by well marked 'induction periods'. Addition of small amounts of third bodies may materially shorten the induction period. The subsequent oxidation then proceeds in a manner consistent with the 'hydroxylation' theory, at a rate dependent chiefly upon the ethane concentration.—**A. Fage** and **W. H. Falkner**: An experimental determination of the intensity of friction on the surface of an aerofoil. Using small surface tubes of the Stanton type, measurements of velocity were taken at distances of 0·002-0·003 in. from the surface, from which the velocity gradients at the surface and the intensities of the surface friction were determined. On each surface the frictional intensity had two maxima, the first associated with laminar flow, and the second with turbulent flow in the boundary layer.—**A. M. Tyndall** and **C. F. Powell**: The mobility of ions in pure gas. In experiments with nitrogen the negative carriers were in every case electrons, but the results with positive ions were variable. Small traces of impurity have a great effect on the mobility of the positive ions. The results are in accordance with the view that a positive ion can capture an electron from a neutral molecule of lower ionisation potential, with a consequent change in the nature of the ion. At pressures of 100 mm. or more, the amount of foreign impurity must be reduced to the order of one part in a million. At present no significance can be attached to any of the values recorded in the literature.—**S. Chapman** and **A. T. Price**: The electric and magnetic state of the interior of the earth. A detailed examination of the currents induced within the earth by the primary outer fields of the daily magnetic variations, and of the storm-time variations of the earth's field during magnetic storms. The induction is supposed to occur within a uniform conducting core of which the upper surface is at a depth of about 250 km. below the earth's surface; evidence is found for a rapid rate of downward increase of electrical conductivity in the layer below 250 km.—**R. H. Fowler**: Speculations concerning the α-, β- and γ-rays of Ra B, C, C″, I. Replacing the ideal Hertzian oscillator in the nucleus used in Miss Swirles's theory by an actual model nuclear quantum-mechanical system, interacting by Coulomb forces with the electrons of the outer atom, shows that there is no likelihood of any serious modification of her calculations so long as the dipole moment of the two nuclear states concerned in the emission of any γ-ray does not vanish. When it does vanish and the nucleus can, practically speaking, not *radiate* this frequency at all, the more correct interaction integral of the revised theory still does not vanish, but survives, operating ejections of the K-(etc.) electron as a β-particle by collision with the nuclear particle, when the K-electron actually enters the nucleus.—**R. Fort** and **C. N. Hinshelwood**: Further investigation on the kinetics of gaseous oxidation reactions. The substances studied were methane, methyl alcohol, and formaldehyde, the two latter being intermediate products in the oxidation of the former. These characteristics of the reactions are best explained by assuming a 'chain' mechanism, which does not seem to depend upon any particular chemical configuration of the reacting molecules, so long as the necessary energy is available. The part played by the walls of the containing vessel depends not only on the dimensions of the vessel but also on the nature of the surface. It seems probable that the adsorbed layer of oxygen may play an important part in breaking the chains which reach the wall.—**C. N. Hinshelwood** and **K. Clusius**: The displacement by ultra-violet light of the explosive limit in a chain reaction. Mixtures of phosphine and oxygen at ordinary temperatures react negligibly slowly except between two sharply defined limits of pressure. In this region explosion occurs, the passage from the slow reaction to explosion being abrupt. Ultra-violet light of wave-length 2500-2800 A. diminishes the lower pressure limit. This effect is shown to be due to the production from the phosphine of a minute amount of an active substance, which does not decay immediately when the illumination ceases.—**C. D. Ellis** and **G. H. Aston**: The absolute intensities and internal conversion coefficients of the γ-rays of Ra B and Ra C. Measurements of the relative intensities of the natural β-ray groups and those liberated from platinum by the absorption of the γ-rays enable the magnitude of the internal conversion coefficient to be deduced. The results appear to be incompatible with a radiation hypothesis of internal conversion and indicate some other type of coupling between the nucleus and electronic system. The experiments provide a method of measuring the absolute intensities of the stronger γ-rays.—**A. A. Robb**: On a symmetrical analysis of conical order and its relation to time-space theory. The time-space geometry of Minkowski and geometries of larger number of dimensions can be built up on a basis of *before* and *after* relations, and congruence can be defined in purely ordinal terms. The importance of such geometries is disguised by the lack of symmetry in the canonical expression for the square of a linear interval. It is now shown that analytical symmetry may be introduced by taking as the canonical form, not a sum of squares, but a sum of products.—**R. A. Fisher**: The moments of the distribution for normal samples of measures of departure from normality. Two methods are given for discussing the distribution of the ratios of the symmetric functions k_3, k_4, . . . obtained from samples from a normal distribution to the powers of k_2, of the same degree.—**D. H. Bangham** and **N. Fakhoury**: The swelling of charcoal (1). An apparatus is described by which the linear expansion of a charcoal rod can be measured simultaneously with the quantity of adsorbed gas causing it. Expansion seems to result from the pressure exerted by the adsorbed molecules at sharp re-entrant angles in the surface of the adsorbent. The expansion caused by the adsorption of a given quantity of gas increases with the temperature.—**I. Ramakrishna Rao**: The behaviour of water with change of temperature and with addition of electrolytes as studied by the Raman effect. With increasing temperature, the band becomes sharper and shifts towards the short wave-length side, due to changes in the single H_2O, double $(H_2O)_2$, and triple $(H_2O)_3$ molecules. Addition of nitric acid also makes the band narrower. At high concentrations, two sharp, well resolved bands are formed, one attributed to double water molecules and the other to hydrates of the acid.—**E. Rudberg**: Energy losses of electrons in CO and CO_2. Characteristic energy losses suffered by an initially homogeneous beam of electrons sent through the gas at low pressures were determined. The distribution curves for the electrons show several well marked maxima, which are characteristic of the energy levels of the particular kind of molecules under investigation. In the case of carbon monoxide the maxima have been correlated with transitions from the normal state of the molecule to excited states known from the analysis of band spectra belonging to this molecule or to singly ionised

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
INSTITUTION OF CIVIL ENGINEERS, at 6.—W. T. Halcrow: The Lochaber Water-Power Scheme.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Section) (at Borough Polytechnic), at 7.—E. R. Corke: Boiler Efficiencies.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—G. H. Dannatt: A Londoner's London.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Royal Technical College, Glasgow), at 7.30.—Dr. A. Jaques: Experiences with Blast Furnace Tar.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Holmes: The Turbo Compressor as Supercharger.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—T. H. Arnold: Technique of the Developments of Microstructures.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Dr. W. H. Linnell: The Purity, Standards, and Tests of Medicinal Substances (Lecture).
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre).—G. Rogers: Address.

WEDNESDAY, NOVEMBER 19.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Royal Agricultural Hall), at 11 A.M.—T. P. Francis: Modern Treatment and Disposal of Sewage, especially as affecting Trade Wastes.
ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave: Report on the Phenological Observations in the British Isles, December 1928 to November 1929.—A. V. Williamson and K. G. T. Clark: The Variability of the Annual Rainfall of India.—A. Moe: The North Sea as a Link between Climate, Plant Growth, and Migration of Birds, in the British Isles and in Norway. Spring near Yarmouth and at Stavanger.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. A. Brammall: A Genetic Study of the Dartmoor Granite, with Analyses by Dr. H. F. Harwood.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square) at 5.30.—R. J. Bracey: A Universal Tube Length and Cover Glass Correcting Lens System for Use with Microscope Object-Glasses.—Dr. W. E. Cooke and C. F. Hill: Microscopical Studies in Pernicious Anæmia. I. The Hæmoglobiniferous Cell.
INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—A. T. Black: Address.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (jointly with Liverpool Engineering Society) (at the Temple, Liverpool), at 6.30.—J. E. Nelson: Electrification of Runcorn and District.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at University, Birmingham), at 7.
SOCIETY OF RADIOGRAPHERS (in Reid Knox Hall, 32 Welbeck Street), at 7.—Dr. J. Duncan White: Training in Radiography.
INSTITUTION OF AUTOMOBILE ENGINEERS (North-Eastern Centre) (at Metropole Hotel, Leeds), at 7.15.—A. H. Girling: A New Automobile Braking System.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—H. Coates and H. J. Norballe: Some Automatic Electric Control Gear Problems.
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (at Leicester Museum), at 7.30.—G. J. V. Bemrose: Exhibition Evening: Leicestershire Fungi.
ROYAL SOCIETY OF ARTS, at 8.30.—Dr. L. Binyon: Persian Painting.
MEDICAL SOCIETY OF LONDON.—Prof. W. Rothenstein: Painting and the Healing Art (Lloyd Roberts Lecture).

THURSDAY, NOVEMBER 20.

BRITISH WATERWORKS ASSOCIATION (at Agricultural Hall), at 2.30.—R. L. Robinson: The Afforestation of Watersheds.—A. Bobbington: The Land Drainage Act, 1930, in Relation to Rivers Pollution Prevention.—D. F. Worger: The Rural Water Supply Problem.
ROYAL SOCIETY (Special General Meeting), at 4.—At 4.30.—Lord Rayleigh: Iridescent Colours of Birds and Insects.—C. R. Bailey, A. B. D. Cassie, and W. R. Angus: Investigations in the Infra-Red Region of the Spectrum. I., II.—Dr. J. K. Roberts: The Exchange of Energy between Gas Atoms and Solid Surfaces.
LINNEAN SOCIETY OF LONDON, at 5.—R. Gopala Aiyar: An Account of the Development and Breeding Habits of a Brackish-water Polychæt Worm of the genus *Marphysa*.—R. E. Holttum: Malayan Ferns.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. L. C. Martin: Colour Vision (1).
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. Bianchi: Some Data concerning Railway Electrification in Italy.
INSTITUTE OF RUBBER INDUSTRY (at Manchester Ltd., Royal Exchange, Manchester), at 7.—G. Martin: The Evaluation of Raw Rubber.
ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 7.30.—Capt. H. Swan: Recent Developments in Engine Cooling, with Special Reference to Oil Cooling.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch) (at Cleveland Scientific and Technical Institute, Middlesbrough), at 7.30.—G. T. Edwards: Ship Repairing.
CHEMICAL SOCIETY, at 8.—Prof. J. Read and R. A. Storey: Piperitone. Part XI. Syntheses of Optically Inactive and Active Piperitylamines, Piperitols, and α-phellandrenes.—Prof. J. Read and W. J. Grubb: Researches in the Menthone Series. Part IX. A New Optical Resolution of dl-menthol and of dl-camphor-10 sulphonic Acid.
INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 8.—Dr. R. Seligman: Some Non-Ferrous Metals in Chemical Engineering.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Clinical and Laboratory Meeting) (at Hospital for Tropical Diseases, Endsleigh Gardens), at 8.15.—Demonstrations by Sir Aldo Castellani, Sir Thomas Carey Evans and Dr. G. R. Mather Cordiner, Dr. N. H. Fairley, Dr. E. P. Hicks, Col. S. P. James, Dr. G. C. Low, Dr. P. Manson-Bahr, J. F. Marshall, Drs. W. S. Sharpe, H. S. Stannus, Prof. W. Yorke and Dr. D. U. Owen.
BRITISH INSTITUTE OF RADIOLOGY (in Reid-Knox Hall, 32 Welbeck Street), at 8.30.—G. Simon: Diathermy in Pneumonia.—Dr. A. Müller: An X-Ray Generator with a Rotating Water-Cooled Target.

FRIDAY, NOVEMBER 21.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. K. R. Rao: The Spectrum of Doubly-ionised Arsenic.—Dr. E. T. Paris: The Determination of the Acoustical Characteristics of Singly-resonant Hot-wire Microphones.—Dr. H. C. Bowker: The Effect of Temperature on Spark Potential.—Dr. L. F. Bates: The Curie Point.—Demonstration of an Instrument for Compounding Curves, devised by Dr. Haughton.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Enlargement of the Prostate, with an Account of the Present State of Knowledge concerning the Etiology of the Condition.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—Dr. J. H. Reid: Nicotine.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A. Eagle and R. M. Ferguson: The Coefficient of Heat Transfer from Tube to Water in Surface Condensers.
SOCIETY OF DYERS AND COLOURISTS (at Literary and Philosophical Society, Manchester), at 7.—Dr. J. L. Hankey: The Treatment of Aniline Black subsequent to Ageing.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—W. H. Clark: A Talk on Lantern Slides.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. P. H. Graham: Ancient Clocks and Horological Curiosities.
INSTITUTE OF BREWING (at Institution of Electrical Engineers), at 8.15.—Dr. E. S. Beaven: The Culture of Barley for Brewing.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Clinical Meeting.
INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Leeds).—Annual General Meeting.
ASSOCIATION OF ECONOMIC BIOLOGISTS.

SATURDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: What Schubert did for Song.
BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Extraordinary General Meeting.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 14.

BOROUGH POLYTECHNIC INSTITUTE, at 6.30.—Prof. J. T. MacGregor-Morris: Iron, Nickel, and Highly-Permeable Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 21 and 28.)
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.15.—J. H. Coste: The Object and Methods of Sewage Treatment, particularly in relation to Inland Towns and Isolated Institutions (Chadwick Lecture).

SATURDAY, NOVEMBER 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. St. George Gray: The Lake Villages of Somerset.

MONDAY, NOVEMBER 17.

KING'S COLLEGE, LONDON, at 5.30.—Prof. B. P. Haigh: Brittle Fracture in Metals (Armourers' and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 24 and Dec. 1.)

TUESDAY, NOVEMBER 18.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: Russian Farming and Agriculture.—At 5.30.—Miss Hilda D. Oakley: The Approach to Reality (1): Through Speculative Thought.
GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Twelve Chapters: a Summary of Recent Advances. (Succeeding Lectures on Nov. 19, 20, and 21.)
UNIVERSITY COLLEGE, LONDON, at 8.15.—Archbishop of York: The Relations between Philosophy and Religion.

WEDNESDAY, NOVEMBER 19.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. Massey: The Prevention of Venereal Disease.
BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. S. P. Mercer: The Romance of a Seed.

THURSDAY, NOVEMBER 20.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Maude E. Kerslake: Contraceptive Problems of Destitute or Injured Women.
KING'S COLLEGE, LONDON, at 5.15.—Miss Theodora Bosanquet: Auguste Comte and the Positive Philosophers.

FRIDAY, NOVEMBER 21.

TOWN HALL, GATESHEAD, at 7.30.—Dr. M. Ray: The Treatment of Rheumatism (Chadwick Lecture).

SATURDAY, NOVEMBER 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Norris: A Survey of Costume from Prehistoric Times to the Elizabethan Era.

SATURDAY, NOVEMBER 22, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3186, Vol. 126]

Administration and Research in India.

WHATEVER may be the outcome in the immediate future of the political situation in India, and however it may be affected by the Round Table Conference now sitting in London, it must be remembered that pledges have been given which would result in the exercise of the effective power of government passing in an increasing degree into the hands of the Indian people. This is not the place, even if it were not too late, to enter into argument as to the wisdom of the course that has been adopted in handling Indian affairs; it is the outcome of a policy which was initiated long ago. Enlightened according to the ideas of its day, that policy, nevertheless, failed to appreciate the essential quality of the problem and the conditions which governed its solution.

Under our dominion in India, the administrative, executive, and judicial functions were long solely in the hands of British officials. In the native States with princely rulers, native institutions functioned under the supervision of a British political officer, whose duty it was in case of need to exercise a firm, if tactful, restraining influence over the head of the State. In both cases, control was vested in men trained in the traditions of a great service, men who looked for no material gain from the position they held. Nevertheless, however sympathetically exercised, this control was an alien control, the control of a foreign aristocracy in a conquered land—a condition with which India had been familiar from her earliest historic times.

With the spread of humanitarian and democratic ideals in the nineteenth century, as the Empire expanded, there grew up the conception of a tutelage of the backward races by the white man. To some this meant no more than the preservation of the *Pax Britannica* and an autocratic, if just and benevolent, rule which eliminated the more objectionable features of native custom, but on the whole left it very much where it was. The line of demarcation between the ruler and the ruled was rigorously observed. This was, on the whole, the point of view of Mr. Rudyard Kipling and on broad lines that of the Indian civilian. It did not preclude, and indeed more often than not was accompanied by, a very considerable understanding of native customs and ways of thought, as well as appreciation of their bearing upon the problems of government.

On the other hand, a more widely held, if perhaps less well informed, opinion regarded it as incumbent

upon the white man to raise the status of the native in the scale of civilisation and to train him to a point at which he would be capable of taking a part in the civic life and government of his country. However this aim is to be regarded as an ideal, there can be no two opinions, in the light of experience, as to the means adopted for its attainment. The end in view was to be attained by education—education, that is, on the European model—and a share in representative institutions when the time was ripe and the native had reached the necessary standard of civic responsibility. Hence we find the children of West Africa on their way to this desirable goal reciting in English lists of the capes and rivers of Great Britain!

In India the opportunity was readily grasped by certain classes of the population. Converts—too often solely *ad hoc*—thronged the missionary schools; universities, with curricula framed on English lines, flourished in the various provinces; and Indians were admitted to the Civil Service, the Bar, and the Bench. Gradually representation was introduced in the local and central councils, though tempered by an official British element; "India for the Indians" then became the cry of the political agitator. Home Rule was admitted as a not unreasonable claim.

The peculiar conditions of India have served to disguise the fact, which soon became apparent in dealing with the backward races in our other dependencies, that training upon European lines and through institutions other than those of the people themselves was not suited to their needs. India has a civilisation of her own with a long history behind it. For centuries her culture has attained high development on its own lines in the arts, in literature, in philosophy, and even in a science of its kind. Those of the Indian peoples to whom this culture was native were intellectual, intelligent, and of a singular flexibility of mind. They rapidly assimilated European ideals and methods of education, at least superficially. Their success in law, in medicine, and in some branches of science has been conspicuous both in their own universities and in those of Europe.

The undoubted intellectual ability and adaptability of a certain section of the population and the clamour of agitators who loudly proclaim their hostility to a 'foreign' rule have led many into thinking not only that India is capable of self-government, but also that Indian rule for India will bring peace and an absence of friction in the work of administration. In truth, all that will have been done will be to take the administration from one race and hand it over to another which will not necessarily stand in much closer relation to the population of its jurisdiction than the European. The educated Indian in number represents an exceedingly small percentage of the total population.

The problem of the government of India, the real India, remains unchanged. India is still not one, but many. The lack of unity arising from differences of caste and of race will still be there. The multiplicity of creeds will persist, even though Hinduism may seek by the imposition of an offici[al] pantheon and a common name to mark off i[ts] millions, with their varied beliefs and their loc[al] godlings, from Mohammedan and Parsi. T[he] customs and modes of thought of the peas[ant] population, the wild tribes, the hill men, the noma[ds] and the outcasts may well be as strange to [the] educated Indian as they are to the English civi[lian] fresh from his university. In the recent exami[na]tion for the Indian Civil Service, it would ap[pear] that of the twenty-four successful candidates f[rom] all parts of India, the big majority were Hindu[s]. In a country so vast as India and varying so profoundly in custom and sentiment, in what respect does any one of these when outside his own district, his own race, and his own cree[d] hold the advantage over the English civilian? Differences of caste, of race, of religion, and o[f] culture will still have to be bridged. Sympathy informed by knowledge will be no less an essentia[l] of good and efficient rule.

The mass of the Indian peoples is indifferent t[o] politics; its vital interests are moulded by it[s] religious beliefs. Whatever may be the form of constitution ultimately adopted, in the last resort its efficiency, in view of the peculiar character of Indian conditions, will rest on the relations of the district official with the people under his jurisdiction. It should be unnecessary to labour the point that this depends upon an intimate knowledge of racial character and religious and social customs. Th[is] goes deeper than the broad distinction betw[een] Mohammedan and Hindu, or even the m[any] differences within the latter group.

It has frequently been pointed out that intimate knowledge such as is here held necess[ary] demands intensive study. In the records of [the] Indian census, in the pages of Risley, of Cro[oke] and of the many others who have written on customs and beliefs of the peoples of India, [is] much invaluable material to form the groundw[ork] of such study; but none would deny that in the collection of information bearing on the ethnology

and culture of the Indian peoples much still remains to be done. Whatever change may be brought about in the government of India, this work should be continued.

There can be no question that the Indian university will have an increasingly important charge in the future of the country. With it will lie a great part in educating the administrator and in preparing him for the performance of his function in the government of his country. In the past, it must be admitted, the curricula of the universities have in too great a degree looked to western culture for inspiration. It is true they have not neglected Indian studies; but even in these, specially in earlier days, they have fostered the literary and speculative bias of the native of India, and especially of the native of Bengal. In Indian studies, literary and textual criticism of the Indian classics, philosophy, epigraphy, and the study of literary historical sources have prevailed, to the almost entire exclusion of the problems and conditions of the living India.

In another column we refer to the records of research which have been carried out at the University of Allahabad in recent years. It is there pointed out that great stress is now laid on research in university work. These records indicate the importance which, to-day, is attached to practical work in the natural sciences. On the other hand, in the more specifically Indian side of the work research is almost exclusively literary. Without in any way attempting to minimise the importance of these studies in their bearing upon the history and culture of India, it is permissible to suggest that the universities have a great field for research at their doors. The ethnology, the social anthropology, and the economics of the Indian peoples are matters of vital importance which call for investigation. These are fields to which the natives of India themselves have paid too little attention. Among them it is true there are a few now living who have earned a world-wide reputation by their devotion to anthropological studies; some whose activities have recently turned in this direction it would not be too harsh to say that their theories have been coloured by their political prepossessions. In view of the practical importance of these studies for the future good government of India, the universities would do well to encourage research in the laboratory and in the field. Incidentally, by so doing they would effect a valuable and much-needed contribution to the advancement of anthropological knowledge at large.

Physics and Reality.

The Mysterious Universe. By Sir James Jeans. Pp. ix + 154 + 2 plates. (Cambridge: At the University Press, 1930). 3s. 6d. net.

WHY do we call the universe mysterious? Is it because we know so much about it or so little? The impression left by Sir James Jeans's fascinating book is that it is because the interpretation given appears more fantastic than that which is interpreted. Perhaps the only true mystery is one which is not destroyed by solution.

We exist as the result of an accident to the sun some 2000 million years ago. The stage thus being set, the actors unaccountably appeared and began to interrogate their surroundings. To primitive man simple things were obviously regular, while complex things were apparently capricious. Caprice was more impressive than monotony, and the universe was thought of as anthropomorphic. As time passed, more attentive observation caused a continuous transfer of phenomena from the category of caprice to that of regularity, and the universe was accordingly reinterpreted as a machine. In these last days the machine has broken down, and left a thought-form which is the present physical conception of the ultimate nature of the world and appears to bring us back to caprice, rechristened 'indeterminacy', as the original source of events.

Such is the panorama of scientific history which Sir James Jeans shows us. With a wealth of apt illustration he traces its course, showing in detail how the relativity and quantum theories have led up to the present position, and in conclusion describes his philosophy of the universe as a thought in the mind of a controlling mathematician who has no perceptible emotion, morality, or æsthetic appreciation.

It is admirably done. Despite a few infelicities—the result, apparently, of undue haste—we know of only one book on the same themes which deserves comparison with it. It is difficult to conceive of a more excellent account of the recent developments of physics for the general reader. Most readers, however, will be chiefly interested in the summing-up, and this we find not so admirable. Sir James's review of mankind's successive attitudes towards the universe is too summary to include transition stages, and one of these seems to us, in view of recent developments, to be of the greatest significance. Let us try to indicate it by presenting two different points of view taken in scientific work and thought.

The intellectual habit of the Middle Ages was one of brilliant but unbridled ratiocination based on arbitrary elements of thought. The battle which, in the seventeenth century, was fought and apparently won by the pioneers of modern science was for the exclusion from philosophy of all data which were not directly derived from observation. Galileo and Newton regarded with a not unnatural horror the introduction of hypotheses to correlate observations, and, with as much consistency as is possible to human beings, they preached and practised a philosophy from which hypothetical causes of phenomena were rigorously excluded.

Time passed, and the scientific description of Nature on the new principles went steadily on. But one momentous day something new occurred. The little imp which is always ready to suggest unorthodox devices to the eager investigator whispered in someone's ear: "You want to correlate observations unconfused by arbitrary ideas based on imagination or dead authority? Very good; but the refusal to be dominated by imaginary notions does not require you to abstain from leading them in chains. Why not invent existences—call them 'parameters' if you like, as the mathematicians do—to serve as connecting links between observed phenomena? You may find that one or two such existences will suffice to correlate whole masses of observations which otherwise would remain independent and disconnected, and lead to the discovery of who knows how many new phenomena. You will have sacrificed no principles and betrayed no trust." So it was done. Atoms and an ether were conjured up, and all went as the imp had said, with a success indeed far beyond his boldest insinuations. These conceptions in turn gave place to electrons, protons, photons, probability waves, and what not, as the attack grew more breathless, until to-day the most widely diverse of Nature's secrets, in the heavens or under the sea, are strung together by a few 'quantum numbers'.

It is all very wonderful, but in the meantime what has happened? Just what has occurred so often before: the creature has taken control of the creator. The conceptual scheme of physics is no longer merely an instrument by which observations are correlated; it is the 'reality behind phenomena'—or rather our nearest approach to the reality, for the scheme is not yet complete. So that, to reach reality, we have to strip experience of everything that can be seen and felt and enjoyed, until we come down to the inexpressible thought-essence of a hypothetical skeleton.

That, however, is not the worst. Not only must phenomena hide their diminished heads; but, also, they are not allowed even in obscurity to wear their own expression. We observe a determinism in the physical world. The scheme requires that it is a statistical determinism; therefore it is not determinism. We observe that Nature proceeds by laws. The scheme requires that they are laws of chance; therefore they are not laws. Sir James Jeans does not finally commit himself to this view, but that appears to be only because he is not yet convinced that the behaviour of electrons will not later turn out to be determined. The one thing which emerges clearly from all this, is that, if these ideas are generally adopted, the spoils of victory have passed from Galileo to the Aristotelians. Galileo will not have suffered in vain, it is true, for three centuries have acknowledged his triumph; but the future will belong to his enemies.

Let us make our position clear. We do not wish to exclude hypotheses from science—that would be absurd at this time of day—but they must not be allowed to usurp a position to which they have no title. Their function is to facilitate the correlation of phenomena, not to pose as the sole prophets of God. Science cannot remain bound by restrictions which in the stress of battle the seventeenth century pioneers felt bound to impose. It must move, but it should move forwards and not backwards. We do not want the 'problem picture' in next year's Academy to represent the triumphant Aristotelians raising over the prostrate body of Galileo a banner bearing the inscription, 'The Reality behind phenomena is Pure Thought'. Rather would we see the seed which Galileo planted blossoming into a tree, rich beyond his conception indeed, but still bearing seeds of its own kind.

We can follow Sir James Jeans through the maze of present-day physics, and do so gladly, charmed by the facile mastery of his exposition, which is so obviously the child of clarity and depth of thought. But when he attempts to discuss the status of physical conceptions in the world of realities, in an utterance which will be accepted as the autho the voice of science by thousands who seek guidanc matters of philosophy and religion, we feel strong that he is darkening counsel, not by words witho knowledge, but, much more dangerously, by kno ledge without equivalent balance of judgme Physics has much to say at the present time; the is no need for it to speak for other departments o thought and feeling as well.

HERBERT DINGLE.

Lavoisier and the Study of Combustion.

The Eighteenth Century Revolution in Science—The First Phase. By Dr. Andrew Norman Meldrum. Pp. vii + 60. (London, New York and Toronto: Longmans, Green and Co., Ltd., n.d.) 4*s*. 6*d*.

TWENTY-FIVE years ago the author of this book placed chemical teachers and students under a lasting debt by the publication of an essay on "Avogadro and Dalton"—a very careful historical and critical discussion of the standing in chemistry of their hypothesis. Incidentally it was shown that many inaccurate statements on the subject were current at the time in the literature presented to students of chemistry, and a real service was done by putting matters in a clear light.

Dr. Meldrum now reappears, handling in the same thorough way a topic of no less interest to students of chemical history—the work of Lavoisier during the four years 1772–75. These years he calls "the first phase" of the revolution effected by Lavoisier, for they culminated in his realisation of the individuality of oxygen, of its place in the atmosphere, and of the part it plays in processes of calcination and combustion. This is, of course, one of the turning-points of chemical history that no teacher or student can disregard. It also marks a region where there has been strife on matters of credit and conduct, with the importation at times of uncomfortable patriotic fervour, and it is one where there was good occasion for Dr. Meldrum to exercise his powers of elucidation.

The book is based mainly on an intensive study of (1) Lavoisier's Memoirs and Journals (so far as the Journals are accessible through Berthelot's "La Révolution chimique—Lavoisier") and (2) Bayen's and Priestley's publications. The result is a historical analysis of great interest and value, which gives the feeling that the author, with a mind sternly braced against the access of prejudice, has got down as deeply into the facts as available materials allow. Until the Lavoisier correspondence published, it does not seem likely that we shall more light on the subject.

hat Dr. Meldrum has done is to trace out with ate care the course of Lavoisier's thought, imental work, and publications from the time 2) when he was seized with the idea that was ceforth to dominate him. In the sealed note osited with the Paris Academy of Sciences in November 1773, Lavoisier records his observation of the increase of weight during the combustion of sulphur and phosphorus and the fixation of "an immense quantity of air". He believes that the same will be found to apply generally to processes of combustion and calcination. The discovery he describes as "appearing to me one of the most interesting of those which have been made since the time of Stahl". How Lavoisier had come to begin his experiments Dr. Meldrum has found no indisputable evidence. He does not mention the view, taken by M. Le Chatelier, that Lavoisier was turned to the study of combustion by having competed in 1766 for an Academy prize on the subject of street lighting. Whatever may have been the stimulus, it is clear the Lavoisier conception of the fixation of air as the general cause of the increase of weight in combustion processes flashed into his mind and became a fixed light that no embarrassments from experiment, no errors in deduction, no hostile criticism could dim.

Dr. Meldrum emphasises again and again the importance of recognising this, in following the course of Lavoisier's work and in trying to understand his relation to those who had been working or were working in the same field. Though at a later date, writing to Joseph Black, he describes himself as having been accustomed to regard Black as his master, there seems no reason to doubt that when Lavoisier made his initial discovery he was unaware of the work of Black, and that he shared abundantly the confusion of mind about gases and the gaseous state that then prevailed and was likely to continue as long as phlogiston held the field. Lavoisier comments on the conspicuous neglect in France of the study of gases. His realisation of the possibility of following processes of gas absorption and gas emission during chemical changes by use of the balance now gave him a fixed principle. When he surveyed the existing records he found only "separate pieces of a great chain". "These authors", he says, "have joined only some links of the chain."

In a memorandum, which Dr. Meldrum gives good reason for dating February 1773, Lavoisier enlarged upon his new ideas and the prospects of discovery which they opened. "The Memorandum", says Dr. Meldrum, "has a note of exaltation and even of inspiration. Nothing like it can be found in Hales, Black, Cavendish, Priestley, Scheele." It may be judged from this how far our author is from any tendency to under-estimate Lavoisier.

Following upon these preliminaries, we are taken through the record of Lavoisier's progress as detailed in the "Opuscules physiques et chimiques", published in January 1774. This part of Dr.

Meldrum's book shows him at his best, and it may be strongly commended to those who are concerned with the teaching of the history of science, where the chief difficulty is to get students to orient themselves into the conditions of a past age and the state of earlier thought. The mere reading of the old masterpieces, such as are published in the admirable series of the Alembic Club, does not suffice to free the mind from astonishment that great men should have been so slow to find the way that now seems so plain, and to have made mistakes that now appear so gross. Nothing, perhaps fortunately, is likely to make the student believe that the same sort of thing is happening with the great men of to-day; but the discussion of Lavoisier's progress, as elucidated by Dr. Meldrum, is as illuminating an example as could be desired of the historian's art applied to scientific discovery.

The concluding chapter of the book is entitled "The Effective Discovery of Oxygen", and here the author is compelled to enter upon the ground where so much controversy has taken place on matters of conduct. We say that Dr. Meldrum has been 'compelled' to enter upon this ground, because it should be clearly understood that the purpose of the book is not controversial. It is to record the history in detail of the first phase of Lavoisier's work—that on combustion—"which led to a revolution in chemistry and even in science", but this necessarily involves particularities relating to the discovery of oxygen.

Dr. Meldrum says in the preface that he presents fresh conclusions on this subject. This does not seem to be quite the right expression, for his 'conclusions' are in essence those which have been reached by others. What Dr. Meldrum does that is fresh is to exhibit in clear detail the course of thought of Priestley and Lavoisier, and to show exactly how Priestley's work helped Lavoisier out of his difficulties.

It is perhaps too much to expect that the book will not be challenged upon its accuracy in some details, and possibly upon some of its conclusions, but we may surely hope that it will not hurt any susceptibilities. On the contrary, it gives a faithful picture of the times and of the confusion of thought on matters that are to-day the schoolboy's elements of chemical knowledge. It shows how easily both discoveries and mistakes of capital importance could be disregarded by the participants, and how far the true history of the modern doctrine of combustion is from being a simple tale that he who runs may read, or one where he can easily apportion praise or blame.

A. SMITHELLS.

High Voltage Cables.

(1) *High Voltage Cables: Theory and Practice of their Design and Operation.* By P. Dunsheath. (The Specialists' Series.) Pp. xii+161. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 10*s*. 6*d*. net.

(2) *High Voltage Cables.* By L. Emanueli. Pp. vii+107+9 plates. (London: Chapman and Hall, Ltd., 1929.) 8*s*. 6*d*. net.

(1) IT seems quite certain that there will be a great demand for high voltage cable for many years to come. In 1924 the consumption of electric energy per head of the population in Great Britain was 100 units. To-day it is more than 150 units, and it is highly probable that by 1940 it will be three times as large. The saturation point is a long way off, and the effect of reducing the number of the supply stations and increasing their size will be to raise continually the pressure of transmission. The demand for high pressure cables, therefore, will go on increasing.

In the book under review, the author first deals with the economic factors that have to be taken into account in high voltage transmission. He next discusses the properties of the insulating materials used in the cables. The question of how the dielectric withstands the electric stress applied to it is still uncertain, but there is no uncertainty about the effect of intersheaths in raising the factor of safety of cables. The chapter on belted, screened, and S.L. cables will be very helpful to students as these types of cable are not yet described in the ordinary text-books. There is also a useful chapter on the current rating of cables and the stability of their dielectrics. The thermal resistivity of a dielectric is defined as the difference of degrees Centigrade required to be maintained between the opposite faces of a centimetre cube of the material so that an amount of heat equivalent to an electrical watt may be transferred continuously across the cube. This definition or something like it is frequently used by engineering physicists, but it seems to us very clumsy and indefinite. Teachers will doubtless improve it. We prefer Fourier's definition. This book is to be commended.

(2) L. Emanueli is the chief engineer of the Pirelli Cable Works in Italy, and he is well known as one of the leading experts on high voltage cables. He has continued the excellent work done by Jona, one of his predecessors. At the Milan Exhibition, so far back as 1906, Jona exhibited cable which had successfully withstood a pressure of 150,000 volts for an hour.

The author in this book points out that the presence of gaseous films and pockets in the dielectric is a frequent cause of breakdown in cables. The presence of highly ionised gas in the small cavities causes distortion of the electrostatic field and a tangential stress is produced above the surfaces of the paper strips. At high stresses gases can migrate through the paper sheets under the action of the ionic bombardment. Thus an ionised path is built up in the direction of the conducting path and breakdown will ultimately result. In the United States there are oil-filled cables operating at 132,000 volts. There is a central duct in the cable which is filled with oil. There are experimental cables also operating at very high pressures in Germany, England, and Italy. In Italy, an oil-filled cable has been operating for a year at 70,000 volts. This book will be of interest to cable engineers.

Our Bookshelf.

Der adsorbierende Bodenkomplex: und die adsorbierten Bodenkationen als Grundlage der genetischen Bodenklassifikation. Von Prof. K. K. Gedroiz. Nach der 2 Auflage des Originals aus dem Russischen übersetzt von H. Kuron. (Sonderausgabe aus den *Kolloidchemischen Beiheften*, herausgegeben von Prof. Dr. Wo. Ostwald.) Pp. viii + 112. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 5 gold marks.

THE translation from Russian into English of a series of pioneering papers by K. K. Gedroiz was in a large measure responsible for focusing attention on the importance of the cation exchange process and the colloidal complex in the interpretation of the properties of soils. A German translation has now appeared of an important paper in which Gedroiz surveys the more recent work, especially in the U.S. Bureau of Soils, the Sudan, and Russia, on the composition and properties of the inorganic colloidal matter of soils, and then attempts to build up a system of soil classification based on the chemical composition of the adsorbing complex. In the present stage of our ignorance of the nature of the soil organic matter, Gedroiz restricts himself to the inorganic colloidal matter. He raises doubts as to the wisdom of the present tendency to identify this colloidal matter with the clay of mechanical analyses, and would prefer to use $0 \cdot 25\mu$ as the upper limit for particle size of colloidal clay instead of 2μ.

After discussing the exchangeable bases responsible for the development of chernozem (or saline) and solontschak and solonetz (or alkaline) soil types, Prof. Gedroiz proposes a method of distinguishing between the acid unsaturated podsol soil and those acid solodi soils derived by breaking down of alkali soils. The so-called amorphous silica soluble in 50 per cent potassium at 100° is greater in the solodi than in the podsol.

Nature Rambles: an Introduction to Country-Lore. By Edward Step. (The "Come-with-Me" Books.) *Winter to Spring.* Pp. vii + 152 + 31 plates. *Spring to Summer.* Pp. viii + 152 + 31 plates. *Summer to Autumn.* Pp. viii + 152 + 31 plates. *Autumn to Winter.* Pp. viii + 152 + 31 plates. (London and New York: Frederick Warne and Co., Ltd., 1930.) 2*s.* 6*d.* net each.

THIS collection of four volumes, divided, as their titles suggest, into the four natural seasons, fulfil one object in making fascinating reading. The author is also to be congratulated on the many splendid illustrations and especially the photographs. Apart from this, the utility of the book is questionable. From an academic point of view, it is practically useless. Besides, a real lover of Nature would prefer to study her along his own lines, rather than along those set out by another. A guide is useful; but this book can scarcely be recommended as such. Placing observations of this type on an ecological basis demands the consideration of causal relationships between habit and habitat. To know the external morphology of a marsh-marigold and to be able to name it on sight is not so useful as to try to find out why it invariably grows in water-logged soils. The author must plead guilty to omitting this important branch of Nature study.

However, the book justifies itself, in that it will take the town-dweller out into the country-side without even leaving his armchair; but he who finds it possible would be well advised to get hold of a good 'flora' and 'fauna' and tramp the country himself.

Old Age, the Major Involution: the Physiology and Pathology of the Aging Process. By Prof. Aldred Scott Warthin. Pp. xvi + 199 (11 plates). (London: Constable and Co., Ltd., 1929.) 15*s.* net.

Two years ago, Dr. Warthin, professor of pathology in the University of Michigan, delivered a lecture before the New York Academy of Medicine on the subject of old age and the aging process. The lecture attracted so much attention that Dr. Warthin was induced to extend it into the form of this most interesting monograph.

The curve of the individual human life, he says, shows an ascending portion, the period of growth or *evolution*; its apex, a relatively short plateau of *maturity*; and the descending portion, the period of retrogression or *involution*. The involution processes, he contends, are essentially physiological in nature, and old age is to be considered as a normal involution and not as a pathological process. He argues his case as a scientific man addressing scientific men. But he does not disguise his hostility to "modern futilities of life-extension of the individual to extreme limits and of possible rejuvenation", and his hope that on such a scientific foundation as he lays there may be built a working philosophy of life.

We have given a bare indication of the contents of a book which is replete with interest, even to the non-medical reader. The descriptions of the successive stages of human life, down to and including senescence and actual old age, are of value, apart from the main purpose of the book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Ether and Relativity.

THE remarkably eloquent Rede Lecture and subsequent small book on "The Mysterious Universe", in which Sir James Jeans seeks to envisage the trend of modern physics in a philosophical direction, will, as is said in the News and Views columns on page 731 of NATURE of Nov. 8, awaken much thought and some disagreement: a result which the conclusion of his preface seems to desire. Certainly he does not scruple to press his conclusions with the utmost boldness wherever they apply, and to display their bearing in many surprising directions. The fact that his contentions about modern physics go far in a direction which specially appeals to me makes me the more critical of what seem their weak points, and a friendly reference may be made to a few places where I join issue with him. He is not an easy person to disagree with, for his knowledge is profound; but one point concerns the meaning and existence of an ether.

As a standard of rest the ether has failed to give any sign, and no experiment made to determine absolute motion has yielded any result except zero. This has been spoken of as a conspiracy, but it may be due to extreme uniformity; it would follow if one and the same perfect substance fulfilled all the functions, while capable of only one speed of transmission, so that differentiation became impossible. I claim that the suggestion is not absence of qualities but perfection. We have had no previous acquaintance with a medium that was "faultily faultless, icily regular, splendidly null", and we are disconcerted; so that (in 1905) we postulate the dictum "Nature is such that it is impossible to determine absolute motion by any experiment whatever", and are tempted to say that any space-filling medium is imaginary.

Sir James Jeans, in his animadversions on the ether of space as a figment of the imagination, quotes with approval a sentence of mine in which I may seem to have given away too much in the effort to secure a kind of general agreement. The sentence quoted runs thus:

"The ether in its various forms of energy dominates modern physics, though many prefer to avoid the term 'ether' because of its nineteenth century associations, and use the term 'space'. The term used does not matter much."

Jeans's comment is:

"Clearly if it is a matter of indifference whether we speak of the ether or of space, of the existence or non-existence of the ether, then even its most ardent devotees cannot claim much objective reality for it."

This use of my admission seems to contain a kind of unfairness. In one of Bernard Shaw's plays, a Roman captain, reasoning with a Christian captive about her prospective martyrdom for not throwing incense on the altar of a heathen god, says, in answer to the plea that she could not sacrifice to false gods:

"Sacrifice then to the true God. What does his name matter? We call him Jupiter. The Greeks call him Zeus. Call him what you will as you drop the incense on the altar flame: He will understand."

That might be quoted as if it were atheism, but it might also be understood as representing a high faith. I wonder that the Christian depicted in the play was able to withstand the argument.

So when I say that for the sake of peace and agreement I am willing to call the ether 'space', or that the name does not matter, I am not implying any disbelief in it, but rather a secure faith which rises above questions of nomenclature. The fact is I am instinctively unwilling or unable to go all the way with Jeans, and to think that nothing exists but mathematical abstractions. The old idea of some kind of a mechanical explanation still has its hold upon me. I have abandoned the old material ether of Lord Kelvin and the nineteenth century, in favour of some hydrodynamic or other perfect mechanism at present unknown. I want a medium with physical properties which can in due time be ascertained and comprehended. I do not suppose that it can be constituted of any kind of matter, or expounded in terms of engineering, and yet I still am unwilling to leave it as a mere abstraction, without properties that can be ascertained; and those properties I at present seek in terms of something physical, responsible for all the activities that have been found existing in space. I am unwilling to shut the door on future discovery, and say that we deal with nothing but abstractions.

Sir James Jeans eloquently contends that the universe is more like a "thought" than anything else, a product of some mind. I have no quarrel whatever with that, but what we know about thought suggests that it requires some physical mechanism to express itself; and that physical though immaterial mechanism is what I seek to understand.

There is one deep-seated contention in which I find myself totally differing from Sir James Jeans, when he says that the theory of relativity not only enables space and time to be unified and treated together in equations and diagrams, but also when he virtually implies that time really *is* one of the dimensions of space. This doubtless was the contention of Minkowsky, who went so far as to say that "space and time separately have vanished into the merest shadows, and only a sort of combination of the two preserves any reality". But it is not in accord with sense or experience to treat time as an actual dimension of space. In the sentence in which Jeans specifically adopts this unification, on page 110, he virtually renders it nugatory by introducing $\sqrt{-1}$ as a necessary factor; having previously taken the velocity of light to be unity. To turn time into space really requires that time shall be multiplied by some velocity and by $\sqrt{-1}$. This is what the four-dimensional mathematicians do, though they did it so long ago that they may have half-forgotten. It is not t, but ict, that is their fourth dimension. With that I have no sort of quarrel. It is equivalent to saying that time is time and not space, that it can be merged with space in an equation, but that it is always kept separate from space, and can be dissected out at the end; for directly the i is removed it reappears as time. The $\sqrt{-1}$ secures it from admixture or confusion.

Jeans treats this unification of time with space as an essential part of the theory of relativity. It seems to me accidental and subsidiary, a practical device rather than a fundamental theory. As to taking the velocity of light as unity, that is another shorthand device, only dangerous if it is forgotten, for neither ingenuity nor habit can really turn a velocity into a pure number. I am willing to grant that an absolute velocity exists, and that space is affected by it; but that very affection makes space something more than geometrical. Space is thereby endowed with a physical quality.

One way of pouring discredit on the ether is to

speak of many ethers; and Jeans goes on to speak of an ether as belonging to each of us, which is indeed nonsense. He elaborates this absurdity on page 104, likening it to the carrying in a shower of rain, not indeed each his own umbrella, but our own rainbow.

All concrete things, in Jeans's philosophy, seem to vanish in a maze of abstractions. Even the waves of which everything is supposed to consist are thought of as abstractions before he has finished, though he has to admit that, as shown on Plate 2, page 42, they are real enough to be photographed. Needless to say, many of his illustrations are helpful; for example, his illustration of the welding together of different dimensions on page 99. Also his parable of the winding river, on page 147, though the moral is that an explorer ought not to be too confident about the direction in which the river is flowing, merely because it happens to be trending in one direction during his particular epoch. The book is full of happy and interesting applications and illustrations, and throughout is absorbingly interesting.

In so far as Jeans exhibits the tendency of modern physics in an idealistic direction, I have naturally no quarrel and welcome his support. Only I do not feel that his contention, that a mathematician alone can hope to understand the universe, is one that will stand scrutiny or substantiate itself. An artist might make another claim. That the Divine Mind can deal with abstractions more fully than any mathematician may be granted, but an Infinite Being has no limitations. His dealing with the abstract does not prevent His also dealing with concrete realities, or cause Him to abstain from attention to the utmost minutiæ. The absence of causation now postulated for the atoms and electrons, because we can only deal with them with any exactness in a statistical manner, is a sign of human limitation, and is not to be thought of as anything ultimate. The 'principle of uncertainty' is not a thing to pride ourselves on, except as a true representation of the present state of our knowledge. The fact that the quantum h enters into it, means that there is more to be discovered. The Divine Artificer does not work with the calculus of probability. The free will of which we have experience is not to be explained as a result of physical indeterminism, though the present appearance of indeterminacy is a sufficient answer to those dogmatists who would wrest the findings of science to make such a thing as freedom impossible. It is useful in so far as it knocks the ground from under their feet, and leaves them without a leg to stand on.

Finally, on the question of the existence of an ether I appeal to the testimony of a greater even than Sir James Jeans. In his book "Sidelights on Relativity", Einstein says, on pages 16 and 17:

"To deny the ether is ultimately to assume that empty space has no physical qualities whatever. . . . Newton might well have called his absolute space 'Ether'."

And on page 23:

"Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable."

I entirely agree; whenever we leave mathematical abstractions and attempt to contemplate what is really happening, or happening in a physical sense, the discontinuity of matter must be supplemented by a continuous medium full of energy; which medium, I venture to say, is used as the instrument for causing and guiding all perceptible motions.

OLIVER LODGE.

Normanton House, Lake, Salisbury Plain,
Nov. 10.

Genetics, Mathematics, and Natural Selection.

IT is a great honour to an author to have his book reviewed by the principal surviving advocate of the theories he has attacked. The only drawback to this honour is that the faculty of criticism, especially perhaps of impartial criticism, is very unequally developed in mankind, and, with the most honourable intentions, many misstatements or other slighter misrepresentations are likely to result. I should like to confine my remarks to six of these from the review of my book in NATURE of Oct. 18, which, I am sure, Prof. R. C. Punnett will be as glad as I to see decently buried. They can all be easily verified.

(a) "Dr. Fisher deplores the cleavage between the mathematical and the biological mind".

Actually, I deny the existence of such a cleavage; and that although I am well aware that a few of the more conservative geneticists are feeling sore, and even anxious, about the increasing tendency of biologists to use mathematical methods. Such a feeling may be worthy of biological study, but is assuredly not characteristic of the biological mind, as I have exceptionally good reason for knowing.

(b) "the selective value of the mutation is regarded as in arithmetic proportion to its size, a view to which we fancy few biologists will be willing to subscribe."

My book is guiltless of any such assertion as this about mutations; on the contrary, an entire section (pp. 38-41) is given to examining why it is that, with highly adapted organs and organisms, the average selective advantage of mutations *falls off* with increasing magnitude.

As the author of the 'presence and absence hypothesis', it is natural that Prof. Punnett should dislike the theory of dominance I put forward; and as a poultry geneticist, that he should give undue prominence to the guess which, in the light of that theory, I have made as to the dominant genes found in the domesticated races of fowls. Such intensive interest might, however, have been accompanied by a higher level of accuracy:

(c) "Hence we must suppose that the mutational changes which give rise to dominant characteristics in domestic poultry show little or no influence in the wild form, that is, are either recessive or nearly so."

This may be Prof. Punnett's own inference; if it is intended to represent mine, as its context suggests, I must quote (p. 61) "not either completely dominant or completely recessive".

(d) "The mutant gene for crest must be regarded as having been brought in by the wild cock, in which it behaved as recessive to its uncrested allelomorph."

Nothing resembling this strange theory has been put forward by me.

Readers who remember the argument of Prof. Punnett's "Mimicry in Butterflies" will be interested in the following:

(e) "he seems rather uncomfortable about the way he disposes of Marshall, stating that we 'can neither assert that the Müllerian principle will work, nor that it will fail'."

Prof. Punnett must have been reading hurriedly; he has left out "so far as these arguments carry us", from before the passage quoted (p. 153). The arguments in question are Marshall's, and Dixey's answer, which effectively neutralised Marshall's argument.

(f) "He strives hard, we think unsuccessfully, to get round it [Marshall's argument]; for in doing so he has to postulate an intermediate state enjoying the advantages of both."

This is one of the postulates of which I say (p. 153) "both are clearly extreme assumptions; neither can be true generally". Naturally, this postulate does

Passage of an Electric Discharge through Gases.

WHEN an electric glow discharge is passed through a tube containing air at pressures of the order of 5 cm. of mercury, the tube lying in one of the two beams in a Jamin's refractometric arrangement, there is a sudden shift of the interference fringes indicating a decrease of the refractive index of air due to the passage of the discharge. A preliminary announcement of the effect has already been made in the columns of NATURE (vol. 120, p. 880), and a detailed account of the experiments published in the *Indian Journal of Physics*, vol. 3, pp. 425-430.

When the discharge is stopped there is an equally sudden shift of fringes in the opposite direction and of the same extent as before, showing that the air has returned to its original state. The switching on of the discharge also causes a sudden increase in the pressure of the tube as indicated by an attached manometer, the pressure getting back to its original value as soon as the discharge is stopped. There is an exact proportionality between the fringe shift and the pressure change; and since the fringe shift if greater than one fringe width cannot be quantitatively observed on account of the suddenness of the shift, the phenomenon is better studied by observing the changes in pressure.

The investigation, which was confined to air in the above-mentioned paper, has now been extended to hydrogen, oxygen, nitrogen, carbon dioxide, and chlorine with nearly similar results as with air, namely, that for a fixed value of the applied voltage the amount of shift or the increase in pressure varies with the pressure and becomes a maximum for a certain value of the pressure, which is different for different gases and for different voltages. The effect was found to be greatest in carbon dioxide and least in hydrogen. Experiments were also made using ammonia, sulphur dioxide, and helium. In the first two the results were vitiated by the decomposition of the gas taking place under the action of the discharge, whereas in helium the effect was only just noticeable, scarcely measurable.

In all the above investigations, electrodes were, as usual, sealed into the ends of small side-tubes attached to the experimental tube, so that the electrodes were rather far away from the track of the light beam. By pure accident, however, while experimenting with air, it was found that if the electrodes are long, coming up to the periphery of the discharge tube, or rather the light beam, the fringe shift as well as the pressure change could be observed even at atmospheric pressure and when no visible glow discharge was passing. Previously, when the electrodes were fairly far away from the edge of the beam of light, the fringe shift was a maximum at a pressure of about 5 cm. and was not appreciable at pressures below 4 mm. or above 10 cm. Also, in these experiments, a Tesla discharge had no effect upon the fringes. Under the new conditions, however, when the electrodes extend right up to the periphery of the light beam, both the discharge from the induction coil and the Tesla discharge produce a fringe shift even at atmospheric pressure, the effect with the latter being even greater than that with the former. The effect can thus be demonstrated very easily. It is not even necessary to close the ends of the tube to observe the fringe shift.

It is found that at atmospheric pressure the maximum effect is produced when the ends of the electrodes (which are in the form of long, stout wires or needles) are just at the periphery of the beam of light. If the end is moved into the path of the beam itself or moved away from the beam, the effect diminishes, until when it is only a centimetre away the effect disappears. Evidently, although there is no visible discharge, there is an electric field radiating from the tip of the electrode, and the effect is a maximum when the field embraces the greatest possible volume of the air. The conclusion previously arrived at, that the effect is due to a pushing away of the gas from the neighbourhood of the discharge, now receives ocular proof, for if a little lycopodium powder is dusted into the tube, it is seen that as soon as the field is put on, the lycopodium particles fly away from the electrodes.

J. B. SETH.
BAL MOKAND.

Physics Laboratory,
Government College, Lahore.

Properties of Dielectrics in Electric Fields.

IN NATURE of Oct. 25 is a communication from Mr. J. Mazur, under the heading of: "Change of the Dielectric Constant of Ethyl Ether with Temperature". This appears a suitable opportunity for raising a question to which I have previously alluded in several communications to the *Phil. Mag.* and in a long letter in NATURE of April 5, 1924. This is that of the nomenclature of the effects found in dielectrics in the wide range of alternating electric fields which have now for many years become increasingly available.

Let us take as a pertinent example the data given for ethyl ether in Mr. Mazur's interesting letter. An early attempt to find the dielectric properties of ether was made by Hopkinson. He first dried the ether by shaking it up with quicklime, and, using an induction coil to create the field, found K was 4·75. Although, however, there was only a small surface of the ether exposed to the atmosphere, within a few minutes K became 4·95 and thereafter observation became impossible, showing how very rapidly minute traces of moisture absorbed from the atmosphere alter the dielectric properties of matter. The above figure for K, and a slightly lower one due to Quincke, have long been quoted in leading tables of dielectric constants. The above experiments were at room temperatures.

Using a field of high frequency, Mr. Mazur finds for different temperatures the following results:

Temp.	K.	
+ 30·0° C.	4·18	
− 105·4° C.	12·39	
− 117·2° C.	2·3	(melting point)
− 118·9° C.	2·0	

Below this K is constant and is very near N^2 for ethyl ether, which is 1·84 for the D line.

In my letter mentioned above, I showed that at a range of frequencies between 8 and 2000, K for celluloid varied from about 12 to 6 at room temperature, and again, by intensive drying, K could be made to vary from about 8 to 4·8 at a low frequency. Similar examples could be multiplied.

Is it not time that physicists found better names for these varying effects than calling them dielectric constants? Faraday's name, 'specific inductive capacity', was less self-contradictory. Early in the century the term 'dielectric coefficients' came into use where the property was found liable to variation, but seems to have dropped out again, possibly as being too cumbersome.

Of late years numerous connexions between dielectric and other properties have been found, and Debye's theory of molecular polarity is receiving increasing experimental support. For these reasons and others, the confusion and inappropriateness of the present nomenclature in this field, and the doubt

as to what exactly the terms used mean, impedes progress. New and convenient terms are needed for expressing the quantities themselves and a general agreement as to the conditions under which the terms should apply. G. L. ADDENBROOKE.

35 Holland Villas Road,
Kensington, W.14, Oct. 30.

Ball Lightning.

PROF. R. W. WOOD's letter in NATURE of Nov. 8, p. 723, is a valuable contribution to our knowledge of this type of lightning. His reference to increasing our knowledge by touching the globe perhaps calls for a word of warning. I think that touching the globe would certainly cause a very severe burn and might possibly also kill the experimenter. Many years ago I saw two globes of lightning. They were reddish yellow in colour and appeared to be rotating. One of them struck a building and burst with a loud report, causing the inhabitants to open the windows and look out to see what had happened, but as there was no trace of anything they looked bewildered. The other drifted away.

Prof. Wood quotes an eye-witness who said that the flashes struck in the water, coming nearer and nearer like advancing shell-fire. This reminds me of a typical case published in the *Phil. Trans.* for 1781, p. 42. It is related how the tenant of a large three-story house facing the sea at Eastbourne was standing and looking through the window at an ominous black cloud. He saw several balls of fire drop successively out of the cloud into the sea. Suddenly he was thrown violently backwards by what he described as a flash of fire. Many people outside the house at that instant saw something which in form and flame they all agreed was like an immense 'sky rocket' strike the house. The tenant's clothes were torn, and pieces of metal he had about him were melted. Every pane of glass in the room was completely smashed. On the ground floor the coachman and a footman were killed, and on the top floor a lady and her maid were rendered insensible. All the bell wires in the house were deflagrated.

I have an impression that globular lightning makes a slight noise as it drifts about. It has been compared to the purring of a cat. A. RUSSELL.

Faraday House, W.C.1.

DURING April 1906, a small storm occurred near Piccadilly Circus. There was one ordinary flash; then some little while later, there was an instantaneous globular flash some distance above the roofs of the buildings. The sound was like that of a shell bursting. I did not see any movement of the globe, although I happened to have been looking in the right direction before it appeared. H. SOUTHORN.

245 Upper Richmond Road,
Putney, S.W.15, Nov. 8.

Crystal Structure of the β-Phase of Aluminium-Bronze.

IN the *Memoirs* of the Ryojun College of Engineering, **2**, p. 205; 1929, and **3**, p. 87; 1930, I have confirmed that the eutectoid transformation of aluminium-bronze consists of a stepped change: $\alpha+\delta \rightleftarrows \beta' \rightleftarrows \beta$, and just as it is impossible to suppress, by water-quenching, the change of austenite into martensite in steel, so also it is impossible to suppress completely the change of the β-phase into the β'-phase in aluminium bronze.

In order to determine the crystal structure of the β-phase, it is therefore necessary either to take a powder photogram at high temperature or to retard the change, $\beta \rightarrow \beta'$, on quenching, adding a third element which passes into the solid solution of the β-phase. The latter method was successfully employed by Elis Persson, who suggested that the said phase should have a body centred cubic superlattice. Extrapolating from the lattice constants of the ternary β-phase of copper-aluminium-manganese alloys, he gave $5{\cdot}833 \pm 0{\cdot}005$ A. for the parameter of the binary β-phase, which contains 12·5 per cent of aluminium (cf. *Zeitschrift für Physik*, **57**, p. 115; 1929).

Recently, by constructing a high temperature camera, I have succeeded in taking a powder photogram of a fine rod of the binary alloy, containing 12·5 per cent of aluminium, at about 650° C., and determined that it belongs to a body centred cubic super-lattice, the parameter of which was found to be $5{\cdot}88_7$ A. at this temperature.

On the photogram obtained from the same alloy quenched from 850° C. in water, the spectral lines belonging to the β-phase appeared very weakly, while the intense lines were found to correspond to a hexagonal lattice, which may be regarded as of the β'-phase. The following lattice constants were obtained for these two phases:

β'-phase: $a = 11{\cdot}13$ A., $c = 6{\cdot}342$ A., $c/a = 0{\cdot}5698$.
β-phase: $a = 5{\cdot}835$ A.

Details of the work will be published in the *Memoirs* of Ryojun College of Engineering.

ICHIJI OBINATA.

Ryojun College of Engineering,
Port Arthur, Oct. 10.

Cage for the Study of Sheep Ticks.

WHILE carrying out work on the life-history of *Malophagus ovinus*, the sheep ked, difficulty was experienced in obtaining an effective cage which could be erected on sheep in the open.

Cages were tried by which pressure of the walls on the body of the sheep was depended upon to provide a close enough fit to confine keds. These were untrustworthy. However, a structure was devised, such that it could be sewn to the skin and lie loosely in the wool, thus preserving normal environmental conditions as closely as possible. This was made by sewing together the short edges of a rectangular piece of muslin 12 in. by 8 in. On one end of the cylinder thus formed the selvage had been retained, so as to afford a suitable hold for the horsehair with which it was attached to the sheep.

Sterilised horse-tail hair was used, enough being collected at one time to provide for several cages, and stored in five per cent phenol.

Preparatory to attaching the cage, wool was clipped away, at the selected site, in the form of a circular track two inches wide leaving a clump of wool about three inches in diameter in the centre.

The cylinder of muslin fitted over the central clump of wool and was hemmed to the skin by means of a double thread of hair. A local anæsthetic (cocaine) was used in attaching one cage, but it was found that if stitching be carried out expeditiously no undue discomfort is caused to the sheep. The wool requires to be washed thoroughly with water to remove cocaine, otherwise death may result to keds.

Closing of the cage was effected simply by drawing the outer edge of the cylinder, bag fashion, and tying with tape. To examine contained keds, the muslin is rolled back in the same manner as a stocking would.

It was found that attachment of such a cage in the region of the hind ribs, half-way down the side, ensured its being covered by the fleece and affording sufficient protection, at the same sime providing conditions favourable to the ked. J. H. TETLEY.

Massey Agricultural College,
Palmerston North, New Zealand, Sept. 26.

Recent Work on Insulin.

CHEMISTRY.

THE purest preparations of insulin so far obtained show the characteristics of a protein and on hydrolysis yield a number of different amino-acids. It is not possible to state that the activity is related to any particular amino-acid or group of acids, although from analogy with other hormones it might be expected that the activity is mediated by a simpler substance than a protein. More recent work on crystalline insulin, first prepared by Abel, has led to the conclusion that the crystals are truly those of the active substance and do not merely contain it adsorbed upon them.

Abel's method of preparing crystalline insulin is laborious and the yield small: C. R. Harington and D. A. Scott therefore sought for a simpler and better method of preparation (*Biochem. Jour.*, vol. 23, p. 384; 1929). They found that the properties of commercial insulin are profoundly modified by the presence in the solution of an active saponin: the saponin appears to sharpen the isoelectric points of the proteins present. If ammonia is added to an acetic acid solution of insulin containing about 1 per cent saponin, a precipitate forms at about pH 4·5 and can be removed: it contains about 30 per cent of the weight but only 15-20 per cent of the activity. Further addition of ammonia does not produce a precipitate until pH 5·6, although the original insulin is precipitated at about 5·0. This precipitate may be already partly crystalline, and if the process is repeated and followed by recrystallisation at the isoelectric point from a phosphate buffer (without saponin), well-defined and large crystals are obtained. The yield is, however, small, 5-15 per cent of the original material. Saponins vary considerably in their suitability, those with a high hæmolytic power being the more satisfactory. Digitonin may also be used.

These results suggested that the function of the brucine-acetate-pyridine mixture used by Abel is not only that of a delicate buffering system, but also that other physical properties of these substances are involved. The authors found that, for successful results, a definite relationship between the volume of the solution and the liquid-glass interfacial area had to be maintained: success was only obtained with a large volume when it was distributed among a number of small containers, or glass rods were introduced to increase the interfacial area. The crystals are small cubes, which usually stand on one corner, giving a hexagonal outline under a low power, as described by Abel: they are quite uniform and analysis shows them to have about the following percentage composition: carbon 49, hydrogen 7, nitrogen 14, and sulphur 3.

As part of the same research, these crystals and Abel's crystals, two samples of each, one of the latter prepared by Prof. Abel himself, were submitted to thorough physiological assay by Scott, K. Culhane, H. P. Marks, and J. W. Trevan (*ibid.*, p. 397). Scott and Trevan used the mouse convulsion method and Culhane and Marks the rabbit 'cross-over' test of Marks, with slight, and different, modifications of the original method. In the latter, the criterion of activity is the average fall of the bloodsugar over five hours after the injection, expressed as a percentage of the initial value: the test is carried out on two days, the animals being divided into two groups, one of which is given a dose of standard and the other a dose of the preparation under test, on the second day the doses of the two groups being reversed. The total percentage reduction of all the animals on the unknown is then compared with the sum of the reductions on the standard. In all tests the same solution of the international standard insulin powder was used.

The results obtained by all four observers agreed closely: thus for the four preparations, values of 23·6, 22·7, 22·9, and 23·9 units per mgm. were obtained, whilst the results of the four observers were 23·7, 24·8, 24·3, and 20·2 units per mgm. The two lower results were given by the rabbit method, but it is not considered certain that this method really gives slightly lower figures than the mouse method, although such a possibility must be borne in mind. It thus appears that crystalline insulin has about three times the activity of the international standard (8 units per mgm.), and the uniform activity of the four batches strongly suggests that the crystals are those of insulin itself and that the activity is not simply adsorbed on to them. Similar values for crystalline insulin have recently been obtained by Abel and by Freudenberg and Dirscherl.

Insulin is destroyed by proteolytic enzymes, strong caustic alkali, etc.: it is inactivated by formaldehyde and acetic anhydride to a certain extent, and the potency can also be partly restored by treatment with weak mineral acid or weak caustic alkali respectively, as shown by Freudenberg. Jensen and Geiling have confirmed the work on acetyl insulin. In a recent paper, F. H. Carr, K. Culhane, A. T. Fuller, and S. W. F. Underhill (*Biochem. Jour.*, vol. 23, p. 1010; 1929) have described another type of reversible inactivation. When insulin is allowed to stand in solution at room temperature in a mixture of 3 parts of anhydrous ethyl alcohol and 1 part of 3 N hydrochloric acid, it slowly loses its activity, complete inactivation occurring in two days. The change in activity might be from 18·0 to less than 0·1 unit per mgm.; it was accompanied by a shift in the isoelectric point towards the alkaline side of that characteristic of insulin hydrochloride (pH 5·0). Both changes were accelerated by increasing the concentration of the acid or the alcohol, or by raising the temperature. Reactivation was carried out by adding to a 1 per cent solution of the inactive insulin an equal volume of 0·0842 N sodium hydroxide, allowing the mixture to stand at 0° for 17 hours and then acidi-

fying to pH 3·5. Complete recovery of potency was obtained and at the same time the isoelectric point returned to about pH 5·0. It was possible to repeat the process with little loss of potency at the second reactivation. Inactivation was obtained with other alcohols, but secondary alcohols were less efficient than primary, and with tertiary little if any change was produced: other mineral acids could replace hydrochloric, but no change was produced with acetic in the same time. The inactivation was accompanied by the shift in the isoelectric point whenever comparative estimates of the two changes were made, but the effect on potency was not always tested owing to the tedious nature of the animal assays.

Reactivation of some of these inactive compounds was successfully attempted. The isoelectric point cannot be used as an indication of the absolute potency: thus the glycerol and butyl compounds obtained after partial inactivation were found to have different potencies but the same isoelectric points. The authors conclude that the inactive compounds are insulin esters and that the activity of insulin is dependent on the presence of one or more free $-COOH$ groups. Formaldehyde inactivation indicates that an $-NH_2$ group is similarly essential for its activity.

A. Krogh and A. M. Hemmingsen (*Biochem. J.*, vol. 22, p. 1231; 1928) have investigated the destruction of insulin by heat at temperatures between 50° and 117°. At a constant temperature the rate of destruction was found to be proportional at any moment to the concentration. The velocity constant at 117° was about a thousand times greater than that at 50°. From the results obtained it was possible to calculate the rate of destruction at temperatures below 50°. Thus at 20°, 5 per cent of the activity might be expected to be lost in 9 months and 10 per cent in $1\frac{1}{2}$ years; these figures confirm the known stability of insulin solutions at pH 3·5-4·0. In this research the potency tests were carried out on mice or rabbits.

PHYSIOLOGICAL ACTION.

Our knowledge of the intimate action of insulin in the body is still very incomplete: it can only be stated that it is concerned with the metabolism of carbohydrates, more especially with the formation of glycogen in the liver, probably aiding its formation from carbohydrate and inhibiting its formation from non-carbohydrate sources, and with the formation of glycogen in muscle and its subsequent oxidation. It tends to shift the metabolism of the body to a predominantly carbohydrate type, but the actual details of its action depend in part upon the conditions prevailing at the moment. Its inadequate functioning appears to be the sole primary deficiency in diabetes mellitus, since Macleod has found that dogs fed on a diet of raw meat, cane sugar, and raw ancreas will live for years when injections of sulin are regularly given (see *Nineteenth Century*, November 1928, p. 674). The raw pancreas the diet is essential and presumably replaces the external secretion which is also lost after pancreatectomy. In human diabetes this function of the pancreas is usually fairly normal.

One of the lines of investigation of the mechanism of insulin action has been suggested by the observation that glucose cures insulin convulsions. Glucal and dihydroxyacetone, mannose and maltose are also effective, but other sugars and related substances are of little or no value. W. O. Kermack, C. G. Lambie, and R. H. Slater (*Biochem. J.*, vol. 23, p. 410; 1929) have recently shown that hydroxymethylglyoxal not only fails to cure the convulsions, but even exerts a toxic action on mice and rabbits, the symptoms observed resembling those of insulin hypoglycæmia. Again, A. Hynd (*ibid.*, vol. 21, p. 1091; 1927) has found that d-glucosimine, d-glucose-ureide, d-glucosamine hydrochloride, and glutose are ineffective in relieving insulin convulsions in mice: the first compound is also toxic. Hence glucose loses its activity when an NH_2- substitutes an $-OH$ group, when the reducing group is substituted or when a second ring structure is introduced into the molecule.

M. W. Goldblatt (*ibid.*, vol. 23, p. 83; 1929) found that in young rabbits starved for 24 hours small doses of insulin increased the liver glycogen, even when death occurred in convulsions: the muscle glycogen either showed no change or might be decreased when convulsions occurred, but was never entirely absent. Adrenaline relieved or prevented hypoglycæmia and convulsions but did not prevent the rise in liver glycogen due to insulin. Ether anæsthesia, however, both relieved convulsions and prevented the rise in liver glycogen. The author concludes that insulin inhibits glycogenolysis from the liver and that the formation of glycogen is a self-limiting process. Thus, in the fed animal, the liver cannot take up any more sugar so that more is available for utilisation and insulin is less effective in producing hypoglycæmia. This may be contrasted with the view that insulin, by causing the withdrawal of sugar from the blood by the tissues, leads indirectly to glycogenolysis from the liver, the degree of hypoglycæmia depending in part upon the amount of this glycogen available for conversion to sugar. If insulin inhibits glycogenolysis, it must also depress glyconeogenesis, otherwise the glycogen store would continue to increase indefinitely.

S. Soskin (*ibid.*, vol. 23, p. 1385; 1929) investigated by a direct method the possibility of glyconeogenesis occurring from fat as well as from protein, and found that in diabetic dogs, 5 days after withdrawal of food and insulin, the administration of olive or cotton seed oil or butter with a pancreatic lipase extract produced in some experiments an excretion of glucose, over and above that occurring during starvation, which was greater than that obtainable from the glycerol of the fat and the protein simultaneously metabolised: since it presumably could not have come from muscle glycogen (which is not converted into glucose) and the liver glycogen store must have been negligible, fatty acid could have been the

only precursor. However, there were many negative results. It may be that positive results are only obtained when the administration of fat coincides with a temporary increase in the capacity of the liver for glyconeogenesis. It was also noticeable that it was impossible to recover animals with insulin when the experiment had been successful.

Whatever the defect in carbohydrate metabolism in diabetes, it does not apparently concern the actual utilisation of carbohydrate in muscle, in spite of the fact that the rate of withdrawal of sugar from the blood by the tissues is less than usual: thus I. L. Chaikoff and J. J. R. Macleod (*Quart. J. Exp. Physiol.*, vol. 19, p. 291; 1929) found that the response of normal and diabetic dogs to shivering was the same so far as the increased respiratory metabolism and rise in the respiratory quotient were concerned: the protein metabolism was not increased. The quotient fell after ½ hour or so, apparently indicating the formation of carbohydrate from fat.

These short summaries indicate the trend of some of the recent work on insulin and must be taken as covering only a small part of the field: they indicate routes, however, by which the problem of the mechanism of the action of insulin is being approached.

Faraday's Diary.

By THOMAS MARTIN, General Secretary of the Royal Institution.

IT has now been announced that, to mark the forthcoming centenary of the discovery of electromagnetic induction, the Managers of the Royal Institution have resolved to publish a document of exceptional scientific interest and importance, Faraday's "Diary". It may therefore be opportune to give some particulars of the manuscript and of how it came to be written. Scientific men have been aware of its existence for upwards of sixty years, and Bence Jones, Silvanus Thompson, and other writers on the life of Faraday have consulted it for material and have quoted passages from it in their writings; but few of the present generation, to whom the name of Faraday has become a household word, can be fully aware of the nature and extent, the scientific and biographical significance, and the extraordinary interest of these hitherto unpublished papers.

The Managers' Minutes of Nov. 4, 1867, record the bequest by Prof. Faraday to the Royal Institution of six folio volumes of "Experimental Notes", two quarto volumes of similar notes, and some unbound MSS. The actual wording of the bequest (1855) is as follows: "Various philosophical notes of experimental investigation on foolscap paper, paged in series, and partly bound in five volumes, a quarto book of Philosophical Notes, a second larger quarto of similar notes. . . ." At the time of Faraday's death the number of bound volumes had evidently increased to six, and after his death the loose papers were bound up, by order of the Managers, in the same style of binding as that previously used, making folio volumes 7 and 8. These eight folio volumes, together with the two quartos, make up the "Diary" as it exists to-day.

The manuscript extends to more than four thousand pages, covering a period of forty-two years, from 1820 to 1862; and provides, indeed, an almost complete and uninterrupted record of the whole of its author's original experimental work. It is written throughout in his own fine, clear hand, with only occasional lapses into illegibility, and with a very few inclusions of matter written by others, but which is nevertheless related to his work.

A very noticeable characteristic, on turning the pages, is the extremely orderly and methodical way in which the notes were kept, very different from the untidiness of the experimental notes of his predecessor at the Royal Institution, Humphry Davy. Every page of Faraday's "Diary" is dated and every paragraph is numbered. No paper is wasted, every sheet being completely filled with writing, and a very large number of the paragraphs are illustrated, always towards the right-hand margin of the sheet, by freehand sketches in ink. These sketches are roughly drawn, with boldness and economy of line, but many of them are very striking, and give an impression of the apparatus they represent which is entirely adequate for the purpose and far more pleasing than that of the more formal diagrams which accompany the published papers.

In the earlier parts of the "Diary" the numbering of the paragraphs is begun afresh in several places, but from the beginning of folio volume 2 an unbroken sequence is preserved almost to the end, the numbered paragraphs in this series running to over 16,000. The numbers are constantly used for reference to earlier observations. It will be recalled that a similar sequence of numbers runs through the published "Experimental Researches in Electricity", although it should be mentioned that there is no correspondence between the numbers in the "Diary" and those of paragraphs in the published works which describe the same observations. Many, perhaps most, of the pages and separate paragraphs have a pencil line drawn through them, vertically down the middle of the page; and it seems to have been Faraday's practice to cross through in this way matter transferred to or made use of in the preparation of his published papers.

The manuscript is not a diary in the commonly accepted sense. It is not a journal or daily record of events, but a laboratory note-book. It was evidently its author's custom to keep it written up from day to day, as his experiments proceeded.

Its contents are entirely scientific, and although it contains observations made outside the laboratory, these are generally such as have a bearing on his work, as when, for example, during the progress of some experiments on the crispations or undulations caused by vibration on the surface of a liquid, he saw one wet day a brewer's dray rumbling over the cobbles, and noticed that the rainwater collected in the tops of the empty butts was thrown up into heaps very like his crispations.

Most of the work was carried out in his laboratory at the Royal Institution, but from time to time observations elsewhere are described, as when in 1831, in the course of the experiments on induced electric currents, he worked "at Mr. Christie's" with the Gowin Knight magnet of the Royal Society, and later, when he obtained leave of the King and stretched a wire across the Round Pond in Kensington Gardens, with plates in the water, to test some ideas on the possibility of induction by the earth's magnetic field, hoping to observe effects due to the diurnal rotation of the earth.

The entries in the "Diary" describe, with every detail of importance or which may conceivably have any bearing on the result, the apparatus he used and the modifications he made in it from time to time as the experiments proceeded. The effects he expected to find and the observations he actually made were set down with the utmost care and precision, and when the results were not in accordance with his anticipations or appeared to be due to defects in the arrangement of the apparatus, they were nevertheless recorded with the same care as when his best expectations were realised. His extraordinary skill and ingenuity as an experimenter and his perseverance in the face of disappointment are constantly brought home to the reader, who may see how he followed, day after day, the same line of thought and tried first this and then that modification until he was satisfied that the effect he was looking for was or was not there and had exhausted every possibility.

Although the "Diary" is a laboratory book containing particulars and sketches of apparatus and numerical and other data to be transcribed, an aid to memory to be drawn upon in the subsequent preparation of his papers, it is more, much more, than a dry record of facts. From its form and from the care with which it was preserved it is evident that he intended it as a personal record of his work to be kept and referred to. The pages are interspersed with little characteristic passages which serve as windows into the mind of the man, and give to the manuscript a personal character and spontaneity which is absent from his formal papers. His enthusiasm for discovery is evident if only from the extent and variety of the work which is recorded and the persistence with which he works at a problem until experiment has given the answer to his speculations. The originality, the fertility and resourcefulness of his scientific imagination are shown at every turn, in the nature of the problems he sets himself to resolve, the apparatus he devises to test his theories, the points he notes down as worthy of further investigation. Frequently the pages describing a particular research will end in two or three paragraphs in which he poses new problems fresh ideas for research which have been suggested by the work that has gone before.

The pages are full of titbits of laboratory information which throw light on the apparatus and methods of a hundred years ago and will delight the heart of the chemist or physicist of to-day. He insulated the wire of the coils he used in his famous experiments on induced electric currents by interposing twine between the turns of bare wire and separating the layers by strips of calico. Many of his galvanometers he made himself, in the roughest and simplest way. He used the tall glass jar from a "guinea and feather fall" in which to construct a delicate instrument for detecting induced currents. "White of egg", he notes down, "is a very good thing for crispations." He constantly remarks on the wonder and beauty of the effects he obtains. He cannot keep the note of elation from his voice as he underlines and doubly underlines the significant observation in some particularly satisfactory trial, and concludes the description with the words "Very good experiment."

The "Diary" shows, as no other document could do, the gradual unfolding in Faraday's mind of the ideas which led him to his great discoveries. In his series of communications to the Royal Society the matter of his notes was rearranged and expanded, the phrasing made more formal, the descriptions amplified, and the conclusions stated. Reference to many of the unsuccessful attempts was omitted. In the "Diary" the experiments are recorded in the order in which they were actually made. Step by step his progress can be traced. The entries are often brief and without regard for grammar, but it is not difficult to supply the deficiencies and to read between the lines. His thoughts, the movement of his ideas towards the conclusions which he reached and published, may be inferred from the nature of his experiments and the order in which he made them. Probably no other man of science of comparable eminence has left a personal record which is at once so complete and so enlightening, so invaluable a key to the development of a great scientific mind.

The first volume of the manuscript is the smaller of the two quartos, a small green-covered notebook. This was used from September 1820 to December 1823. Faraday's scientific work in these early years (he was twenty-nine years of age in September 1820) was largely chemical and analytical, including the investigation of new compounds of chlorine and carbon, but the volume contains also a few important electrical experiments. The entries for September 1821, for example, record his well-known first experiments on electromagnetic rotations, which led to the misunderstanding with Dr. Wollaston. That for Christmas Day 1821 describes how he first succeeded

in making a wire carrying an electric current rotate under the influence of the earth's magnetic field alone. The second, larger, quarto volume covers the period December 1823 to November 1832. Its contents are also largely chemical, and it contains the record, in May 1825, of the discovery and analysis of bicarburet of hydrogen (benzene).

The second quarto is no more than two thirds filled. Evidently in 1831 Faraday decided to keep his notes on loose sheets of foolscap paper, and from that date onwards (there is some overlapping between the second quarto and the first folio) the "Diary" is on sheets of this character which have been afterwards bound up into volumes. The slim folio volume 1 (February 1831 to June 1832) must be one of the most significant, as it is certainly one of the most interesting scientific manuscripts in existence, for besides some experiments of a miscellaneous character, it contains substantially the record of the work communicated to the Royal Society in the first and second series of the experimental researches in electricity, embodying the discovery of electromagnetic induction. The induction of an electric current in a coil of wire was first successfully obtained, by 'make' and 'break' of the current in an adjacent voltaic circuit, in the famous ring experiment on Aug. 29, 1831.

It is impossible, within the limits of a short article, to give even a summary of the contents of the "Diary". Moreover, one at least of the published volumes will be available, it is hoped, in time for the Faraday Celebrations in September 1931. The notes are carried on from 1831, through the eight folio volumes down to the year 1862, when his powers were failing and his experimental work was at an end. An entry for Mar. 12, 1862, records an experiment which seems to be the last he ever made. He was hoping to obtain an effect of magnetism on light. He failed to find it. It was not the first time he had made this experiment unsuccessfully; but his scientific intuition was not at fault, for others have since found the effect that he was seeking.

Obituary.

Prof. Adolf Engler.

THE death of Heinrich Gustav Adolf Engler, aptly described as the *Altmeister* of systematic botanists, on Oct. 10, in his eighty-seventh year, removes a prominent and striking personality from the botanical world. 'Engler's System' is a phrase familiar to all students of the science, and has been in recent years a subject of warm discussion among those interested in phylogeny and more especially in the 'natural' arrangement of the families of flowering plants. In his student days, Engler came under the influence of the great German systematist Eichler, whose 'System' was a definite attempt to arrange plant-families in series advancing from the more primitive to the more highly specialised; the simplest type of flower was regarded as the earliest and advance implied an increase in number of parts and specialisation of structure. Engler's 'Syllabus', which was a modification of Eichler's system, has been widely used in systematic works and a large proportion of Continental and American 'floras' follows his arrangement. The criterion of primitiveness has been challenged by the school which regards the simplest types of flowers to be reduced and not primitive forms, but in the recently published edition of his 'Syllabus' the veteran botanist vigorously defends his position and suggests that the less-known parts of the African continent may conceal forms which will provide links in support of his theory.

The 'Syllabus' was the basis of arrangement of "Die natürlichen Pflanzenfamilien", a systematic description of the families and genera of plants, initiated by Prof. Prantl and Prof. Engler in 1887 and carried to completion by Engler after Prantl's death early in the progress of the work. The "Pflanzenfamilien" had a wider appeal among botanists than the more erudite and more strictly technical "Genera Plantarum" of Bentham and Hooker. The distribution of the work of compilation among a large number of botanists led to a certain inequality of treatment; but it went far beyond any previous production as a revision of the families and genera of all the groups of the vegetable kingdom. A new and enlarged edition is in course of publication, and of two large volumes issued during the present year under his editorship, Engler was also the author of the greater portion of one and of part of the other, a tribute to his remarkable virility and continued power of work.

A still more ambitious production was the "Pflanzenreich", begun, with Engler as editor, in 1900: a series of complete monographs of the families of flowering plants; a large number of volumes have already appeared.

Engler was in the prime of life when in 1889 he went from the University and Garden of Breslau to Berlin, as professor in the University and Director of the Botanic Garden and Museum. His first scientific post was under Prof. Nägeli in Munich, and his earlier work dates from that University and Botanical Museum and Garden.

One of his early interests was the Saxifrages, on which he published a monograph in 1872. He also contributed (1878–82) monographs of several families to Martius's monumental "Flora Brasiliensis"—which was continuing under Eichler's editorship. Among these was the Aroids, a family Engler made specially his own, and monographed in de Candolle's "Monographia Phanerogamarum", where he elaborated an arrangement of the genera on genetical lines. A developmental study of world floras found expression in his "Versuch einer Entwicklungsgeschichte der Pflanzenwelt seit der Tertiärperiode" (1879–82); and the series of volumes entitled "Die Vegetation der Erde" organised by the late Prof. Oscar Drude and himself in 1895 continues to provide authoritative accounts by experts of the

vegetation of specific areas of the earth's surface. German overseas expansion found in Engler a helpful exponent in organising the botanical exploration of the German spheres of influence in tropical Africa and New Guinea, and in the collation and publication of the results.

In 1881 Engler founded his "Botanische Jahrbücher", a medium for the publication of communications on taxonomy, plant-geography, and plant-history. The increasing importance of the Berlin Garden and Museum under his directorship as a centre of taxonomic work was reflected in the growth of the publication, which still appears regularly.

A conspicuous monument of the abundant energy and organising power of Adolf Engler is the fine Botanic Garden and Museum which he planned at Dahlem, outside Berlin, to replace the former restricted quarters in the city. Here in the open country he was able to develop his ideal, and the Berlin-Dahlem establishment holds a high place among the botanical institutions of the world. Here he continued to work after his retirement, and here, we gather from an appreciation by his pupil and successor, Prof. Ludwig Diels, he found his last resting-place. Few men have equalled his output of botanical work or exercised directly or indirectly a greater influence on the development of the branches of botany to which he devoted sixty years of unremitting and fruitful labour.

A. B. R.

MR. B. B. WOODWARD.

BERNARD BARHAM WOODWARD died on Oct. 27, aged seventy-seven years. He was the only son of Bernard Bolingbroke Woodward, Librarian of the Royal Library, Windsor, and of his second wife, Emma, daughter of Mr. George Barham of Witherdale Hall, Suffolk. He was grandson of Samuel Woodward, the Norwich geologist and archæologist, and nephew of S. P. Woodward, the well-known author of "The Manual of the Mollusca", and of Dr. Henry Woodward, Keeper of Geology in the British Museum (Natural History). He was educated at Merchant Taylors' and University College schools, but his education was interrupted by the early death of his father, and he started life as a clerk in Messrs. Robarts, Lubbock and Co.'s bank.

In 1873 Woodward was appointed Curator to the Geological Society, and was responsible for the removal of the Society's collection from Somerset House to Burlington House and its rearrangement in the new premises. In September 1876 he entered the Printed Book Department of the British Museum, and on Oct. 13, 1881, he was transferred to the new Natural History Museum at South Kensington and was placed in charge of the General Library there, being promoted first-class assistant on Aug. 22, 1887. He retired on July 21, 1920, but was further retained until the beginning of 1922 to carry on the work of the Library Catalogue. He was twice married, his second wife dying in 1904, but leaves no children.

With the scientific environment of his youth it is no wonder Woodward formed a collection of shells when he was ten years of age, and though in early manhood an ardent geologist, serving five years as secretary of the Geologists' Association, all through his long life malacology was his favourite study. Apart from a few popular articles, his first serious contribution was on the Pleistocene Mollusca of the Barnwell gravels in 1888, and from then forward, although hampered with ill-health, he was the author or joint author of a very large number of papers dealing with many aspects of malacology, published in the *Annals and Magazine of Natural History*, the *Journal of the Linnean Society*, the *Quarterly Journal of the Geological Society*, the *Proceedings* of the Zoological and Malacological Societies, the *Essex Naturalist*, *Geological Magazine*, and in many scattered reports on archæological excavations.

Woodward was responsible for the Molluscan portion of the "Zoological Record" from 1893 until 1896, whilst the articles on the non-marine mollusca of the various counties in the Victoria County Histories are from his pen. He was author of "The Life of the Mollusca", 1913, "Catalogue of the British Species of Pisidium", 1913, and joint author of "The Synonymy of the British Non-Marine Mollusca", 1926, the two latter being published by the Trustees of the British Museum. In his official capacity, he was responsible for the formation of the finest natural history library in the world, whilst his "Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History)", five volumes, 1903–15, and supplement, 1922, will always remain as a permanent memorial to his knowledge and painstaking accuracy. This scientific knowledge was always at the service of all students, and he contributed many paragraphs upon malacological papers to the columns of Research Items in NATURE. His death is mourned by a large circle of friends.

DR. LUDWIG MOSER, director of the Institute for Analytical Chemistry at the Technical High School in Vienna, and president of the Verein Oesterreichischer Chemiker, died on Sept. 26 after a motor accident in which his wife was also killed. We learn the following particulars from the *Chemiker-Zeitung*: Born at Vienna in 1879, Moser studied under Vortmann at the Technical High School, and after spending some time in industrial work was appointed assistant to Vortmann. In 1920 Vortmann retired and Moser succeeded to the chair. He reorganised the Institute, which was transferred to new premises, and a department was devoted to micro-chemical analysis. Moser was an untiring investigator, and up to the time of his death more than ninety publications had appeared under his name, many of which related to the rare earths. He also published volumes on the estimation of bismuth and on the preparation of pure gases. At the time of his death he was engaged on the manuscript of a "Lehrbuch der analytischen Chemie", which is not more than half completed.

News and Views.

DR. F. G. BANTING, of Toronto, has been made an honorary fellow of the Royal College of Surgeons of England: he is the first member on whom the College has conferred the honorary fellowship. It will be remembered that about nine years ago Dr. Banting, working with C. H. Best, obtained pancreatic extracts which were active in reducing the symptoms of diabetes in depancreatised dogs: their reinvestigation of the problem of the hormone of the pancreas led directly to the preparation, by J. B. Collip, of purified extracts, suitable for the treatment of human diabetes. The modern treatment of diabetes by insulin dates from this work of Banting's, and although insulin cannot be described as a cure for the disease, yet it has brought immense benefit to numerous patients. In fact, the diabetic, whether child or adult, can face the chances of life to-day almost as well as the non-diabetic. Lord Moynihan, at a meeting of the Council of the Royal College of Surgeons on Nov. 13, when the honour was conferred, pointed out that the discovery of insulin was the first piece of really scientific research in the realm of medicine contributed by the British Dominions. The work was of a physiological character bearing on the practice of surgery, though in itself something entirely outside the surgeon's craft; but its value deserved the recognition of surgeons.

H.R.H. THE PRINCE OF WALES, in honouring the recently incorporated Association of Scientific and Technical Institutions by his presence at dinner in the Guildhall on Nov. 13, once again directed timely attention to the national and imperial significance of a policy of co-ordination and co-operation in the exploitation of material and intellectual resources. Eight years ago His Royal Highness gave support and encouragement to the movement of which the present scheme, which involves the establishment of a central building for the use of the constituent and associated societies, is a logical development. A movement had, he said, been inaugurated which, if steadily supported and wisely guided, may confer benefits upon industry as a whole, both in Great Britain and in the Empire, the extent of which we can only dimly foresee. The time has long passed when any one industry, or any one branch of science, can hope to develop to its full stature without an intimate knowledge of what is going on in other departments of human activity; to say that further research is urgently necessary in almost every branch of industry and science is almost a truism. The Prince congratulated the presidents and councils of the constituent bodies on their foresight and wisdom, expressing his confidence that the outcome is bound to have a favourable effect on the course of wages and of industry. Other speakers at the dinner, at which Sir Ernest Rutherford presided, were Sir John Cadman, Sir Robert Horne, Dr. G. C. Clayton, Sir Auckland Geddes, Sir William Larke, and Mr. Eric Macfadyen, and it was announced that Mr. Robert Mond had made a gift of £10,000 to the Association. The registered office of the Association is Burlington House, Piccadilly, London, W.1, whence a copy of the Memorandum and Articles of Association and information concerning the conditions of individual life-membership may be obtained.

THE Imperial Conference which ended last week is the first over which a Labour Prime Minister of Great Britain has had the privilege to preside. It was not unreasonable to hope, therefore, that this Conference might be distinguished from previous ones by a departure from orthodoxy in its approach to the problems of Imperial co-operation in the development of that large portion of the earth's surface which is comprised by the British Commonwealth of Nations. Yet it must be confessed that the only distinctive feature about this Imperial Conference has been the obvious marked cleavage of opinion on most of the subjects under discussion between the representatives of the Dominions on one hand and those of Great Britain on the other. Little that is tangible has emerged from some weeks of labour. It has been suggested that the comparative failure of the Conference was due to lack of preliminary preparation on the part of Great Britain, and that on no subject on the agenda did Great Britain give a clear lead to the Dominions; and it must be confessed that the criticism appears to be justified. The best and most obvious way to stage Imperial economic discussions is to have prepared beforehand a survey of the methods by which the Imperial Government seeks to achieve economic unity. In this connexion it is disappointing to find how little prominence was given to a proposal, which has authoritative adherents in this and other parts of the Empire, for the creation of an Imperial Secretariat with functions similar to those of the League of Nations Secretariat. Such a secretariat would act as the supreme co-ordination body for the various Imperial bureaux already in existence. It would ensure continuity between the four-yearly Imperial Conferences; and it could, if it were properly supported, present to each Conference an adequate survey of the resources, actual and potential, of the Empire as a whole, without which all talk of the rationalisation of Empire industries is vain.

FROM our point of view, however, the most disappointing feature of the Conference has been the scant attention which appears to have been given to the relation between scientific research and the developments of the material resources of the Empire, and education. It may be that the present Government considers that all that is necessary in connexion with scientific research has already been said or done by previous Conferences. But previous Conferences have scarcely ever considered the influence of Great Britain as a cultural centre, and the means by which the various parts of the Empire can take advantage of the facilities available here for higher education and training. It is a fact perhaps not generally

known that the United States deliberately offers attractions to educationists in British Dominions, while Great Britain has hitherto had little to offer them. The incorporation of a scheme of educational studies in the University of London is now an accomplished fact, and it is, therefore, a pity that no attempt was apparently made to arouse any enthusiasm among the Dominion Premiers for this new link in the chain of Imperial co-operation.

A MOST valuable collection of records and publications on amentia has been presented to the Library of the Royal College of Surgeons of England by Dr. Thomas Brushfield, who was formerly Senior Medical Officer of the Fountain Hospital for Imbeciles at Tooting, under the Metropolitan Asylums Board. The records comprise the detailed histories which Dr. Brushfield compiled of all the children who came under his charge from his appointment in 1914 until his retirement in 1927, with photographs of the children taken on admission and after treatment. The histories are classified by the types of amentia—mongolism, cretinism, microcephaly, and so on—and Dr. Brushfield has preserved elaborate details not only of each child's physical condition and family history, but also of the mental tests employed in each case and of the progress of such as were fit to attend school. All these records are fully indexed, and numerous tables have been drawn up summarising and analysing the material from various aspects. These histories and statistics covering so long a period from the time when the particular study of mentally deficient children was only beginning, are all the more valuable because they have not been continued on any such a scale as was undertaken by Dr. Brushfield. He has presented them to the College Library so that they may be readily accessible for any research worker in this subject, for whom they ought to prove of inestimable value, as there is no comparable collection of similar material available.

BESIDES his first hand records, Dr. Brushfield has also presented his very large collection of papers and cuttings on amentia, gathered from all over the world. These will be kept together in connexion with Dr. Brushfield's own records, and the donor has prepared a full index to them. The papers cover not merely the varieties of amentia, but whatever may possibly bear on the subject, and there are numerous entries in the index under such headings as birth, encephalitis, endocrines, skulls, etc. To complete the usefulness of the collection, Dr. Brushfield has compiled a bibliography of books and articles issued up to the present, of which there is no copy in his collection, on all the subjects covered by his index. He further very generously proposes to keep this bibliography up-to-date and to incorporate into the collection whatever publications he may continue to collect. It is most sincerely to be hoped that there may be workers who will be glad to avail themselves of this carefully prepared material, and that some of them will care to continue the collecting of this special literature, which Dr. Brushfield has so industriously and disinterestedly begun.

THE tsetse flies of Africa appear to be immune from all ordinary methods of control, and the problem is being approached from many aspects. Mr. Harris, who is a Government entomologist working in the Zululand Game Reserve, some years ago came to the conclusion that these insects seek their prey entirely by sight. According to the *Times* of Nov. 14, he gave a demonstration of his recently devised tsetse trap before a number of entomologists and provincial authorities. The trap takes advantage of the fact that the insect is attracted to roughly shaped dummy animals, that it usually attaches itself to the abdomen, and reacts to contrasts of light and shade. It consists of a wooden frame supported on legs and covered with hessian, except at the bottom, and has a gauze panel at the top. Its rough resemblance to an animal appears sufficient to attract the insects in considerable numbers. They settle on the lower part of the trap, and coming within the hessian walls, they are attracted by the light showing through the gauze above, and so enter the trap proper. In the demonstration 18 of these traps were set up, and at the end of a day they were found to contain 1393 flies, of which 912 were females. The fact that such a trap will remain in good order for 18 months, and requires little supervision, suggests that the method is one of sufficient promise to merit its being tested out for a prolonged period.

LEAFLET No. 31 of the Astronomical Society of the Pacific deals with the near approach of Eros, which will be the closest recorded approach to the earth of any planet. The asteroid or minor planet Eros, although normally more remote than Mars, has such a large eccentricity (0·223) that on Jan. 30 next it will approach within 16,000,000 miles of the earth. This will give astronomers the best opportunity they have ever had of measuring the actual distance of a planet, and for several years preparations have been made for the campaign that has now begun. The scale of the solar system is accurately known from mathematical considerations and the observed periods of the planets, so that a knowledge of the distance of any one of these bodies furnishes the distances of all of them. The sun, Venus, and Mars, which are our closest neighbours, are so large and bright that sufficiently accurate measures of their positions are not possible. Eros combines the double advantage of a closer approach than any other body, and of presenting a beautiful stellar image that can be accurately measured on a photograph. During the forthcoming close approach Eros will suffer large perturbations by our system. From these it will be possible to improve our knowledge of the mass both of the earth and of the moon; in fact, the value that will be obtained for the latter will probably be more accurate than any now available. Even at its brightest, Eros is only of the seventh magnitude, so is not visible to the naked eye, although it can easily be seen in a small telescope.

THE elm disease, which is now known to be caused by the fungus, *Graphium ulmi*, first appeared in Holland and Belgium in 1919 and has since spread over most of western Europe. The first definite case recorded in England was at Totteridge, Herts, in the

autumn of 1927, but there is little doubt that the disease was present in the Isle of Wight and probably also in other districts some years prior to that date. From 1928 onwards the Forestry Commissioners have carried out annual surveys, the main findings from which are as follows. The disease has increased steadily each year both as regards rate of spread and intensity of attack and now occurs over the greater part of England. The disease varies greatly in intensity in different districts, but, as a whole, the proportion of trees attacked is quite small and usually less than 5 per cent of the diseased trees have been actually killed. Locally, however, the death-rate may be quite considerable and the disease assume an epidemic character. The rate of attack also is very variable and apparent recovery may take place, for certain trees in which the disease was found in 1928 recovered the following year and are still quite healthy. There appears to be a close connexion between the disease and the elm bark beetle, *Scolytus destructor*. There can be little doubt that the beetle helps to spread the disease by boring infected trees, and the only control measure suggested is that dead elm trees should be removed as promptly as possible, as they provide breeding ground for the bark beetle.

PROF. C. C. J. WEBB'S Hertz Lecture before the British Academy (from the *Proceedings of the British Academy*, vol. 16. London: Oxford University Press, 1930. 1*s*. 6*d*.) is a consideration of the thesis that our knowledge of one another, that is, our recognition of one another as 'selves' or 'persons', is a primary and fundamental form of knowledge, not derivable from or subordinate to our recognition of selfhood in ourselves, or our perception of an external world of things. The lecture falls into two parts. First it is shown that knowledge of others cannot be reduced to an inference from knowledge of self and knowledge of things since all such inferential accounts presuppose the mutual recognition which they are designed to explain. Moreover, it is held that the development both of self-consciousness and of external perception involves the implicit recognition of the distinction between self and others; so that indeed, of these three forms of knowledge, the apprehension of other selves is "in all probability the first to predominate in human experience". Prof. Webb, therefore, is disposed to hold that however intimately all three forms of cognition may be interconnected in the mode and order of their psychological development, each is logically independent, and that no one of them could be derived from any combination of the others.

THE second part of Prof. Webb's lecture draws out the implications of this result especially in the sphere of religious experience. For that experience, though it may arise through any of the three forms of awareness, is always essentially an *intercourse*—a 'social' experience—and may therefore be held to claim the authenticity which has been shown to belong to our recognition of others as 'socii'. Our knowledge of the object of religious experience differs, of course, profoundly from our knowledge of other selves: but Prof. Webb holds—supporting his argument by a comparison of his own view with Prof. Alexander's that these differences are not such as to invalidate the claim here advanced. This bare synopsis indicates only the course of a brilliant lecture. Both parts of it raise difficulties. But suggestion is the business of the lecture form: and this certainly is an admirable example of philosophical thinking and expression.

WE have received from the authorities of the University of Allahabad the first four volumes of "Allahabad University Studies", in which are published the results of research work carried out by members of the various departments of the University in the period 1925–1929. In a prefatory note to the first volume the Vice-Chancellor, Dr. Ganganatha Jha, explains that although research work has been carried on at Allahabad since the seventies of the last century, no attempt has previously been made to place the results on record or to assist in their publication, excepting only in *Indian Thought*, a quarterly journal of Oriental research conducted for a time by the late Dr. Thibaut and himself. With the recent reorganisation of the University on a unitary basis, and in view of the stress now laid on research, the authorities have thought it desirable that members of the University should have a vehicle of publication of their own. This object is eminently praiseworthy, provided the editorial board ensures that the standard maintained is worthy of an institution of university rank.

IT is unfortunately the case that too many educational institutions in outlying parts of the world are prone to issue publications which swell the already overwhelming volume of scientific literature with contributions which are little more than academic exercises. Some of the contributions to the Allahabad volumes are not above criticism in this respect. It is a danger to which the study of English in India is particularly exposed. This must be inevitable in a subject which looks to European rather than Indian culture for its inspiration. On the other hand, Mr. F. J. Fletcher, Principal of Agra College, has written an excellent study of George Bernard Shaw and the place of his writings in the development of modern English society, which is admirable as an analysis and to the Indian student should be an illuminating introduction to certain aspects of English culture. It might, however, have appeared more fittingly in a 'Review'. Although, taking the four volumes as a whole, the various departments of university studies, science, law, philosophy, history, and so forth, are well represented, it is to be noted that while it is as a record of research bearing upon specifically Indian studies that these volumes should have a special interest, these subjects, well represented in the first two volumes, dwindle sadly in numbe in the twc later.

DR. A. P. LAURIE delivered a lecture on photomicrography applied to the work of Rembrandt and his school, at the Royal Academy of Arts, on Nov. 12. Painters such as Rembrandt, who showed their brushwork, had each their own 'hand-writing' with the brush, and can thus be identified. By taking prints,

cutting them up, and placing them one on another, it is possible to make a very close and accurate study of such individual characteristics. Another purpose served is the revelation of weakness in drawing. A magnification of two diameters has been found to be best for Rembrandt and his school. Long experience and special skill are required to obtain photographs which are strictly comparable. It is also necessary to have records from undoubted pictures of the painter's work throughout his career, and also that of members of his school, as a dossier for testing the authenticity of a given picture. Dr. Laurie illustrated Rembrandt's brushwork throughout his career, and the brushwork of his school, by means of a series of lantern slides. While putting forward his opinion with due caution and diffidence, Dr. Laurie said he believes that pictures painted by Carel Fabritius, Flinck, Bol, and possibly Drost, will be found among 'accepted' Rembrandts; that there was a period during Rembrandt's successful time at Amsterdam when he was turning out pictures with the help of his pupils; and that in the first half of the eighteenth century there was a very skilful forger of 'Rembrandts' in his later style. On the other hand, probably no painter of his time has left so many examples as Rembrandt of his personal individual handiwork.

IN *World Power* for October it is pointed out that France is now divided approximately into fifty regions each one of which is surrounded by a triangular or a quadrangular grid of wires at very high pressures, fed by about fifty steam or hydroelectric stations. It is noteworthy that the Paris area is connected only to Caen and the Massif Central. During the War, it was considered advisable to equip Paris with powerful steam stations situated on the Seine and supplemented by a supply from the Massif Central hydroelectric stations. Now that the coal mines in the north have been practically reconstructed, interconnexion will very shortly be made between them and Paris. Future increases in the electric demand will be met by stations near the northern pit-heads. The western regions, and Brittany in particular, have a very poor electric supply. It has been suggested that this might be remedied by the installation of powerful tidal power stations. Another suggestion is to plunge tubes in the sea near Brest which will utilise, in the method proposed by Claude and Boucherot, the temperature difference between surface water and deep water for the generation of electric energy.

ONE of the tallest concrete buildings in the world, A Noite, has been erected in Rio de Janeiro. It has 25 floors and is more than 410 feet in height. The *Westinghouse International Journal* for October calls it a beautiful building in a beautiful city and says that it rivals the famous Sugar Loaf Mountain on the other side of the bay on which Rio is situated. Judging from the photograph shown of this beautiful city, taken from the air, we can scarcely endorse the praise given to the building. For a building of this height, a very elaborate lift installation was a necessity, as a very speedy, efficient, and accurate service has to be maintained. The Westinghouse Electric International Co. has installed its inductor control system, the operation of which is almost entirely mechanical. Stops from outside the lift are registered on a signal panel. When a car approaches within 25 feet of a landing stage where a call has been registered, both an audible and visible signal warns the operator to centre the switch. The lift-car is thus placed under the control of the inductor and automatically slows down, making a level, even stop at the floor with a minimum time lost in deceleration. If the lift-car happens to be fully loaded, the operator simply passes the floor and the call is automatically transferred to the next car. The speed of the cars is 700 feet per minute and each can carry a load of 2500 lb. There are four entrances to the lifts and they have now been working for several months very satisfactorily under heavy traffic conditions.

IN Germany the protection of birds is generally controlled by the Imperial Law of 1888, which details in a schedule, not the birds to be protected, as does British law, but the harmful species which may be destroyed. In Prussia, however, there have existed old codes in the various provinces of the State, often at variance with each other. The announcement is now made from Berlin (by Science Service, of Washington, D.C.) that new and uniform laws for birds and wild flowers have been enacted by Prussia. During the proper open seasons the following birds may now be hunted in Prussia: wild ducks, wild geese, most of the quail family, sandpiper, curlew, snipe, gulls, terns, and pigeons. Thirteen 'outlaw' species are listed which may be killed without restriction at any time, including several hawks, all crows, sparrows, grebes, and herons. All the remainder of the birds are given the benefit of an absolute closed season, although certain, like ospreys and kingfishers, that are given protection generally, may still be shot if necessary for the protection of fish ponds. No more bounties will be paid for the destruction of predaceous birds; bird-lime and traps for catching or injuring birds are prohibited; and birds must not be hunted by the aid of artificial lights. Further, certain wild animals which destroy birds but also prey upon rodents to an even greater extent, notably the wild cat, pine marten, and mink, are given absolute protection. The new list of prohibited plants contains thirty names, mostly of species which have been subjected to destructive collecting by dealers.

SEVERE winters in Great Britain are not common, but when they do come, havoc usually results in many domestic water-supply systems. A public service has therefore been rendered by the Royal Institute of British Architects by the production of a small pamphlet entitled "Report on Damage to Plumbing Work caused by Frost" (R.I.B.A., 9 Conduit Street, W., 1930. 3*d*.) which shows those who have interests in property what should be arranged to prevent damage. Initiated by the Science Committee of the R.I.B.A., the suggestions are the result of the deliberations of a conference which included representatives from the Ministry of Health, the L.C.C., and a number of other bodies representing various interests. These

suggestions include plumbing matters dealing with the location of pipes and provision of stop-cocks, instructions to householders upon precautions to prevent freezing in water systems, and hints upon hot-water boilers in connexion with frost stoppages.

THE next annual Congress of the Royal Institute of Public Health will be held in the City of Frankfurt-on-Main on May 19–24 (Whitsuntide), at the invitation of the German Government, the Municipality, and the University of Frankfurt. The Congress will be presided over by the Marquess of Reading. The inaugural meeting will be held on the morning of May 19, and the scientific work of the Congress will be conducted in English in the following sections: Section I., State medicine and municipal hygiene; Section II., architecture, housing, and town planning; Section III., industrial hygiene: Section IV., women and children and the public health; Section V., tuberculosis; Section VI., pathology, bacteriology, and biochemistry. Educational visits will be paid to the chief places of interest in the city of Frankfurt, including the new housing developments. Some of the chief spas and health resorts of the Rhine and adjacent districts will be visited, including Wiesbaden, Homburg, Nauheim, Kreuznach, and Munster-am-Stein. On May 23, a whole day's visit will be made to Heidelberg. Delegates are being invited from the governments, municipalities, universities, and other public bodies of Great Britain and Ireland and the British Dominions, as well as from continental and foreign countries.

AT the anniversary meeting of the Mineralogical Society, held on Nov. 4, the following officers were elected: *President*, Sir John S. Flett; *Vice-Presidents*, Dr. G. F. Herbert Smith, Prof. C. Gilbert Cullis; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Dr. J. W. Evans; *Editor of the Journal*, Dr. L. J. Spencer.

SIR VENKATA RAMAN, Palit professor of physics in the University of Calcutta, has been awarded the Nobel Prize for Physics for 1930, for his work on the scattering of light and the discovery of the Raman effect; and Prof. Hans Fischer, director of the Institute for Organic Chemistry of the Technical High School, Munich, has been awarded the Nobel Prize for Chemistry for 1930.

THE July–September number of *The World's Health* (Vol. 11, No. 3), the organ of the League of Red Cross Societies, is a British Empire number, and contains a history of the Red Cross in Great Britain by Sir Arthur Stanley, a review of Red Cross problems in India by Norah Hill, and a description of the Red Cross clinic for rheumatism in Peto Place, Regent's Park, London, by R. H. P. Orde.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 178 of nearly 1500 second-hand works relating to botany and gardening, many formerly the property of the late Sir George Watt; also Catalogue No. 179 giving the titles of upwards of 1100 works on the subjects of conchology, entomology, geology, ornithology, and general zoology. Both catalogues can be had free upon application to the publishers.

A NEW part—No. 3—of "An Illustrated Catalogue of a Valuable Country Library" has just been published by Messrs. Henry Sotheran, Ltd., 43 Piccadilly, forming No. 820 of "Sotheran's Price Current of Literature". Nearly 3000 works are listed, many of which relate to science and travel. As is usual with the catalogue of which this forms a part, the list is enriched by numerous bibliographic notes which should be of interest and value to collectors and librarians.

THE Bulletin of the Royal Academy of Denmark for 1929–1930 (*Oversigt Kgl. Danske Videnskabernes Selskabs Forhandl.*) contains a complete list of the Academy's publications from its foundation in 1742 to June 1930. This, which is compiled by Asger Lomholt, is arranged under authors and then chronologically. Most of the papers can still be purchased in separate form or in the relatively small parts of the *Oversigt*; the price of each is quoted. The List should therefore be of value to librarians, bibliographers, and booksellers. This part of the *Oversigt* costs 4 kroner (about 4*s*. 6*d*.).

IN the annual report for 1929 of the South African Institute for Medical Research, Johannesburg, recently issued, the director, Sir Spencer Lister, summarises the routine and research work of the Institute. It has been ascertained that in pneumonia and pneumococcic meningitis the strains of the pneumococcus causing these diseases are constantly changing; also, that some of the pneumonic infections occurring among the native mine labourers of the Witwatersrand goldfields seem to be caused primarily by a filterable virus followed by a secondary pneumonic infection. As a result of experimental work, it has been found that nine species of fleas are capable of transmitting plague under laboratory conditions. Dr. Pirie has prepared a pathological report on 600 cases of tuberculosis occurring among native miners, and Dr. des Ligneris has continued his investigations upon cancer, employing Rous's fowl sarcoma for the experimental work.

WE have received the first number of the second volume (March 1930) of the "Index to the Literature of Food Investigation", compiled by A. E. Glennie for the Department of Scientific and Industrial Research (H.M. Stationery Office, 1930). The arrangement is similar to that in the previous numbers, each title being accompanied by a few lines indicating the nature of the work reported and the conclusions reached. The index is preceded by a brief review of noteworthy developments during 1928–29, which is provided with its own bibliography of 79 references. It is proposed to give such a review with the first number of each volume. This summary is useful as a means of keeping in touch with the more important advances in the subject, on which a large number of papers are published annually: thus, upwards of 800 papers are summarised in the present half yearly list. The review deals with the freezing or chilling of meat, the smoking of fish, disease in fruit, corrosion in tins, and some engineering problems; to some of

these subjects reference has already been made in our columns.

DURING the last few years Messrs. Thomas Murby and Co. have become known as publishers of books on geological subjects. Their geological supplies department, or at least the extent of its resources, is perhaps less familiar. A catalogue which they have recently issued can be consulted with profit by teachers and students who may from time to time desire to purchase apparatus and materials for geological work in the field or laboratory. Hammers, collecting bags, map cases, and clinometers are represented in great variety. Collections of rocks, minerals, ores, crystals, thin sections, and fossils are available, specially selected in several cases to illustrate standard text-books on mineralogy, petrology, and palaeontology, together with card trays, cabinets, and slide boxes suitable for the storage or display of specimens. Petrological microscopes by well-known makers are supplied, and all the accessory apparatus required for petrographic methods. Crystal models and structural models of considerable interest for teaching purposes have recently been introduced. Intending purchasers of geological materials and accessories such as those mentioned should consult Messrs. Murby's catalogue.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :- An assistant lecturer in geography at University College, Nottingham The Registrar, University College, Nottingham (Nov. 26). A lecturer in elementary general chemistry at the National Bakery School, Borough Polytechnic The Principal, Borough Polytechnic, S.E.1 (Nov 28). A resident clinical pathologist at the Manchester Royal Infirmary -The Chairman of the Medical Board, Royal Infirmary, Manchester (Nov. 29). An assistant lecturer in geography at the University College of Hull—The Registrar, University College, Hull (Nov. 30). A whole-time head of the Aristotle Road, Clapham, Junior Commercial and Junior Technical Evening Institute The Education Officer (T 7), The County Hall, Westminster Bridge, S.E.1 (Dec 1). An assistant anatomist in the University of Cape Town The Secretary, Office of the High Commissioner for the Union of South Africa, 72 Strand, W.C.2 (Dec. 17). A full-time pathologist at Napier Hospital, New Zealand The Managing Secretary, Hawkes Bay Hospital Board, Napier, New Zealand (Jan. 10). A male assistant in the sheep department of the Rowett Research Institute Experimental Stock Farm -The Secretary, Rowett Research Institute, Bucksburn, Aberdeen.

Our Astronomical Column.

A Study of Spectroheliograms. An important contribution to the study of the sun's atmosphere by means of spectroheliograms, which record the sun's surface in monochromatic light at different levels from the photosphere to the top of the chromosphere, is given by L. D'Azambuja in *Annales de l'Observatoire de Paris*, Section d'Astrophysique, à Meudon, Tome 8, Fas. 2. Hitherto most spectroheliograms have been obtained in the hydrogen light ($H\alpha$) and in that of ionised calcium (H and K), though Deslandres in 1894, Hale and Ellerman in 1903, and Fox in 1905 first respectively recorded the sun's surface in the light of other elements. D'Azambuja's present research is concerned chiefly with such elements as magnesium, iron, calcium (neutral), sodium, and strontium, that are characteristic of the lower chromosphere or reversing layer. For this work a powerful spectroheliograph such as that at Meudon is essential, and it was possible to study the changes as the narrow selecting slit was set respectively at the middle and at the edge of the spectral line used. As is well known, there are significant differences (explicable as being mainly due to difference of level in the sun's atmosphere) between spectroheliograms taken in the light which comes from the narrow central portion of the $H\alpha$, H, or K lines and those obtained when the edges of the lines are likewise isolated. A comparison of these established differences with those observable in the case of the lines due to lower-lying elements, together with a knowledge of the curves of intensity of the lines, forms the basis of the present discussion.

The memoir also contains results relating to the infra-red lines, $\lambda 8498$ and $\lambda 8542$, of ionised calcium. The possibility of obtaining spectroheliograms with these lines was indicated by C. R. Davidson at Greenwich in 1927, when he measured their intensities relative to those of H and K in the spectrum of the chromosphere. Using hypersensitised neocyanin plates, D'Azambuja has successfully obtained spectroheliograms in these radiations. The memoir, which contains excellent illustrations, whilst presenting new results, is a valuable book of reference to the work of others in this line of solar research.

Identity of a Minor Planet. M. Delporte detected an interesting object at the Uccle Observatory on Sept. 29. He was doubtful whether it was a comet or minor planet, but there is now little or no doubt of its planetary nature. The following orbit is given in *Circular* 364 of the Berlin Recheninstitut by A. Kahrstedt.

M	327°·21	
ω	57·92	1930·0
Ω	1·01	1930·0
i	22·29	1930·0
e	0·2975	
Period	3·538 years	
q	1·631	

It seems very probable that the object is identical with 330 Adalberta, discovered at Heidelberg in 1892, but not seen since that year.

The following observations were then obtained (*Astr. Nach.* 3319):

Heidelberg M.T.	Apparent R.A.	Apparent Decl.
1892 Mar 18ᵈ 11ʰ 23·0ᵐ	11ʰ 57ᵐ 2·90ˢ	0° 6′ 19·6″ N.
„ 20 11 40·0	11 51 28·30	0 8 31·3 S.

It was only by a curious chance that this object received a number and a name. Another planet discovered on 1892 Mar. 19 received the designation 330 Ilmatar; this was afterwards found to be identical with 298 Baptistina, and the planet of Mar. 18 was given the number 330 in order to fill the gap.

If the new object is Adalberta, the period must be about 3·613 years, if 11 revolutions were completed between 1891 and 1931; or 3·31 years if 12 revolutions were completed. Prof. J. Comas Sola announces the discovery at Barcelona of a planet of mag. 10·7 in Pisces, but gives no position: it may be the Delporte object.

Research Items.

Burial Customs of the Akaju, Southern Nigeria. Burial customs of the Akaju tribe, Ogoja division, Southern Nigeria, are described by Mr. C. B. G. Watson in *Man* for November. Guns are fired to announce the death, and for the next two days relatives spend their time collecting food and palm wine. On the third day the corpse is dressed in a new loin-cloth, woollen cap, and shirt or singlet, and is hung in a hammock in the yard of the house. A fire is lit beneath it, the smoke serving in some degree as a preservative. The fire is tended by the wife, or in the case of a woman by women of the same age grade or by her fellow-wives. A man is kept thus for from fifteen days to thirty days according to his wealth, a woman for ten days. On one day a man of the same age grade wearing a special cap dances round the corpse. In the grave, which is oblong with a special recess for the head, the body is placed in a sleeping posture on its side, looking westward if a man, eastward if a woman. Money may be placed in the grave, a hoe is placed on a man's head, a machete may be placed on his chest, and a gun with the trigger removed by his side. No pottery or eating utensils are buried in the grave or broken at its side. After interment, no further ceremonies take place.

Price of Potatoes.—In "Factors Affecting the Price of Potatoes in Great Britain" (University of Cambridge, Department of Agriculture, Farm Economics Branch, Report No. 15), R. L. Cohen attempts to explain the fluctuation in potato prices during the forty-five years for which data are available. Total production tended to fall until 1898, and has since risen, on the average, until the present time. The more recent increases may largely be attributed to higher acreage being put under potatoes on account of the unprofitable nature of other crops, but the interests of neither producer nor consumer would appear to have been served by this heavier production. The analysis of data shows that, generally speaking, imports move in the same direction as prices, and are consequently a result more than a cause of price changes. The chief cause of fluctuation in home production is the variability of yield per acre. Variations in yield are so irregular that farmers cannot contrive to alter their acreage in compensation in order to attempt to stabilise yields, which would have a steadying effect upon prices. It is very desirable that correct information as to the season's production should be spread among British farmers with the view of price adjustment, to prevent foreign producers getting the benefit of high prices at times of shortage, while home growers are still receiving the lower rates of times of plenty. Further benefit would be derived if the fluctuations in growers' prices could be rendered more comparable with those of retail prices, as this would not only tend to stabilise rates from year to year, but also would result in a larger aggregate sum being received by the farmer for his potatoes.

Surface Precipitation Reaction of Living Protoplasm.—In the *Proceedings of the American Philosophical Society*, vol. 69, 1930, L. L. V. Heilbrunn has a very concise statement of his suggested explanation of the astonishing increase in viscosity in living protoplasm that may take place under various conditions, and which is so closely associated with the phenomenon of its 'stimulation' by various external agents. He shows that the films which immediately form at the surface of the extruded protoplasm, when a living cell is burst open in water, only form in the presence of calcium, and that, under certain conditions, similar small films, around vacuoles, form in the protoplasmic mass. This suggests an analogy with the clotting of blood; in the first stage of this process, calcium reacts with blood platelets, thrombin is produced, and this substance can produce clotting even in the absence of calcium. Similarly in the surface precipitation of the protoplasm exuding from a burst egg of the sea urchin, in the first stage an interaction occurs between pigment and calcium and a substance is produced which can bring about the precipitation in the absence of calcium. In the protoplasm, as in the case of the blood, one problem is to explain why this precipitation does not occur until external conditions alter. The reason appears to be, in part, that the calcium inside the living cell is not free, but is bound chemically. Immediately it is freed, on 'stimulation', the precipitation reaction occurs throughout the mass and a great increase in viscosity occurs.

Haploid Plants and Animals.—Prof. R. Ruggles Gates and Miss K. M. Goodwin publish a very valuable review of this subject, with comprehensive bibliography, in the *Journal of Genetics*, vol. 23, 1930. In the plant, the sporophyte generation is occasionally produced with the number of chromosomes characteristic of the sexual cells prior to fertilisation. The authors describe a new case of such a haploid plant in *Œnothera* and pass in review other cases previously described in this genus and in seven other genera of flowering plants. The haploids are smaller than the normal diploids, with smaller cells, and are almost completely sterile. Such plants have appeared (*a*) after crossing, especially with a distantly related species; (*b*) after subjection to cold at the time of fertilisation; and (*c*) (in the tomato) "spontaneously". In the case of animals, many more experimental methods appear to have been employed to bring into being such haploid organisms, but such animals usually either fail to reach maturity or double their chromosomes during development. In certain species of animals, of course, haploid males are the rule, and the authors discuss the theoretical difficulty thus created, as, from the known facts as to the part played by chromosomes in the determination of sex, one set of chromosomes with one '*x*' body might be expected to carry female characters.

Tung Oil.—Tung oil is an essential raw material of present-day varnish manufacture, and its unique properties as a drying oil render it indispensable for certain types of varnish. [It] is also now widely used [a]s an ingredient of certain types of paint media and in the manufacture of electrical insulating varnishes. The demand for tung oil, the possible extension of this demand, and the increasing areas being planted with the seed of *A. Fordii* both in the United States and in the British Dominions, Protectorates, and Colonies has led to the Imperial Institute preparing a memorandum on "The Production of Tung Oil in the Empire", with the co-operation of the Tung Oil Sub-Committee of its Advisory Committee on Oils and Oil Seeds, which is issued by the Empire Marketing Board. The memorandum sums up the history of tung oil under sources of production, its cultivation in the Empire and in the United States, and comments upon the further developments in the Empire. It then deals with methods of cultivation, growth of trees and yield, plantation costs, and utilisation of the nuts. Tabular statements show the exports (amounts and prices) of tung oil from China for the years 1924–28, roughly averaging £3,000,000 per year; the imports into the United States of America for the same years, which reached the £3,000,000 mark in 1929; and the

imports into Great Britain for the same period, the amount in 1929 amounting to a value of £273,350. On the subject of the future outlook, the memorandum states that the increased production will naturally tend to reduce the price, but the reduction should not be so great as to render the cultivation unprofitable. There will always be a demand for tung oil, as it is a raw material essential in some industries, and should always command a higher price than linseed oil.

An Amœba Growing in Cultures of a Yeast. Aldo Castellani has observed the presence of an amœba in glucose-agar cultures of a yeast-like fungus, *Cryptococcus pararoseus* Cast. (*Jour. Trop. Med. and Hyg.*, June 2, July 1, Aug. 1 and 15, 1930). The amœbæ appeared as large, delicate, roundish or oval bodies, which from time to time slowly emit blunt pseudopodia of clear ectoplasm, usually singly. A single round nucleus is present in the protoplasm, which often contains yeast cells. The diameter without pseudopodia varied from $13 \cdot 5\mu$ to $22 \cdot 5\mu$. Movements of translation were observed only in preparations made with Ringer's solution. Cysts occur, 9μ to 12μ in diameter, with a somewhat coarse granular protoplasm and well defined double-contoured membrane. The organism develops only in association with fungi or bacteria: for example, typhoid bacilli, alive or dead. When inoculated into cultures of various bacteria, alive or dead, zones of clearing or lysis were observed. The systematic position of this amœba is discussed by M. Douglas, who concludes that it is an undescribed species belonging to the genus *Hartmannella*, for which he proposes the name *Hartmannella castellanii* (*Jour. Trop. Med. and Hyg.*, Sept. 1).

Reversal of Cilia on the Gill of Mytilus. D. Atkins (*Jour. Mar. Biol. Assoc.*, **16**, 1930) found that nearly one third of the mussels obtained from the Fal Estuary during October and November 1927 presented abnormalities in their gills "doubtless correlated with some factor in the environment". Mussels from other localities were occasionally found with abnormal gills, perhaps in the majority of cases due to the presence of a large female pea-crab (*Pinnotheres pisum*), but the percentage of pea-crabs in the mussels from the Fal was so low (4·8 per cent) that their presence could not account for the large number of abnormal cases observed. The most interesting abnormality is the occurrence of supernumerary food grooves on the surface of the gill, accompanied in most cases by a permanent reversal of the beat of the frontal cilia on that part of the lamella between the main and secondary grooves. Particles drawn on to that part of the gill over which the cilia beat in a reversed direction are carried dorsally into the secondary groove and along it until they reach a filament with normal ciliation, along which they are passed into the main groove. While the author considers that the evidence points to a reversal of the effective beat of the cilia, she has not overlooked the possibility that the epithelium bearing these cilia may be partly formed anew after the production of the secondary groove, and the cilia may from their first formation have acted in the reverse direction.

Absorption of Fats and Lipoids in the Plaice. Mr. B. Dawes (*Jour. Mar. Biol. Ass.*, vol. 17, No. 1, pp. 75-102; 1930) gives an account of his investigations on fat and lipoid absorption in plaice. He found fat to occur in all three types of cell composing the gastric epithelium of the plaice, at the end of a fasting period extending over six or seven days, but to be completely absent from the mucosa of all post-pyloric regions of the alimentary canal at such times. He found a marked increase in the fat content of the superficial epithelium of the stomach after thirty hours and fifty hours of gastric digestion, the stomach thus being shown to be an effective organ of fat absorption. Considerable quantities of fat are present in the duodenal and intestinal epithelia after fat-containing meals have been digested. The rectum also is capable of slight fat absorption. The author suggests that there is a transference of the function of fat absorption from the stomach to the post-pyloric intestine when the frequency with which meals are taken is increased. Globules of true fat are not typically observed in the areolar tissue layer of the alimentary canal, though lipoid granules may occur in abundance. It is concluded that resynthesis of the cleavage products of fat does not occur in this layer.

***Atlantobellerophon*, a New Rhætic Gastropod.** Under the name *Atlantobellerophon zealandicus*, n. gen. et sp., Dr. C. Trechmann describes a *Bellerophon*-like mollusc from the Upper Trias, or Rhætic, of New Zealand (*Trans. N.Z. Inst.*, vol. 61). That its affinities are with *Bellerophon* and its allied forms, here discussed by the author, is evident. That it was presumably a Heteropod mollusc and allied to the modern *Atlanta*, as the author is inclined to infer, is a suggestion which malacologists are scarcely likely to accept without much stronger evidence, seeing how widely apart *Atlanta* and *Bellerophon* have always been ranked in the molluscan phylum.

Raman Effect. A valuable analysis of the literature of the Raman effect published up to the end of June of this year is given by S. Bhagavantam in the September number of the *Indian Journal of Physics*. Some three hundred and fifty references are dealt with—a large increase on the 150 listed by Dr. Ganesan last year in the same journal—and have been grouped under twenty-six heads, the first three of which contain book references and articles of a general character, and the remainder papers on special aspects of the effect. These are followed by an author index and an alphabetical list of the substances which have been studied, and there is a further list of almost a hundred other papers on light scattering which have been published by Indian authors since 1919.

Radioactivity of the Alkali Metals. Investigation of the radioactivity of potassium and rubidium, which is a matter of considerable difficulty when attempted by the usual methods, has been much facilitated by the introduction of the new sensitive particle counter of Geiger and Muller, and the radioactive constants for these elements found in this way by W. Mühlhoff (*Annalen der Physik*, vol. 7, p. 205) are probably as accurate as any yet published. Mühlhoff has confirmed the existence of a hard γ-radiation from potassium, and, from comparative measurements with radium-C and thorium-C, finds for the value of its absorption coefficient in lead, $\mu = 0 \cdot 59$ cm.$^{-1}$: the absorption was followed up to a thickness of more than 8 cm. Measurement of γ radiation from rubidium could not be undertaken for lack of material, but the β-ray activity was found to be 14·2 times that of potassium, and it was confirmed that many of the rubidium β-rays are relatively very slow, their absorption coefficient in aluminium approaching 10^3 cm.$^{-1}$. The half-period for decay of rubidium is given as $4 \cdot 3 \times 10^{11}$ years, and the half-period for potassium $1 \cdot 5 \times 10^{13}$ years, but the latter number must be reduced to $7 \cdot 5 \times 10^{11}$ years if, as is probable, radioactivity is confined to the heavier isotope (41), which is present to the extent of some 5 per cent in ordinary potassium. In any event, the average life of a potassium or rubidium atom is not less than about 100 times that of an atom of uranium.

Band Spectra of Carbon Isotopes.—The July issue of the *Astrophysical Journal* contains an article by A. S. King and R. T. Birge, in which they review the work which has been done up to the present on the isotope bands of carbon. The evidence for the existence of the heavier isotope, of atomic mass 13, is now conclusive, bands due to the molecules $C^{12}C^{13}$, $N^{14}C^{13}$, and $O^{16}C^{13}$ being known to accompany the more intense bands of $C^{12}C^{12}$, $N^{14}C^{12}$, and $O^{16}C^{12}$, and from a study of the isotopic bands of C_2 at 1737 A. ($C^{12}C^{12}$) and 4744·5 A. ($C^{12}C^{13}$) it has now been shown that the mass ratio of the isotopes is 12 to 13, with an accuracy of one part in ten thousand. The most surprising result of this investigation is, however, that the relative intensity of two related isotope bands depends upon the conditions of excitation, making it impossible to estimate their relative abundance with certainty. There is some evidence that the controlling factor may be the effective temperature of the source; when the degree of excitation is low, as in a furnace or in the *N* type stars, the spectra associated with the heavier isotope are prominent. With more intense excitation, such as that of the arc, bands due to the heavier isotope are less strong, the only evidence for the existence of C^{13} from this particular source being a group of lines in the cyanogen band at 3883 A. It is not easy to see how such differences can arise, and after a discussion of the most probable influences (true differences in relative abundance, excitation difference, and dependence on the optical path), the authors practically leave the question open with the remark that the abundance of the isotope of mass 13 and the dependence of its spectrum upon excitation conditions will require much additional evidence. [See in this connexion NATURE, Oct. 25, p. 649.]

The Schütz Law of Enzyme Action.—According to the Schütz law, if x is the quantity decomposed, E the quantity of enzyme, and t the time, then $x/\sqrt{Et} = K$, a constant. In the *Journal of the Faculty of Agriculture*, Hokkaido Imperial University, Sapporo, Japan, vol. 28, part 3, K. Nakajima describes experiments by many previous investigators, and in a critical discussion arrives at the conclusion that the so-called law has no validity in the kinetics of enzymes except in the form $x/\sqrt{E} = K$ for dilute pepsin solutions. He also criticises the Arrhenius law and the Northrop theory, which are held to confirm the Schütz law. A bibliography is provided.

Solubilities of Salts in Ethyl Alcohol.—In the October number of the *Journal of the American Chemical Society*, some experiments on the effect of one salt on the solubility of another without a common ion, ethyl alcohol being the solvent, are described by Seward and Schumb. An increase in solubility (as in other solvents) was found. In agreement with results of previous experimenters, it was found that the solubility curves show considerable deviations from the theoretical curve given by Debye and Hückel's equation, but they are considered to be in qualitative agreement with the extensions of that equation which take account of ionic size.

Reactivity of Coke.—The reactivity of a coke, which measures its capacity for reacting with steam and carbon dioxide, has usually been expressed as the percentage of each gas decomposed under defined conditions. This method of expression does not allow of a quantitative comparison of different cokes, or of the application of values determined under one set of conditions of temperature, gas velocity, etc., to another set of conditions. These shortcomings are avoided by a method described at a meeting of the Society of Chemical Industry, at Leeds on Oct. 28, by Dr. A. Key and Prof. J. W. Cobb, who express reactivity as the reciprocal of the weight of coke required to decompose a definite percentage of gas under specified conditions. It is not necessary to find this weight experimentally, since it is related to the percentage of gas decomposed by a standard weight of coke. This relation has been found and expressed on a reactivity curve which covers all known kinds of coke. It was also shown that the reaction between carbon and carbon dioxide is unimolecular with respect to the gas, while that with steam deviates from this because of complications. The uses of cokes are very largely dependent on their reactivity, and a method of comparison which can be applied generally should prove of great value in the study of carbonised fuels.

Synthesis of Creatine and Alacreatine.—A method worked out by Wheeler and Jamieson in 1908 for the preparation of alkylated guanidines is applied by H. King in the October number of the *Journal of the Chemical Society* to the synthesis of creatine. Sarcosine hydrochloride is treated with alkali and methyl isothiocarbamide hydriodide, with production of a 40 per cent yield of crude creatine. From alanine, the base alacreatine was similarly obtained. The substances were analysed as the crystalline picrates.

Sulphonation of Hydrocarbons.—Although it is generally supposed that saturated hydrocarbons are more or less inert to powerful sulphonating reagents, there have been references in recent technical literature which indicate that this is not the case, and in a paper in the October number of the *Journal of the Chemical Society*, G. N. Burkhardt shows that when an excess of *n*-hexane, cyclohexane, or methylcyclohexane is stirred vigorously with fuming sulphuric acid (35-65 per cent SO_3) at 0°-10° for four to five hours, practically all the sulphuric anhydride is used up. About 1 mol. of sulphur dioxide is formed per mol. of hydrocarbon, and oxidation of some of the hydrogen of the hydrocarbon is an important part of the reaction, perhaps after sulphonation has occurred. The product contained sulphato-sulphonic acids, such as are formed by the action of fuming sulphuric acid on unsaturated compounds; the barium salts, however, were not crystallisable, and special methods were used for the identification of the products of reaction.

Bionomics of Marine Algæ.—In *Bulletin* 67 of the Bernice P. Bishop Museum, "Hawaiian Marine Algæ", Miss Marie C. Neal investigates the seaweeds of the Hawaiian reefs by studying certain small areas throughout the year. The iron stakes which marked out the areas proved very satisfactory for algal growth, also concrete slabs and blocks. Most of the algæ are at their lowest state in December and January, the largest kinds old and dying out. Young plants appear usually in February, when temperatures are slightly higher. Many of the seaweeds have regular life cycles, maturing once, twice, or three times in a year. The succession of plants on an originally clean surface was approximately uniform, diatoms appearing first, then *Ectocarpus*, sometimes *Colpomenia sinuosa* third, or *Padina*, minute green, blue-green, or red algae occurring at the same time. The succession was rather different on a scraped concrete block which was nearer shore and exposed to the air at very low tides, and was thus subjected to some drying and to strong light, the surrounding shallow water being often warmer than the deeper area. The best base for algæ is apparently an immovable one, raised above the sea floor so that sand and stones do not collect on it. Many of the larger seaweeds grew fastest before maturity. The work is illustrated by many text figures.

Colour Vision.*

By Prof. H. E. ROAF

THE physiological problem in colour vision is to determine the varieties of receptors which are present in the retina. An experimental investigation of some aspects of this problem is summarised below.

The best starting point is the result of some investigations on hypochromats (colour blind individuals).[1] The object was to find out if there was any particular region of the spectrum in which they differed from the 'normal'. They were asked to copy geometrical designs in colour, and the copies were compared with the originals in the light of a recombined spectrum from which any specified region could be eliminated. It was found that agreement could be obtained only if the long wave-length end of the spectrum was eliminated. The cases varied in the extent to which the spectrum must be cut down, but it is not certain whether this was due to differences in the degree of the defect or to mere chance; that is, they might make different mistakes in making another copy. At the same time, there is not necessarily any diminution in sensitivity to light (rise in threshold) even to those parts that they fail to discriminate.[2] This is one of the main objections to the Young-Helmholtz hypothesis.

The graph relating wave-length to change in wave-length necessary to produce a visible difference in colour shows two minima (maxima of discriminating power), one about 5800 A. and the other about 4900 A.[3] In hypochromats the former is absent, whilst the latter is as well marked as in 'normals'. This is further evidence that there is a failure to discriminate between the long wave-length and neighbouring parts of the spectrum. It can be said that the hypochromat fails to discriminate what affects the normal as a red element; thus a yellow by loss of red value is matched with green.

To explain the phenomena revealed by the preceding series of experiments, we have to imagine some system whereby the differences between 'red' and 'green' are diminished or abolished without an alteration in the threshold to light from the long wave-length end of the spectrum. On the other hand, the difference between 'green' and 'blue' (neutral region of hypochromats) is as great as with normal individuals.

A type of experiment which ought to show to what extent separate receptors are stimulated by different regions of the spectrum is to shine two lights on the same area of the retina and to measure to what extent they interfere with each other. Quite different results were found for central and peripheral vision.[4]

For central vision, long wave-lengths raise the threshold for all regions of the spectrum, whilst shorter wave-lengths have comparatively little effect on longer ones. Fig. 1 shows an experiment of this sort with three different backgrounds. The ordinates show the multiple of the absolute threshold which is necessary in order to produce a noticeable difference against the background. It is clear that a background of 6214 A. interferes with the visibility of all parts of the spectrum, whilst backgrounds of 5404 A. and 4708 A. have comparatively little effect on the 'red' end of the spectrum. An additional point is that the curves are horizontal down to about 6000 A., which suggests that this part of the spectrum varies only in brightness, and not in colour, with alteration in the wave-length.

With peripheral vision, short wave-lengths raise the threshold for the whole spectrum.

These experiments suggest that there is some common underlying factor in all sensations of light: a fact which is recognised by Hering's assumption that there is a black-white substance and by the spreading out and overlapping of the sensation curves in the Young-Helmholtz hypothesis.

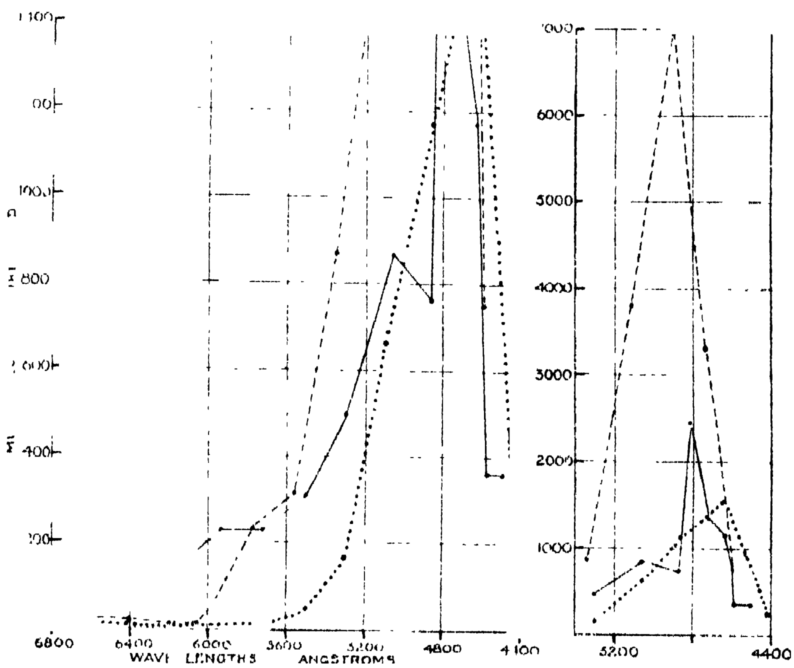


FIG. 1.—Ordinates, multiples of absolute threshold; abscissæ, wave-lengths in A. In order to show the higher values a part of the range is reproduced in one-fifth of the scale. Continuous line, background of 6214 A.; interrupted line, background of 5404 A.; dotted line, background of 4708 A.

It is possible to explain the facts of colour vision on the assumption that there are three sets of receptors (see Fig. 2):

(a) One which is stimulated by the whole of the visible spectrum and this may correspond with the sensation curve of the dark adapted eye;

(b) One which is stimulated by long and medium wave-lengths from the extreme 'red' end to about 4900 A.;

(c) One which is stimulated by long wave-lengths from the extreme 'red' end to about 5800 A.

As shown by the diagrams in Fig. 2, the long wave-length end of the spectrum stimulates all three sets of receptors and the short wave-length end stimulates only one set. That the short wave-length end of the spectrum stimulates a special mechanism is shown by measurements of visual acuity.[5] Wave-lengths less than 4900 A. have a low ratio of intensity to brightness and to visual acuity. Additional evidence that the 'blue' mechanism is stimulated by the whole spectrum is that blue is seen when a pure long wave-length stimulus is looked at slightly eccentrically.[6]

* Substance of a contribution to a joint discussion—"In what Sense can we speak of Primary Colours?"—of Section I (Physiology) and Section J (Psychology) of the British Association at Bristol on Sept. 8.

The three sets of receptors might be explained on the basis of three photochemical substances or that there is one photochemical substance with coloured filters in front of the receptors. The second suggestion receives support from comparative anatomy, as amphibians, reptiles, birds, and marsupials all have

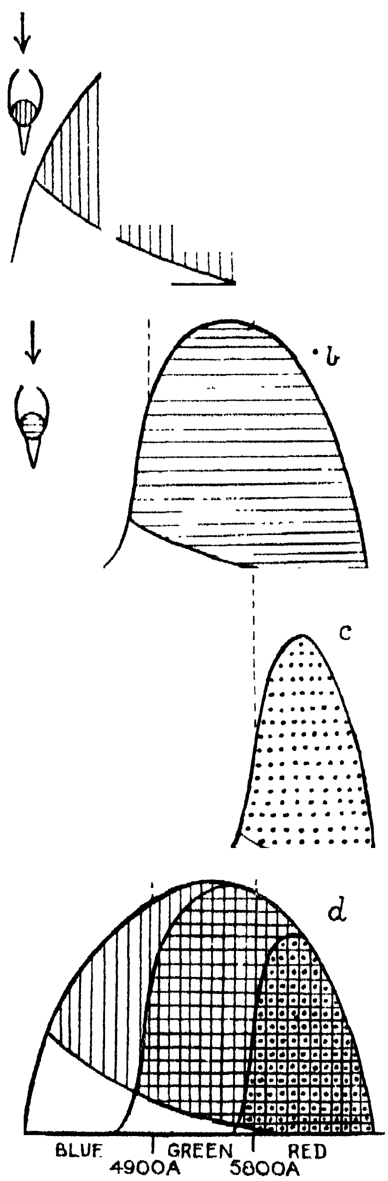


FIG. 2.—(*a*) Sensation curve for receptors sensitive to the whole of the visible spectrum.
(*b*) Sensation curve for receptors which fall off rapidly in sensitivity about 4900 A.
(*c*) Sensation curve for receptors which fall off rapidly in sensitivity about 5800 A.
(*d*) Superposition of the three sensation curves. The clear area indicates the photochromatic interval. The shift of maximum brightness with increase in intensity may be due to the effect of stimulating more than one set of receptors at the long wavelength end of the spectrum. For the hypochromat the dots would be deleted, leaving the other two sets of receptors active as in the 'green' area.
Insets: cones from hen's retina with corresponding coloured globules. The arrows show the direction of light.

coloured globules in front of the cones. As shown by the insets on the diagrams, those for the hen (red, yellow, and almost colourless) agree with the sensation curves deduced from experiments on human vision.[7] If such coloured globules should be discovered in the fovea of the human retina, the facts of colour vision would be explained. Perhaps, instead of cones with almost colourless globules, the rods may be the structures stimulated by the whole of the visible spectrum in the peripheral part of the eye. That cases of *retinitis pigmentosa* are blue blind is in favour of the blue sensation being the result of stimulation of rods.

This view is as sound from the photochemical point of view as the Young-Helmholtz hypothesis. It does not require quite so much unsupported speculation and it agrees better with the facts.

[1] Roaf, *Quart. Jour. Exp. Physiol.*, **14**, p. 151; 1924.
[2] Bradbrooke and Roaf, *ibid.*, **15**, p. 417; 1925.
[3] Roaf, *ibid.*, **16**, p. 379; 1927.
[4] Roaf, *ibid.*, **18**, p. 213; 1928.
[5] Roaf, *Proc. Roy. Soc.*, B, **106**, p. 276; 1930.
[6] Roaf, *Jour. Physiol.*, **69**, proc. p. 1; 1929.
[7] Roaf, *Proc. Roy. Soc.*, B, **105**, p. 371; 1929.

Preservation of Fish at Sea.*

FISH, even when kept in ice, soon show signs of deterioration which gives rise to 'staleness'. There are degrees of staleness, and a stale fish is not necessarily unfit for human consumption, but it is nevertheless of poor quality in the eyes of the market buyer and fetches a correspondingly lower price. If, therefore, means could be found to bring fish to market in a fresher condition after voyages of several days, the fish would sell at a better price, and the consumer enjoy a better article.

The deterioration of the fish may be caused either by intrinsic changes or by the effects of bacteria; it was one of the first aims, then, of the research to find to what degree either of these two causes was responsible for the staleness of fish. Research was carried out on board two steam trawlers specially fitted for the purpose. It has been shown that by far the more important factor in the staling of the fish is bacterial action, and that aseptic methods go far to keep the fish in good condition while at sea. This finding gives much satisfaction, as it shows at the start that results which may be of economic value to the fishermen can be obtained.

Cooling with ice does not stop bacterial action; it merely slows it down. It is therefore of importance that the fish should be thoroughly washed, after gutting, under aseptic conditions so far as possible. This, although it by no means sterilises the fish, reduces the initial contamination to a minimum and tends to keep the fish from rapid deterioration when stowed under suitable conditions. Full details and suggestions are given in the report for the equipment of trawlers with the necessary plant, and it is estimated that a capital expenditure of about £500 would be entailed and the running costs increased by about £400 a year. It remains to be seen whether the fishing trade will consider this outlay a financial proposition.

Since the introduction of the aseptic method would only extend the period during which a fish will keep fresh from 6-7 days to 10-12 days, it follows that it will only be of real value to short-distance vessels. While it would help towards keeping a larger proportion of the catches of long-distance vessels fresh, there would still be a large amount of fish caught early during the voyage that would inevitably become stale, or even bad. For the vessels making long voyages the possibilities of brine-freezing are being explored. The possible commercial advantages of this method are, however, not so sure, because, although the good flavour of the fish is preserved, the fish itself loses much in appearance; it can therefore only be taken by the salt-curers and smoke-curers.

* Department of Scientific and Industrial Research: Food Investigation. Special Report No. 37: The Handling and Stowage of White Fish at Sea. By Adrian Lumley, J. J. Piqué and Dr. George A. Reay. (London: H.M. Stationery Office.)

Problems of Cotton Growing.

A RECENT publication of the Empire Cotton Growing Corporation is a detailed report of the Conference on Cotton Growing Problems which was held in August last at the Shirley Institute, Didsbury, the station of the British Cotton Industry Research Association. The conference was attended by officers of the Corporation and of the Institute, by representatives of the cotton growing countries of the Empire, Egypt, and the Research Stations of Trinidad and Amani, as well as by other workers directly engaged on problems bearing on cotton. The sixteen papers presented, with the discussions thereon, covered much ground and included in their survey problems of manufacture in the factory as well as problems of production in the field.

The main problem, around which all others orientate, is the nature of the characters which go to produce quality in cotton, the raw material of the industry. This subject was introduced, appropriately at the commencement of the conference, by Mr. Peirce. Here is raised a problem which carries back at once to field conditions, the cause of immaturity, that 'curse of Lancashire'—neps. The evidence given by Mr. Bailey from the Sudan indicates a definite relation between nepiness and drought. The discussion ranged over the effect of gins in producing neps, as well as their behaviour in the processes of spinning; and it showed how much there is still to learn with regard to the origin of neps. The subject of quality in cotton was carried a step further by two papers from the Shirley Institute: on uniformity of cotton, by Mr. Underwood, and on the methods of correlating the strength of yarn with hair properties, by Messrs. Foster and J. Gregory.

On the agricultural side many problems were reviewed. The organisation of a seed supply which will retain purity in the crop when grown, as it is in Uganda and Nigeria, by a host of small cultivators, formed the subject of a paper by Mr. Lewin, of Nigeria: the practicability of limiting the number of varieties, in view of the variations of soil and climate found in any single territory, was raised on a reference from the Uganda Government and provided an interesting discussion—not unconnected with the subject of 'new place effect', introduced by Mr. Hutchinson, of the E.C.G.C. Research Station, Trinidad; while the discussion of the efficiency of cotton picking machines, raised by the Tanganyika Government and of interest to so many cotton areas owing to the acuteness of the labour problem, indicates that at the present time there is little hope of any practical solution.

The application of more fundamental research to cotton growing problems was also discussed. Two papers, one by Dr. Maskell, formerly of the E.C.G.C. Research Station, Trinidad, and the other by Dr. Gregory, of the Imperial College of Science and Technology, and Messrs. Crowther and Lambert, of the Sudan, dealt with the application of Dr. Fisher's recent methods of plot technique and analysis of field experiments. The former dealt more particularly with the possibility of securing a co-ordinated series of experiments in the different cotton growing territories, a subject to which reference was made in an editorial article in NATURE of April 12 last; the latter recorded some interesting results obtained in the Sudan by the application of these methods. The discussion on both papers illustrated the practical limitations by which such lines of investigation are rigidly bound.

The work at Rothamsted on the investigations, under controlled conditions, bearing on that widely distributed and elusive disease 'black-arm' (*Bacterium malvacearum*) was described by Dr. Stoughton, and the discussion revealed a critical attitude by many to the value of results obtained under such abnormal conditions of growth of the host plant. Finally, Prof. Weiss introduced a discussion of the subject of grafting and chimæra formation in its application to cotton.

On Oct. 21 a meeting of the Administrative Council of the Empire Cotton Growing Corporation was held, and in presenting the quarterly report of the Executive Committee, the director referred to the fact that the Sudan Government is about to reorganise its work on agricultural research, and with the view of effecting closer co-ordination between the different research workers, a Research Policy Committee is to be set up, of which the financial secretary will be chairman. In addition, an officer will be appointed to control the whole of the agricultural research work and to be the official channel of communication between the Research Farm in the Gezira and the Sudan Plantations Syndicate. With the consent of the Corporation, this post has been offered to, and accepted by, Mr. M. A. Bailey, the Corporation's plant breeder in the Sudan.

Reference was also made at the meeting to the success which has attended the use of steel ploughs at the Corporation's Seed Farm in Nigeria, and to the gratifying fact that neighbouring farmers, who are cultivating the land adjoining the Seed Farm on a co-operative basis, intend to purchase steel ploughs from the Corporation to replace their wooden ploughs, as they appreciate the superiority of the work which they are capable of doing. It is hoped that this movement will extend, with a consequent improvement in the standard of native agriculture in the district.

In Nyasaland a programme of seed control and distribution has been carefully prepared. The variety of cotton known as *U*.4, first bred at the Corporation's Experiment Station at Barberton in the Transvaal, is giving promising results in various parts of Nyasaland under widely different climatic conditions. It is believed that it may be possible by selection to obtain both an early and a late strain of *U*.4 that will between them meet the requirements of the different parts of the Protectorate in which cotton is cultivated.

University and Educational Intelligence.

BIRMINGHAM.—Leave of absence has been granted to Profs. Brash (Dean of the Faculty of Medicine), Haswell Wilson, and Daly, to visit the United States as guests of the Rockefeller Foundation to inspect the buildings and equipment of medical schools in that country in view of the building and development of the new medical school of the University of Birmingham.

There is a considerable increase in the entry of medical students to the University this session, but the number of entries to the University as a whole shows only a slight increase.

CAMBRIDGE.—The Appointments Committee of the Faculty of Agriculture and Forestry has appointed Dr. H. G. Sanders, of St. John's College, to be University lecturer in agriculture.

The Regent House has approved the recommendations contained in the report of the Council of the Senate on Mr. Montague Burton's benefaction for the endowment of a professorship of industrial relations, with a stipend of £1200 a year. If after the payment of this stipend and the appropriate pension contribution there is still a surplus in the fund in any year, it

is provided that it shall go into a separate fund from which may be paid the expenses of the professor in visiting Geneva, in order to keep in touch with the International Labour Office, or in investigating at first hand industrial relations in America. The new chair is to be called the Montague Burton Professorship of Industrial Relations and will be primarily assigned to the Faculty of Economics and Politics.

OXFORD.—At a meeting of Congregation held on Nov. 11, a decree was passed establishing regulations for the Joint Coal Mining Diploma of the Universities of Oxford and Birmingham. The decree provides that candidates for the diploma who are graduates of the University of Oxford must have obtained a class in the final honour school of engineering science, and must have attained a satisfactory standard in geology as a special subject. They must also present certificates of at least four months' practical experience in mining, and must attend the diploma course in mining at the University of Birmingham, extending over one session.

On Nov. 13, Prof. Pannekoek, of the University of Amsterdam, delivered, on behalf of Prof. Milne, a lecture on "Researches in the Intensities of Absorption Lines in Solar and Stellar Spectra". By means of certain formulæ and substitutions, which he employed with great fluency and readiness, he showed how the investigation of these intensities is capable of throwing light on the chemical constitution of solar and stellar atmospheres. Certain discrepancies between the calculated and observed results require further research. They may possibly indicate (as suggested by Prof. Milne) that some physical data need reconsideration in the light of astrophysics.

NOTICE is given by the Institution of Chemical Engineers, that application forms, particulars of the 1931 associate membership examination of the Institution, and a memorandum on "The Training of a Chemical Engineer" are obtainable from the Hon. Registrar, Institution of Chemical Engineers, Abbey House, Westminster, S.W.1. The latest date for the return of application forms is Dec. 22.

Historic Natural Events.

Nov. 24, 1639. Transit of Venus.—The rare occurrence of a transit of the planet Venus across the sun's disc was first predicted and then observed on this date (old reckoning) by Jeremiah Horrocks and also by his friend Wm. Crabtree to whom he had communicated his prediction. "I then beheld a most agreeable spectacle, the object of my sanguine wishes, a spot of unusual magnitude and of a perfectly circular shape, which had already fully entered upon the sun's disc on the left, so that the limbs of the Sun and Venus precisely coincided, forming an angle of contact. Not doubting that this was really the shadow of the planet, I immediately applied myself sedulously to observe it." Only four other such transits have been seen, those of 1761, 1769, 1874, and 1882. The next is due in 2004.

Nov. 23-24, 1926. Rock Fall at Roquebillière.—Following heavy rains, a crevasse opened on the steep flank of the Maritime Alps above Roquebillière on Nov. 22. Suddenly on the night of Nov. 23-24 a great mass of rock broke away and fell on the village, destroying a dozen houses and killing 25 persons. The catastrophe was due to the saturation of the ground above a sloping bed of clay, down which the whole mass slipped.

Nov. 26-27, 1703. Defoe's Great Storm.—On the night of Nov. 26-27 the southern half of England was visited by a storm unequalled for at least 300 years and possibly for far longer. Daniel Defoe, the author of "Robinson Crusoe", compiled a detailed and graphic account of the disaster, with the help of correspondents in all parts of the country. The greatest intensity of the storm was experienced to the south of a line from Pembroke to Yarmouth, and here the damage was so great that masses of lead from the roofs were rolled up and carried considerable distances. Houses were blown down, unroofed, or otherwise damaged, and the cost of building materials rose to three or four times the normal level. Eddystone lighthouse was destroyed, with Winstanley, its designer; and according to Defoe's account there was great loss of shipping. The loss was greatest on the south and south-east coasts of England and even in the Port of London many ships were driven aground. On the shores of the Severn the damage was accentuated by an abnormally high tide. At Bristol the water rose eight feet above the previous highest level. In south-west England the winds began from south-west and veered to north-west; in south-east England they began from south-south west and veered to west. There were several interesting peculiarities: the storm was generally accompanied by lightning, though the wind drowned the noise of the thunder. A 'spout' or tornado was observed at 4 P.M. on Nov. 26 near Oxford, and possibly elsewhere; and among the buildings of London the wind produced remarkable eddies, the damage to the roofs taking place on the eastern or leeward sides of the houses. In Kent the trees and grass were covered by a deposit of salt 25 miles from the sea. On Nov. 28 there was a very high tide in the Thames, which added to the confusion by flooding riverside London. The st[orm] ravaged Holland on Nov. 27, struck Hanov[er] and Copenhagen on the night of Nov. 27-28, while severe gales which may have been due to the same storm were afterwards reported from the Baltic, Sweden, Finland, and northern Russia. These led Defoe to conjecture that the storm, originating in North America, may have travelled entirely round the globe, losing force in the Arctic and dying out near its birthplace.

Nov. 26-27, 1898. "Portland Storm". A violent storm traversed the coast of New England, accompanied by a heavy fall of snow. One hundred and forty-two ships were wrecked, with a loss of 455 lives, including the steamship *Portland*, which left Boston in spite of a storm-warning from the Weather Bureau, and foundered off Cape Cod, this disaster costing 175 lives.

Nov. 26-29, 1921. Glazed Frost.—During a period of strong northerly and north-easterly winds, snow and freezing rain fell steadily for more than three days in Massachusetts, forming thick coatings of ice on all trees and telegraph wires. Wires one quarter of an inch in diameter carried ice two inches in thickness, and weighed $1\frac{1}{4}$ lb. per foot, and whole rows of telegraph and trolley-car poles were snapped off at the base, while almost every tree lost at least one good-sized branch. Communications and electric supply were interrupted for days, several people were injured and a number of horses killed.

Nov. 27, 1909. Hurricane. A violent hurricane struck the Cocos Islands (Keeling Group) soon after 7.30 P.M.; the wind and high seas did considerable damage. At 8.15 P.M. cable communication was interrupted owing to the vibration of the instruments. The centre of the storm passed over about 10 P.M., the barometer reading being 947 mb. (27·96 in.).

Societies and Academies.

LONDON.

Society of Public Analysts, Nov. 5.—**G. M. Moir**: The determination of the milk proteins. By mixing definite quantities of milk with a suitable acetic acid and sodium acetate buffer, maximum casein values are obtained between *p*H 4·5 and 4·7. Casein thus precipitated is identical with the substance precipitated by acetic acid alone at *p*H 4·2. For the combined determination of albumin and globulin the filtrate obtained from the iso-electric precipitation of the casein is treated with trichloroacetic acid to give a concentration of about 4 per cent, and the nitrogen the resulting precipitate determined by Kjeldahl's ethod. Casein and globulin are determined by pre-pitation with neutral saturated magnesium sulphate r sodium sulphate, and the individual proteins calcu-ated by difference. **S. G. Clarke**: The lead reduction ethod for the volumetric determination of tin, and he interference of copper and antimony. Tin is etermined by Powell's method of reduction from e stannic condition by means of lead, and direct tration with iodine, in an atmosphere of carbon oxide. Copper causes the results for tin to be too w in direct proportion to the amount of copper esent. Antimony also interferes, a considerable nount of tin being removed from the solution by precipitation of the antimony; this reacts with iodine during the titration. **W. J. Agnew**: A w method for determining traces of chromium in el. Chromium is oxidised with potassium per-anganate, excess permanganate being reduced by hydrochloric acid. The iron is then precipitated with sodium carbonate, and the dichromate determined by Evans's colorimetric method based on the purple coloration which it gives with diphenylcarbazide.

Linnean Society, Nov. 6. **J. G. de Man**: On a new species of the genus *Hoplophorus* (*Oplophorus*) H. M. Edw. A new species of deep-sea prawn belonging to the genus *Hoplophorus*. The specimens were taken from the stomach of a groper, *Polyprion prognathus*, captured in 2 fm. of water off the east coast of the South Island of New Zealand, at a place where deep water comes to within a short distance of the shore. **Isabella Gordon**: Brachyura from the coasts of China. In the endeavour to find satisfactory systematic characters for the discrimination of species and genera, particularly in the families Xanthidæ and Portunidæ, attention was given to the form of the abdominal appendages in the male sex. These appendages appear to afford a ready and reliable means of distinguishing males of the species discussed here and also in other species. **H. H. Allan**: Some remarks on wild hybrids in the New Zealand flora. Wild hybrids are very prevalent in the New Zealand flora, and those hybrids occur, for the most part, as highly polymorphic swarms, often between extremely diverse species, and showing a high degree of fertility. Where a species occurs alone it shows no 'variability', apart from environmentally induced modifications, and reproduces itself truly. The many so-called 'variable' species of the flora are really artificial groups compounded of true-breeding forms along with various hybrids. These artificial groups are now being studied by means of artificial hybridisation.

PARIS.

Academy of Sciences, Oct. 20. The president announced the death of Adolf Engler, *correspondant* for the Section of Botany.—**Ernest Esclangon**: New observations of the trans-Neptunian planet and a new determination of its orbit.—**Georges Perrier**: The fourth general assembly of the International Geodesic and Geophysical Union; Stockholm, August 1930.—**Serge Bernstein**: An interpolation formula.—**P. Vincensini**: Surfaces of constant total curvature.—**Paul Delens**: Representations of complex elements and conformal transformations on the sphere.—**S. Finikoff**: Transformations of couples of stratifiable congruences.—**Paul Mentré**: The complexes produced by a non-special linear congruence.—**Alfred Rosenblatt**: The unicity of solutions of partial differential equations of the first order.—**Henri Poncin**: A particular case of flow.—**Ch. Ledoux**: Method and apparatus for studying the deformations of aerial helices.—**Mme. Camille Flammarion**: Photographs of the trans-Neptunian planet Pluto. Photographs were taken on Aug. 30, Sept. 3 and 25. On the last date the negative was satisfactory, permitting the determination of the planet's position with reference to neighbouring stars: the planet was estimated to be of mag. 15.—**J. J. Trillat**: The structure of celluloid. Study of the structure with an X-ray spectrograph of celluloid films of constant thickness containing variable proportions of camphor. The relations found between the intermolecular distances of the external ring and the proportions of camphor are given graphically.—**Jean Thibaud**: Remarks on the fine structure of the α-radiation.—**C. Pawlowski**: Researches on the artificial disintegration of some elements. The presence of disintegration particles has been proved for carbon, magnesium, aluminium, silicon, and sulphur, but for the heavier elements, iron, zinc, silver, and lead, only the reflected α-particles have been observed. The numerical results agree with those obtained by another method by Bothe and Franz.—**Louis Meunier** and **Jacques Corbière**: The absorption of fatty materials from an aqueous emulsion by wool fibres.—**Hackspill** and **Winterer**: The decomposition of the bromates of the alkaline earths by heat. The rate of oxygen evolution with rise of temperature has been studied by a continuous photographic method. Barium bromate gives a point of inflection at 300° C. corresponding with the possible formation of barium perbromate, but attempts to isolate this salt have been unsuccessful.—**G. Lejeune**: The equilibrium of cerous and perceric salts.—**Georges Brus** and **J. Vebra**: Crystallised complex compounds starting from bornyl and isobornyl acetates.—**J. H. Hoffet**: The age of the limestone formations of central Indo-China.—**J. Fromaget**: The age of the porphyrites and rhyolites in Haut Laos and the bordering regions.—**Georges Dubois** and **J. Pierre Hatt**: Peat bogs and post glacial forest modifications of the middle Vosges. An application of the method of pollen analysis.—**Jean Lugeon**: The examination of the upper ionised layers at sunrise between Paris and the Sahara by short waves. The results obtained by the atmospheric and short wave methods are in close agreement, and suggest that on the date of the experiments (Nov. 2) there were four reflecting layers at altitudes of 280, 185, 85, and 50 km. During the night the short waves are reflected by the upper ionised layers, but during the day are reflected by the lower layers.—**R. Argaud** and **M. Pesqué**: The persistence of the phacocytic activity of the thymus in the course of its involution.—**Fontaine**: Researches on the internal medium of the sea lamprey (*Petromyzon marinus*). Its variations as a function of those of the external medium.—**Ph. Jayet-Lavergne**: A physico-chemical theory of sexuality.

BRUSSELS.

Royal Academy of Belgium, April 5. **E. De Wildeman**: The morphology of *Zygæna ericetorum*.—**Th. De Donder**: The physical interpretation of the

constant h of Planck by gravific.—Th. De Donder: The invariantive theory of the calculus of variations (6).—D. V. Jonesco: A problem relative to a recurrence formula or to a finite difference equation.—Lucien Godeaux: Researches on the cyclic involutions belonging to an algebraical surface.—Raymond Defay: The thermodynamical study of surface tension, affinity, and adsorption velocity (5). Jacques Van Mieghem: Study of retarded potentials. G. Gueben: The distribution of the radiation round radium tubes. The study of the distribution of radiation round radium tubes is of importance in radium therapy and has already been the subject of several publications, mainly from the mathematical point of view. The experimental method used by the author is based on the action of the radiation on a photographic plate, followed by measurements with a microphotometer. The proportionality between blackening and radiation found by Hoed and Stoel is confirmed. The relative advantages of the radiographic and ionometric methods for practical use are discussed.—H. Keiffer: The mechanism of lactation in mammals.

May 6. G. Cesàro: Some functions of the sides or angles of the triangle capable of being expressed as a rational function of the perimeter and of the radii of the inscribed and circumscribed circles. Armand Renier: A scientific centenary: André Dumont and the geological constitution of the province of Liége. Lucien Godeaux: (1) Remarks on desmic surfaces of the fourth order. (2) The complex locus of the straight lines belonging to the quadrics of a network. (3) Plane curves of the sixth order possessing six points of inflection. M. Maury: The geodesic service. Report on the work of 1929. The programme of work included the establishment of the triangulation network of the Grand Duchy of Luxemburg, and linking up the French, Belgian, and Luxemburg systems. Alb. J. J. van de Velde: The sterilisation of flours and enzymes in the state of powder. Earlier researches with flour proved that of the various reagents tested, only carbon disulphide treatment gave a sterile powder, leaving the biochemical properties unchanged. Experiments on the sterilisation of enzymes (amylase, pepsinase) are described: even after a double treatment at the ordinary temperature with carbon disulphide, the hydrolysing properties of both these enzymes remained unchanged. A. De Waele: Contribution to the study of cholesterol in the earthworm. The presence of cholesterol was proved, and found to be chemically and physically identical with that obtained from the higher animals. The proportion found was 0·092 per cent and no other sterol was present. Raymond Defay: The thermodynamic study of surface tension. Affinity and adsorption velocity (6). R. H. J. Germay: The Lagrange formula. Mlle. Georgette Schouls: Study of dynamic azeotropism. Radu Badesco: A functional equation (3).—Fernand Bolus: Surfaces of the fourth order possessing three double singular points. Raphael Deladrière: The parametric or homogeneous form in the calculus of variations.—E. Leloup: Concerning *Monothera obliqua*.

June 7.—Th. De Donder: The invariantive theory of the calculus of variations (8). Th. De Donder: The physical interpretation of Planck's constant h by the gravific. Applications (2). P. Bruylants, L. Ernould, and M. Dekoker: The α-methylbutenoic amides. Raymond Defay: The thermodynamical study of surface tension. Affinity and adsorption velocity (7). Jacques Van Mieghem: The study of retarded potentials (4). L. Godeaux: The correspondence between two surfaces and birational transformation of space. M. Winants: Some linear partial differential equations possessing three distinct families of real characteristics.—R. H. J. Germay: The rôle of an exponential in the development in series of solutions of generalised Lagrange equations. Application to the Gauss equation. M. Alliaume: Simplifications of the Gauss method for the determination of orbits in the case of a very distant planet.—A. Castille: The ultra-violet absorption spectra of the α-methylbutenoic amides.—Miron Nicolesco: A theorem of M. Pompéiu.—J. Thoreau: The crystallographic characters of the α-methylbutenoic amides.—M. Nuyens: The quantification of the gravific and electromagnetic fields.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 11, 1930. P. Davidovich: Spectroscopic problems in the study of new stars. A. Cvetkov: The part played by statistical fluctuations in a living organism from the point of view of the ionic theory of excitation. Theoretical considerations on the problem. P. Wittenburg: Discovery of an Upper Triassic fauna at Wrangel Land. New data for a palæogeographical map of the Upper Triassic period are supplied by the discovery of *Pseudomonotis ochotica* Keys. and *P. ochotica* var. *densistriata* Tell. at Wrangel Land. A. Mordvilko: Notes on Aphids (1-3). Description of *Brasilaphis bondari*, gen. and sp. n., from Brazil belonging to the peculiar subfamily *Setaphidinæ*, consisting of only four genera distributed in the tropic and subtropics. Attention is directed to *Neophyllaphis* Takah., living in Japan on *Podocarpus*, and description is given of *Tetraneura takahashii*, sp. n. from roots of *Miscanthus* in Formosa. S. Smirnov: Two new forms of Copepoda from the Amur region. Descriptions of *Attheyella borutzkyi*, sp. n., and *Cyclops languidoides* Lillj. var. *gracilicaudatus* n. var. V. Barovskij: Description of a new genus of the tribe *Lygæini*, family *Lygæidæ* (Coleoptera). *Emblethyoptera brevicornis*, gen. and sp. n., is described from the South Ussuri region.

Comptes rendus, No. 12, 1930. P. Lazarev and L. Teile: Action of certain substances, introduced into an organism by different methods, on the centres of peripheral vision. When morphine was injected into the blood the mean increase in the sensibility of the eye was greater than when morphine was taken through the mouth. P. Lazarev and P. Belikov: Action of quinine on the centres of vision and of hearing. Since the time necessary to produce effect on the eye and the ear by the same substance (quinine) is different, it may be concluded that the physicochemical mechanism of the visionary and the auditory centres are different. S. Kostychev and S. Klupt: The activity of ferments in the maceration juice of yeast after filtration and dialysis. The reduction of the fermentative power of the yeast juice is a specific character of the zymase, while the carboxylase, mutase, invertase, and maltase of the juice are not affected by the filtration; the true diastases are not, then, absorbed in the filter. I. Kozhantchikov: Habits of the sable (*Martes zibellina* L.) in the Sayan mountains and its geographical distribution. An analysis of the distribution of the sable on the basis of its ecological requirements. B. Dzerdzejevskij: Some results of the aerological observations on Lake Baikal. Balloon observations on the velocity and direction of wind at different altitudes.—V. Vlodavec: Geological investigations carried out in 1925 in the region of the River Umba, Kola Peninsula. The investigations revealed a wide distribution in the area of rocks belonging to the habbro-pyroxenite formation. A. Saukov: The cinnabar deposits of Nertchinsk. A description of the deposits from the point of view of their possible exploitation.

Official Publications Received.

BRITISH.

Canada. Department of Mines: Mines Branch. The Gypsum Industry of Canada. By L. Heber Cole. (No. 714.) Pp. viii+164+20 plates. (Ottawa: F. A. Acland.) 30 cents.

Transactions of the Mining and Geological Institute of India. Vol. 24, Part 3, July. Pp. 223-339+viii plates 15-18. 2.8 rupees; to non-Members, 4 rupees. Vol. 25, Part 1, August. Pp. 79. 2.8 rupees; to non-Members, 4 rupees. Member List 1930. Pp. 26. (Calcutta.)

Proceedings of the University of Durham Philosophical Society, 1929-1930. Vol. 8, Part 3, July. Pp. iii+161-279+vii. (Durham.) 5s.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 9: The Foundations of Yarn Strength and Yarn Extension. Part 4: The Influence of Yarn-Twist on the Diameters of Cotton Yarn, and on the Proportions of Fibre Slippage and Fibre Fracture in Yarn Breakage. By A. N. Gulati and Dr. A. J. Turner. Pp. ii+22. (Bombay.) 8 annas.

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Period ended 31st December 1929. v+54+11 plates. (London: H.M. Stationery Office.) 1s. net.

The Organization of the Electrical Industry in Great Britain. By Good. Pp. 44. (London: Institution of Electrical Engineers.)

The North Staffordshire Field Club. Transactions and Annual Report, 1929-30. Edited by H. V. Thompson. Vol. 64. Pp. 211+A24. (Stafford.) 7s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1318 (E. 35): Detonation and Lubricating Oil. By R. O. King and Dr. H. Moss. (T.C.E. 717.) Pp. 22+3 plates. 1s. 3d. net. No. 1330 (E. 37): Wind Tunnel Experiments on Steam Condensers. By Dr. R. G. Harris, F. E. Caygill and R. A. Fairthorne. (T. 2591, T.G.E. 467.) Pp. 2+10 plates. 1s. 6d. net. No. 1330 (Ae. 462): Maximum Force on the Fin and Rudder of a Bristol Fighter. By F. B. Bradfield and R. A. Fairthorne. (T. 2961.) Pp. 4+1 plate. No. 1331 (Ae. 463): Hinge Moments of Balanced and Unbalanced Ailerons on R.A.F. 15 Wing, to Large Angles of Incidence. By F. B. Bradfield and R. A. Fairthorne. (T. 2965.) Pp. 9+ plates. net. (London: H.M. Stationery Office.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1929. Fifteenth Report. Pp. vii+64. (London: H.M. Stationery Office.) 5s. net.

Annual Report for the Year ended March 31st 1930 of the Council of the National Institute for the Blind. Pp. 60. (London.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 17: The Marine Mollusca of the Shores and Shallow Waters of County Dublin. By Nathaniel Colgan. Edited by A. R. Nichols. Pp. 391-424. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 45: Photo-electric Measurement of Illumination in relation to Plant Distribution. Part 3: Certain Spruce, Larch, Oak and Holm Oak Woods. By Dr. W. R. G. Atkins and Florence A. Stanbury. Pp. 517-531. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Empire Cotton Growing Corporation. Report of the Executive Committee ... October 21st 1930. Pp. 8. (London.)

... of London, University College. Calendar, Session 1930-1931. Pp. 509+ccvi+34. (London: Taylor and Francis.)

University College of North Wales. Calendar for Session 1930-31. Pp. 409. (Bangor.)

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1930. Pp. 31+2 maps. (Wellington, N.Z.: W. A. G. Skinner.)

Ministry of Agriculture and Fisheries. Report on Salmon and Freshwater Fisheries for the Year 1929. Pp. 63+8 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 61, Part 2, June. Pp. iii+215-450+plates 39-67. (Wellington, N.Z.)

Osmania University, Hyderabad. Publications of the Nizamiah Observatory. Astrographic Catalogue 1900.0, Hyderabad Section (Part 9), Dec. −20° to −21°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of T. P. Bhaskaran. Vol. 7: Measures of Rectangular Co-ordinates and Diameters of 88,506 Star Images on Plates with Centres in Dec. −23°. Pp. xx+305. (Hyderabad.) 15 rupees, 20s. net.

Empire Cotton Growing Corporation. Conference on Cotton Growing Problems, August 1930: Report and Summary of Proceedings. Pp. 166. (London.) 6s.

The Journal of the Board of Greenkeeping Research. Vol. 1, No. 3, October. Pp. 109-189+8 plates. (Bingley, Yorks.: St. Ives Research Station.) 2s. 6d.

Ordnance Survey. Report on the Experimental Revision of the 1:2500 Ordnance Survey Plans with the aid of Photographs taken from the Air. (No. 2, 1928-30.) Pp. 8. (London: H.M. Stationery Office.) 2d. net.

FOREIGN.

The Fishery Experiment Station, Government General of Tyosen, Husan, Tyosen, Japan. Annual Report of Hydrographical Observations, No. 2-3: For the Years 1927-28. Pp. 12+2 plates. No. 4: For the Year 1929. Pp. 11+6 plates. Oceanographical Charts for the Year 1928: Appendix to Annual Report of Hydrographical Observations, No. 3. 24 charts. Oceanographical Charts for the Year 1929: Appendix to Annual Report of Hydrographical Observations, No. 4. 12 charts. (Husan.)

Ministry of Finance, Egypt. Report of the Department of Mines and Quarries, 1928. Pp. ix+44. (Cairo: Government Press.)

Huvuddragen av Stockholms Geografi. Pp. 19+357. (Stockholm: Geografiska Forbundet.)

United States Department of Agriculture. Circular No. 109: Parasitism of the Mediterranean Fruit Fly in Hawaii, 1914-1918. By H. F. Willard and T. L. Bissell. (Corrected edition.) Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 78, Art. 1: New Two-winged Flies of the Family Calliphoridae from China. By J. M. Aldrich. (No. 2841.) Pp. 5. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 266: On the Stark Effect of Aluminium and Carbon. By Yoshio Ishida and Masaichi Fukushima. Pp. 123-144+plate. 22 sen. No. 267-273: Thickness of the Oxide Film which produces Temper Colour on Iron, by Masawo Kuroda; Resistance of Impact on Water Surface, Part 2: Cone (continued), by Shunpei Watanabe; Über die ... Kohlenoxyds unter gewöhnlichem Druck, ... Wirkung des Eisenkatalysators, von Shiraro Kodama; Studien in der Fluorenreihe, von Kenzo Nakamura. Pp. 145-188+plates 5-30. 90 sen. (Tokyo: Iwanami Shoten.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 9, Septembre. Pp. 463-592. Année 2, No. 10, Octobre. Pp. ... (Prague: Regia Societas Scientiarum Bohemica.)

Acta Zoologica Fennica, 9. Edidit Societas pro Fauna et Flora Fennica. Beiträge zu einer einheitlichen Auffassung gewisser Chromosomentypen mit besonderer Berücksichtigung der Chromosomenverhältnisse in der Spermatogenese von Alydus calcaratus L. (Hemiptera). Von Enzio Reuter. Pp. viii+187+8 Tafeln. (Helsingforsiae.)

Visindafélag Íslendinga (Societas Scientiarum Islandica) 5: Some additional Notes on Thermal Activity in Iceland. By Thorkell Thorkelsson. Pp. 31+3 plates. (Reykjavík: Bóksprentsmiðjan Gutenberg.)

Comité national français de Géodésie et Géophysique. Assemblée générale du 5 avril 1930: Compte rendu publié par G. Perrier. Pp. 63. (Paris.)

Rapport annuel sur l'état de l'Observatoire de Paris pour ... par M. Ernest Esclangon. Pp. 40. (Paris.)

Journal de la Société des Américanistes. ... Pp. ... (Paris.)

Proceedings of the United States National Museum. Vol. 77, Art. 5: The Excavation and Repair of Betatakin. By Neil Merton Judd. (No. 2828.) Pp. 77+36 plates. Vol. 77, Art. 6: A Monograph of the Foraminiferal Family Polymorphinidae, Recent and Fossil. By Joseph A. Cushman and Yoshiaki Ozawa. (No. 2829.) Pp. 195+40 plates. (Washington, D.C.: Government Printing Office.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1929. By William Henry Fox. Pp. 77+ plate. (Brooklyn, N.Y.)

Cornell University Agricultural Experiment Station. Bulletin 505: Some Factors affecting the Cost of Operation of Retail Feed Stores in New York State. By Whiton Powell. Pp. 126. Bulletin 506: ... on New York Farms. By C. W. Gilbert. Pp. 80. Memoir 128: Genetical and Cytological Studies of Mendelian Asynapsis in Zea mays. By G. W. Beadle. Pp. 23+6 plates. Memoir 130: A Study of Meadow Crop Diseases in New York. By James G. Horsfall. Pp. 139. Memoir 131: ... Cold Storage and Freezing Studies on the Fruit of the Vinifera Grape. By R. D. B. Cattack. Pp. 37. (Ithaca, N.Y.)

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 12, October: Records of Meetings, 1928-1929, 1929-1930; Biographical Notices; Officers and Committees for 1929-1930, 1930-1931; List of the Fellows, Associates and Foreign Honorary Members; Statutes and Standing Votes; Rumford Premium; Index. Pp. 463-613. (Boston, Mass.)

CATALOGUES.

The Thring High Pressure Indicator. Pp. 4. (London: C. F. Casella and Co., Ltd.)

Verlagskatalog, 1811-1930. Pp. 178. (Leipzig: Wilhelm Engelmann.)

Surveying Instruments, Drawing Instruments and Materials, Photographic Apparatus and Materials, Plan Reproduction. Pp. iv+254. (London: A. West and Partners.)

Books on the Subjects of Conchology, Entomology, Geology, Ornithology and General Zoology. (Catalogue No. 479.) Pp. 32. (London: ... and Co., Ltd.)

... Supplementum Iconographiae Botanicae. (No. 78.) Pp. 58. (Berlin: W. Junk.)

Diary of Societies.

FRIDAY, NOVEMBER 21.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science), at 2.30.—Dr. H. I. Barin: The Specific Resistance of Willows to Insect Attack.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—Major W. H. Goddard: The Application of Diesel Engines to Road Transport.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.—Dr. E. G. Thomson: The Role of Hydrology in Preventive Medicine.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. E. T. Paris: The Determination of the Acoustic Characteristics of Sharply-resonant Hot-wire Microphones.—Dr. K. R. Rao: The Spectrum of Doubly Ionised Arsenic.—Dr. H. C. Bowker: The Effect of Temperature on Spark Potential.—Dr. F. L. Bates: The Curie Points.—Demonstration of an Instrument for Compounding Curves designed by Dr. Haugh.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Enlargement of the Prostate, with an Account of the Present State of Knowledge concerning the Etiology of the Condition.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—Dr. J. H. Reid : Nicotine.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A. Eagle and R. M. Ferguson : The Coefficients of Heat Transfer from Tube to Water.

SOCIETY OF DYERS AND COLOURISTS (at Literary and Philosophical Society, Manchester), at 7.—Dr. J. L. Hankey : The Treatment of Aniline Black subsequent to Ageing.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—W. H. Clark : A Talk on Lantern Slides.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. P. H. Graham : Ancient Clocks and Horological Curiosities.

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—G. F. C. Caswell : The Erection of Steelwork.

INSTITUTE OF CHEMISTRY, at 8.—B. F. Howard : Some Notes on the Cinchona Industry (Streatfeild Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. T. W. Eden, Dr. J. S. Fairbairn, and others : Discussion on the Interim Report of the Departmental Committee on Maternal Mortality and Morbidity.

INSTITUTE OF BREWING (at Institution of Electrical Engineers), at 8.15.—Dr. E. S. Beaven : The Culture of Barley for Brewing (Horace Brown Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Clinical Meeting.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Leeds).—Annual General Meeting.

SOCIETY OF DYERS AND COLOURISTS (London Section).—Prof. F. M. Rowe : Properties of Insoluble Azo Colours on the Fibre.

SATURDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene : What Schubert did for Song.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Extraordinary General Meeting.

MONDAY, NOVEMBER 24.

INSTITUTE OF ACTUARIES, at 5.—Sir Alfred Watson : The Analy Sickness Experience.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.45.—C. H. Russell : Machine Tools.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. Paley Yorke and others : Discussion on The Syllabuses of Day and Evening Courses in Electrical Engineering—Do they meet Commercial Requirements?

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—G. Bianchi : Some Data concerning Railway Electrification in Italy.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. H. Reynolds : Slides and Films in the Exhibition of the Society.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Bradley and S. A. Wood : Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen : Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.

ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling : Modern Domestic Scientific Appliances (Cantor Lectures) (1).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—J. L. Payne : A Case of Re-plantation and the Result after Nine Years.—Dr. A. F. Hurst : The Teeth and the Stomach.

MEDICAL SOCIETY OF LONDON.—Clinical Evening.

TUESDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—G. E. Woods Humphrey : The Development of Air Communication in Africa.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir W. H. Bragg : Two Old Friends of the Royal Institution (2) : Warren de la Rue.

EUGENICS SOCIETY (at Linnean Society), at 5.30.—W. T. J. Gun : The Heredity and Environment of our Empire Builders.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—G. Bianchi : Some Data concerning Railway Electrification in Italy.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—O. Bloch : How it Works in Photography (3) : The Emulsion Maker's Point of View.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—G. C. Waite : Preparation of Standard Steels.

DESIGN AND INDUSTRIES ASSOCIATION (at Institution of Electrical Engineers), at 8.—R. D. Best and R. McGrath : Discussion on Modern Electric Lighting and Lighting Fixtures.

WEDNESDAY, NOVEMBER 26.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at Caxton Hall), at 5.30.—Rhys Jenkins : Early Fire Extinguishing Engines.

INSTITUTION OF ENGINEERS IN CHARGE (jointly with Association of Supervising Electrical Engineers) (at Magnet House, Kingsway), at 7.15.—H. J. Eley : Ventilation by Air Movement.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—O. E. Fletcher : Further Aspects of Boiler Design.

ROYAL SOCIETY OF ARTS, at 8.—Prof. W. A. Bone : The Chemical Constitution of Coal.

THURSDAY, NOVEMBER 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. L. C. Martin : Colour Vision (2).

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—Dr. O. F. Hudson : Solders.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Projection of Films.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—L. J. Kettle and W. Tatlow : Progress in the Electrical Industry.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—Dr. F. C. Martley : The Importance of Blood-grouping Tests in Paternity Cases.

FRIDAY, NOVEMBER 28.

GENETICAL SOCIETY (at Linnean Society), at 3.—A. E. Gairdner and Dr. C. D. Darlington : The Theory of Ring-formation exemplified by *Campanula persicifolia*.—J. Philp : An Explanation of the Inheritance of Double Flowers in *Matthiola incana R.Br.* based on Cytological Evidence.—At 3.45.—Prof. A. H. R. Buller : Sexual Phenomena in the Higher Fungi.—C. Diver : Studies in the Genetics of the Common Garden Snail, *Helix aspersa*.—A. A. Moffett : Cytology of Pomoideæ.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Hinde : The Ocean-going Tramp Steamer from the Owner's Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. H. E. O'Brien : Electric Traction (Students' Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—E. Batten and others : Discussion on Export Trade Emancipation.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. H. Willett : Photography applied to Science.

INSTITUTION OF CHEMICAL ENGINEERS.—S. Mayne : The Sources of Published Technical Data and how they should be used.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Society of Dyers and Colourists) (at Glasgow).—F. W. Lake : Dyeing and Dry Cleaning.

SATURDAY, NOVEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene : Ver. in Song.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 21.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at Surveyors' Institution), at 5.30.—Col. C. H. Bressey : Some of our Road Problems.

TOWN HALL, GATESHEAD, at 7.30.—Dr. M. Ray : The Treatment of Rheumatism (Chadwick Lecture).

SATURDAY, NOVEMBER 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Nairs : A Survey of Costume from Prehistoric Times to the Elizabethan Era.

UNIVERSITY OF CAMBRIDGE (at Newnham College), at 5.—Prof. A. V. Hill : Biology in Education (Henry Sidgwick Memorial Lecture).

MONDAY, NOVEMBER 24.

UNIVERSITY OF LEEDS, at 5.15.—Prof. R. Robinson : The Colouring Matters of Red and Blue Flowers, Fruits and Blossoms.

TUESDAY, NOVEMBER 25.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin : Russian Farming and Agriculture.—At 5.30.—Miss Hilda D. Oakeley : The Approach to Reality Through History and Practice.

WEDNESDAY, NOVEMBER 26.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—L. Ward : The Prevention of Accidents in Factories and Workshops.

KING'S COLLEGE, LONDON, at 5.30.—H. T. Tizard : Scientific Industry.

UNIVERSITY COLLEGE, LONDON, at 5.30.—A. M. Wijk : Stockholm and Environs. (Succeeding Lectures on Dec. 3 and 10.)

BELFAST MUSEUM AND ART GALLERY, at 8.—J. Taylor : Venetian Art.

UNIVERSITY OF READING, at 8.15.—J. H. Coste : The Object and Method of Sewage Treatment (Chadwick Lecture).

THURSDAY, NOVEMBER 27.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. H. Chapple : Contraceptive Responsibilities of the Medical Practitioner.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Dr. J. S. Owens : Atmospheric Pollution.

FRIDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 5.30.—Sir Robert Philip : The Outlook on Tuberculosis : Changing Orientation (Malcolm Morris Memorial Lecture).

SATURDAY, NOVEMBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley : Some Mediæval Beasts, Real and Otherwise.

CONGRESS.

FRIDAY, NOVEMBER 21.

PUBLIC HEALTH CONGRESS (at Royal Agricultural Hall).

At 10.30 A.M.—Discussion on Sterilisation of the Unfit.

At 11 A.M.—Meeting of Institute of Public Cleansing.

H. Cook : The Future of Public Cleansing Work.

At 3.—Prof. C. S. Myers : Industrial Psychology and Public Health.

Meeting of Association of Superintendents of Parks and Botanic Gardens.

W. W. Pettigrew : Public Parks in Relation to Public Health.

Meeting of British Red Cross Society Hospital Library.

NATURE

SATURDAY, NOVEMBER 29, 1930.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

State Research in Chemistry.

IF Prof. G. T. Morgan's presidential address to the Chemistry Section of the British Association, at the recent meeting at Bristol, was not of the kind that provides arresting headlines for the daily Press, the reason is to be sought rather in deliberate choice of treatment than in lack of material, for we live in times—to many of us it still seems strangely novel—when State experiments and chemical research are both regarded as good copy, and fair game for the alliterative caption. The British Association exists primarily for the advancement of science as an element of culture; the addresses are designed to provide a bridge between the minds of two groups of thoughtful people, of whom one group is formed of pioneers engaged in the search for a particular kind of knowledge, whilst the other includes those similarly engaged elsewhere, as well as members of the general public who are interested to know something of the habits of this thing called scientific research which seems to touch their lives at every turn.

Instead of providing a critical survey of selected problems or an account of experimental advance along some well-defined path, Prof. Morgan offered a contribution to the study—in which, from various points of view, every member of his audience could participate—of a certain phenomenon, namely, the application, under the direct control of the State, of centralised and co-ordinated team-work to promote the more rapid advance of a science. Just as in the early stages of an investigation into natural effects it is most appropriate to record observations with accuracy and to determine what relations exist between the new and the old, so in this instance it was appropriate that the director of the Chemical Research Laboratory should avoid prophecy and special advocacy, but should confine his address chiefly to statements of fact and observations. His address forms a valuable basis to which, as time passes, there will be added the results of experience and of thoughtful suggestion and criticism; we of strong faith in the great future which lies in the path of this still new adventure welcome the convincing proof of vitality with its promise of robust growth.

The national value of such research as is being carried on at Teddington is, of course, no longer in question; no longer—in the abstract, at any rate—is it even ignored. Should it be asked how distinctively *national* in its significance is the technical work performed there, the reply might quote an example of the highest importance offered by the

studies on low temperature tar. The abatement of the smoke nuisance has long been a matter of popular discussion, but complaints have for the most part 'ended in smoke', so indissolubly wedded is the Briton to the coal fire which turns his house into a home. The new process of low temperature carbonisation of coal has at length given him a fuel which, while preserving his domestic amenities, contributes in no small measure to a solution of the problem of diminishing atmospheric pollution. If the price of this smokeless fuel could be made more attractive, there is no doubt that its use would quickly become widespread, and in time perhaps universal, to the great content of the guardians of the public health and to the convenience of aeronauts and astronomers. The price of the fuel depends not only on the output but also on the opportunities which exist for the exploitation of the by-products- aqueous liquor and tar. Now this tar differs markedly in its composition and characteristics from that hitherto produced, and its exhaustive examination, necessarily the first step in its exploitation, is pioneering work of first importance. It is self-evident that such an investigation is not only one which will be lengthy and will demand co-operative effort in a high degree, but also one which when developed along industrial lines can scarcely fail to lead to definite economic advantage, no less than to noteworthy contributions to chemical and possibly geological science.

It would be difficult at the present stage to estimate the full extent of the advantage to be anticipated from the development of low temperature carbonisation; it is sufficient to indicate that a general stimulation of industry following the return of coal to its former economic status is not to be excluded from view. Apart, however, from such mundane, if vital, considerations, is the impetus which the work will give to the world-wide advance of organic chemistry by providing (as did that on its elder brother, 'coal tar') starting-points for synthesis and relationships for elucidation. Already the presence of a substantial proportion of pyrocatechol has been demonstrated, a coloured hydrocarbon has been separated, and it has been observed that, speaking generally, the products tend to be the methyl derivatives of their high temperature tar analogues.

Surely no better example of the unreality of division of chemistry into 'pure' and 'applied' sciences is needed. Application can never precede discovery but often promotes it; and leaders of the chemical profession, whether their outlook be from a chair or from a board room, see the same fundamental knowledge supporting their endeavours and the same fundamental difficulties obstructing them. Work of this calibre can be represented in the museum of the laboratory only by a few shelves of bottles and specimens; their neighbours are no less significant in their relation to the development of a science, for they are early examples of pure substances which have been prepared by simplified processes rendered possible by the application of moderate pressure, whilst the series of primary alcohols (including ethyl), aldehydes, and acids derived from the catalytic interaction of carbon monoxide and hydrogen, offers both an intriguing contribution to the study of catalysis and a material success capable of industrial expansion. Each glass case that is opened discloses the steady progress of pioneering exploration where practice has outrun perception, as with synthetic resins; where the engineer has solved problems of a new technique (our thoughts return to the first air-pump and its contribution to chemical advance); in the new iatro-chemistry, where therapy and the 'architecture of molecules' move forward with mutual aid, not disdaining to strew their path with substances of curious behaviour and with incidental contributions to the study of valency. So essentially practical a matter as the corrosion of metals is not without its surprises and its puzzles; who would have thought that the green patina on copper roofs is not verdigris but basic copper sulphate eventually corresponding in composition with the mineral brochantite? And why does iron not rust so quickly when confined in a muslin cage as when not so confined?

This is the type of work which engages the attention of a staff of twenty-five chemists and thirty-two others, housed in a building adjacent to the National Physical Laboratory, and it is fully worthy of the attention of a State organisation. Like the German Reichsanstalt, the Chemical Research Laboratory owes its parentage to conditions evolved from war, although the former institution has now arrived at years of maturity. Neither can the Laboratory claim seniority in Great Britain as a public institution devoted to the prosecution of scientific research and its application to industrial needs, for its immediate neighbour has during the past thirty years discharged that duty. An essential difference in the nature of the work undertaken by the two institutions is to be found in the fact that whilst that of the Chemical Research Laboratory consists exclusively of original research, that of the National Physical Laboratory

includes testing, and hence provides substantial opportunities for fee-earning. That this should be so does not, of course, detract *ipso facto* in any way from the quality of the research carried on concurrently with the routine testing, which constitutes an essential public service. Nevertheless, it was doubtless wise not to burden a chemical laboratory, created specifically for exploration, with duties of a like nature. Should the usual facilities for obtaining such service prove inadequate or non-existent, there would presumably be little technical difficulty associated with a modification of the present policy.

We have already remarked that the Chemical Research Laboratory is the home of centralised and co-ordinated team-work. The unit is not the individual worker, whose efforts are likely to be discounted—not always by his own fault—through lack of adequate co-operation with others, but the 'working party'. As a coherent team the working party receives from the director its mandate to operate in a certain field: as a team it collects information and gathers experience. Not least among the national services rendered by the Laboratory must be counted the training, both in method and in spirit, of leaders in chemical research, particularly of those who will carry the habit of co-operation with them into the industrial world. It must not be forgotten that such 'key' problems as have been entrusted to the Laboratory require for their solution not only skill, knowledge, and strategy of a high order, but also substantial resources, expanding facilities, and the application of sustained forces.

Prof. Morgan refers to the undertaking as "a State experiment"; it is from one point of view an experiment, but not one of the result of which there need be much doubt. When Francis Bacon gave his opinion that States should not try experiments, he added the qualification "except the necessity be urgent or the utility evident", advising that it would be "well to beware that it be the reformation that draweth on the change, and not the desire of change that pretendeth the reformation". Reformation in our national attitude towards research (particularly chemical research, in which the material returns are often subject to but little delay) and towards chemical industry there has indeed been, and changes in our institutions have occurred in consequence—all too slowly and timidly, as some think who should be in a position to judge. These harbour no doubts concerning the utility or the urgency of the necessity. There may, of course, still be those who regard the 'experiment' as a novelty to be suspect: merely an innovation in tune with modern custom, a fashionable enterprise of which some indefinite good may come. Others, and we may hope the majority, see in it an effective new tool at the service of an industrial nation; some indeed, perhaps those who most clearly read the signs of the times, think of such a development as this in terms of future employment, of the standard of living, and of human happiness and well-being. *Scientia imperii decus et tutamen.*

Kepler's Letters.

Johannes Kepler in seinen Briefen. Herausgegeben von Max Caspar und Walther von Dyck. 2 Bande. Band 1. Pp. xxviii + 396. Band 2. Pp. xvi + 348. (München und Berlin: R. Oldenbourg, 1930.) 20 gold marks.

THE present year is the three-hundredth anniversary of the death of Kepler. The volumes before us mark the occasion. All that remains of Kepler, and it is a great deal, is already available in Frisch's edition. But Frisch is frankly unreadable. He had all the faults that sometimes accompany German thoroughness. In particular, as the editors of the volumes now before us remark, the letters come off very badly, being cut up and distributed here and there according to the subject treated of.

Max Caspar and Walther von Dyck have prepared a book for German readers which has the intention of bringing the man rather than the scientific ideas of three centuries ago before us; in fact, many of the scientific passages are omitted or compressed. Kepler's life was passed in evil times. A great deal of it was passed in penury and family distress. The counter-Reformation, with the vindictiveness of those who had come back to what they regarded as their own, framed the early part. When he went to the service of the Emperor Rudolph in Austria, an endless war with the Turk surged on the confines of the country and crippled civilised efforts. The Thirty Years' War wrapped the end in spectral gloom—though by that time Kepler himself was very tough. Messrs. von Dyck think that the present times are evil times, too, and that these letters will fortify Germans and do them good. The letters are a selection of those by Kepler and to him. They exist mostly in Latin, and these have been translated and make pretty easy reading, very different from those in the German of his time, where prolixity, long involved sentences, bad spelling, and the exasperating

practice of mixing Latin phrases with his vernacular make heavy going.

The book is a scholarly book and well done, though not intended as a prime authority. It is meant for current reading and has only a brief index. It includes a bibliography of sources where originals may be found, though each letter is not ascribed to its source. It includes also a brief list of dates and facts for all the persons referred to, and a certain number of portraits and other illustrations, well reproduced from interesting originals.

Taking the book, then, as we are meant to take it, what impression do we form of Kepler? Certainly the editors have banished a good deal of fog, but what we see is still not clear. Kepler was not one of those men of genius who can turn each matter that they touch into gold for all time by a single phrase. One reads his letters about religion, and of the refusal of the sacrament to him, and again of how he declines the proposal of his friend the Jesuit Guldin that he should join the Church of Rome, only to be led deeper and deeper into details that are long since dead and better forgotten. The same is true of the letters dealing with the case when some spiteful neighbour prosecuted his mother for witchcraft, and although the charge seems to have been entirely baseless, actually succeeded in spinning it out from year to year and incarcerating the old lady and threatening her with torture, in spite of Kepler's many letters to the Grand Duke of Württemberg urging that it should be brought to an issue. Perhaps of necessity they are detail, detail, detail.

Be that as it may, it is to be feared that Kepler, before he discovered Kepler's Laws and became famous, must have seemed, to those of his contemporaries who had enough contrivance to dodge the lesser troubles of this world, a formidable bore, always in poverty and domestic embarrassment, an able man without a spark of humour, writing immense letters about himself or any other subject, ticking off each with level emphasis and immense prolixity of detail. He had an unhappy life. Perhaps he expected people to have unhappy lives. He mentions the burning of Giordano Bruno, and that he was said to have shown a firm face in his trials, but expresses no horror of the deed. One of the portraits of him shows a face of fearful intensity, and energy, and frustration. It was not his fault that the world ill-treated him. The Emperor Rudolph II. wrote a rescript to his treasury to pay his pension, and the treasury did not pay it. His wife's relatives disapproved of his marriage and did not pay. Still, what have we to do with all that? He is dead long since, and we have our own bothers, of which he knew nothing.

There are, however, other personal features in Kepler's story that one would read these letters very ill if one did not see. There was no subtlety in Kepler. Fate bludgeoned him, but he did not bow his head. *Hier steh' ich, ich kann nicht anders*, might have been said by him, if he had had any instinct for a vital phrase. He sent Galileo his book "Mysterium Cosmographicum", and Galileo replied politely with guarded words this was thirteen years before he used a telescope—that perhaps he believed the Copernican theory more than circumstances allowed him to say. Kepler answered with the insistence of a man who sees one truth and sees it only. He had the kind of courage that a bull has he made straight for his object. Besides that, he had a warm and generous heart. He cherished his old and true friends, and he had some, though they were not able to help him much. The great event of his life was his meeting with Tycho Brahe. Tycho, when established under the protection of Rudolph, after his exile from Denmark, asked Kepler to be his guest. Kepler went, and stayed with him for six months; and Tycho, like the great gentleman he was, placed his castle and family and servants, as well as his scientific stores, at Kepler's service. In the end something went wrong, and Kepler lost his temper and behaved outrageously; and there is a letter, full of noble remorse, to Tycho, taking all the blame Tycho again behaved like a great gentleman and bore no grudge; and from that association we have the planetary laws, and how much more that is later history.

Kepler's scientific ideas do not really enter into these volumes, but they cannot be kept out. If the essence of mathematics is form, he had no mathematical genius. Number was what interested him. He had an intense conviction that the secret relations of things would be found in the relations of number. It led him elaborately astray twice—in relating the musical intervals with the distances of the planets, and in relating the latter with the dimensions of the five regular solids. Only later was his persistence in calculating rewarded in finding the planetary laws.

Great pains and labour must have gone in producing this book, and the editors have made the circle that is interested in such things their debtors by rendering the material so available. It is to be hoped that that circle will not be a small one.

R. A. S.

The South Atlantic Islands.

British Museum (Natural History). Report on the Geological Collections made during the Voyage of the Quest *on the Shackleton-Rowett Expedition to the South Atlantic and Weddell Sea in 1921-1922.* Pp. ix + 161 + 3 plates. (London: British Museum (Natural History), 1930.) 12*s.* 6*d.*

THE voyage of the *Quest* in 1921-22, in spite of the change of plans after the tragic death of Sir Ernest Shackleton, has thrown important light on the geology of the South Atlantic islands owing to the energy of the geologist, Mr. G. Vibert Douglas, and the use that has been made of his collections by Mr. Campbell Smith. The specimens were presented by Mr. Rowett to the Mineral Department of the British Museum (Natural History), and an authoritative account of them, with several new analyses, has been prepared by Mr. Campbell Smith and other experts.

The volume includes twelve reports, including descriptions by Mr. Vibert Douglas of South Georgia and Tristan da Cunha and an account, in conjunction with Mr. Campbell Smith, of the rocks of Zavodovskii Island and of rock fragments, sedimentary, metamorphic, and plutonic, dredged from the Weddell Sea. Mr. Campbell Smith, the editor of the volume, describes the petrography of Tristan da Cunha, Gough Island, St. Helena, and Ascension; Dr. G. W. Tyrrell, the geology and petrography of South Georgia; Mr. G. H. Part, the rocks of St. Vincent; Dr. H. S. Washington, those of the St. Paul's Rocks; Dr. C. E. Tilley, the basalts of Elephant Island, South Shetlands; Miss A. Vibert Douglas, the deep-sea deposits, and Prof. Gordon, fossil wood from South Georgia.

The contributions which throw most light on the history of the South Atlantic are those on South Georgia, regarding which there are two theories. Suess interpreted the island as a fragment of an arc that once connected the main Andean chain with its extension in Grahamland. This view is supported by the claims that South Georgia consists of a series of overfolded and faulted Mesozoic rocks and that its igneous rocks are represented in the Andes of the Argentine. According to the alternative view, which is based mainly on the observations and collections of Mr. D. Ferguson, South Georgia is a remnant of an old South Atlantic land and the connexion of the Andes and Grahamland passed to the west of it. This view rests on the conclusions that South Georgia consists of three series of rocks, of which one is Lower Palaeozoic, the second Mesozoic, and the third includes igneous rocks of the Atlantic type, which are also found in the pre-Andean foundation of Argentina, while the typical Andean igneous rocks are unknown in South Georgia.

The new evidence is consistent with the latter theory. The only new fossil found is a piece of fossil wood; it is referred to that indefinite genus *Dadoxylon* (*Araucarioxylon*), by Prof. Gordon, who regards its age as more likely to be Mesozoic than Palaeozoic. This identification is consistent with the age assigned to the Upper and Middle parts of the Cumberland Bay Series. The claim that the whole of the sedimentary rocks belong to one Mesozoic series is not supported either by Mr. Douglas, who argues in favour of the separation of the two sedimentary series by an unconformity, or by Dr. Tyrrell, who points out the difference in composition between the older and newer sediments. The main change that seems not unlikely in Ferguson's classification is that the beds which yielded his older fossils may be more closely associated with the underlying Cape George Harbour series than with the Cumberland Bay series as now restricted by Dr. Tyrrell.

The structure and relations of South Georgia can only be settled by the collection of more fossils, which will establish horizons which are at present provisional. Fortunately, further fossils have been discovered by Dr. Holtedahl and are being investigated by Prof. Wilckens. It is to be hoped that these fossils will solve the South Georgia problem.

The contribution to the petrography of the St. Paul's Rocks, by Dr. H. S. Washington, has also an important bearing upon the history of the South Atlantic. He shows that the rock is a wehrlite-dunite, which has undergone change by pressure, and includes such characteristic metamorphic mineral species as jadeite and actinolite. Dr. Washington nevertheless hesitated before accepting the rock as non-volcanic because of its geographic position, and he considers the possibility of its being a submarine lava. He concludes, however (p. 134), that "the rock is almost undoubtedly metamorphosed or shows signs of pressure", also (p. 136) that jadeite "is generally regarded as being characteristically, if not exclusively, of metamorphic origin". He concludes, "if it were not known whence the specimens came, the microtexture, with the mineral and chemical composition, would lead unhesitatingly to the belief that the rock is a somewhat metamorphosed peridotite, and probably of plutonic origin"; and he considers that the St. Paul's Rocks are part of the Atlantic floor that has been upraised to the surface, and that the wehrlite block found by Daly at Ascension indicates that that island also stands on a continental basis. J. W. G.

Dietetics.

(1) *A Laboratory Handbook for Dietetics.* By Prof. Mary Swartz Rose. Third edition. Pp. xiv + 269. (New York: The Macmillan Co., 1929.) 12*s.* 6*d.* net.

(2) *Food Values in Practice: Simple Guidance in Diet Planning and Cookery.* By Ethel M. Dobbs. Pp. xvi + 240. (London: University of London Press, Ltd., 1929.) 4*s.* net.

(3) *Properties of Food: a Practical Text-Book for Teachers of Domestic Science.* By W. M. Clifford and Prof. W. H. Mottram. Pp. 128. (London: University of London Press, Ltd., 1929.). 2*s.* 6*d.*

(4) *Food, Health, Vitamins.* Being a new edition of "Food and Health". By Prof. R. H. A. Plimmer and Violet G Plimmer. New edition. Pp. viii + 120. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 3*s.*; paper, 2*s.*

THE importance of a proper diet for healthy living is now well realised by medical men and health workers, but is not always appreciated by the general population: even with such knowledge, the devising of a suitable dietary within the means of the more poorly paid members of the community is not always easy. Again, it is essential nowadays that all those responsible for feeding the inmates of institutions, hospitals, schools, etc., should arrange their diets on scientific principles. To supply dieticians and others interested with the requisite knowledge, numbers of manuals have been written, varying from the scientific treatise on nutrition to the primer suitable for the lay reader. Several such works have been published in recent years, covering a part of this possible range in depth of scientific knowledge, and four are now before us.

(1) Dr. Rose's handbook is intended for the dietician and provides the information necessary for the planning of dietaries for people of different ages and either sex. A brief account of the composition and uses of foods is followed by examples of the methods of calculating the food requirements and specimen dietaries. Height-weight-age tables are supplied, and, forming the bulk of the book, tables of the composition, including calorie value, of all the common foodstuffs.

(2) Dr. Dobbs's book covers part of the same ground, but in a more elementary manner: it is intended for the enlightened housewife and health worker rather than the dietician. Simple dietary calculations are included; methods of cooking are described in detail; nearly half the book is devoted to recipes for dishes suitable for the normal household, in fever and convalescence, in pregnancy, and for the constipated, the fat and the thin.

(3) Dr. Clifford and Prof. Mottram have written their little book for teachers of domestic science; simple chemical tests for the different foodstuffs are described, special attention being devoted to the demonstration of the properties of foods with only the minimum of chemical apparatus. Experiments are given to show how food is digested and what happens to it when it is cooked, and a chapter is devoted to the calculation of calorie and other values of food from tables. The chemical tests described show no little ingenuity and can be carried out by anyone possessed of only an elementary knowledge of chemistry.

(4) Prof. and Mrs. Plimmer's book has now reached its fourth edition; its outlook is different from that of those previously referred to, since the necessity for an adequate vitamin intake is especially emphasised. At the same time, the essentials of a complete dietary are fully described and two simple balanced diets at minimum cost are given: an extra chapter on diet in special cases has been added. The fact that four editions have appeared in five years indicates that this small work fulfils a real want; and opportunity is taken to bring the text up-to-date, since the subject dealt with is one in which our knowledge is advancing rapidly in many directions.

Experiments on Atomic Physics.

Electron Physics. By Dr. J. Barton Hoag. Pp. ix + 208. (London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

THIS book is an account of a laboratory course on modern physics which has been developed by the author and Prof. A. J. Dempster at the University of Chicago. The experiments to be performed are twenty-three in number, nine of which illustrate properties of radioactive bodies, and the remainder properties of electrons and ions, and some of their applications. With each group of experiments there is an up-to-date summary of the theory and standard results of that branch of the subject. There are three excellent appendices on vacuum technique, and two on the use of electrometers and electroscopes, a collection of problems, and some tables of atomic constants.

Most of the experiments described are familiar, but several will be new to many teaching laboratories, in particular the determination of the charge of an electron by the oil-drop method, the use of

the photoelectric cell, and two methods for finding the ratio of charge to mass for an electron by magnetic bending of cathode rays. The general standard is such that the book could also quite well have contained the measurement of e/m for an electron by the Zeeman effect, the use of an X-ray spectrometer, and the photography of trails of ionising particles with a Wilson cloud chamber.

In a sense, however, the actual contents are only of secondary importance. The publication of a book of this type is in itself effectively a statement that it is just as desirable, and possible, for students to carry out a connected set of experiments on the properties of atoms and electrons, as it is for them to do experiments in sound, or heat, or geometrical optics, or in any of the better established branches of physics. After all, to advance no other arguments, this newer work bears very closely on everyday life, and the equipment required to teach it is not in the end more elaborate than much in current use. The main difficulty comes in deciding what is to be thrown out to make room for it in a course necessarily limited to, say, three years.

On one important point the judgment of the author may be challenged. He states in his preface that "The book has been prepared for the student who has had one year of college physics or its equivalent". Experience in English laboratories suggests that work of this type might not be appreciated by a student in his second year, and that he would quite possibly fail to grasp the significance of what he was doing; in his final year, however, it would be of the utmost value. K. G. E.

History of Determinants.

Contributions to the History of Determinants, 1900–1920. By Sir Thomas Muir. Pp. xxiv + 408. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 30*s.* net.

IT is almost exactly half a century since a forty-page "List of Writings on Determinants", compiled by Thomas Muir, was published in the *Quarterly Journal of Mathematics*, marking the inception of an attempt to provide a complete history of determinants, up to 1900 if possible. How the attempt was crowned with success forty-two years later, by the publication of vol. 4 in 1923, is common knowledge. The work we now review goes beyond the original intention; when supplemented by several extraneous articles cited, in the *Proc. Roy. Soc. Edin.* and the *Trans. Roy. Soc. S. Africa*, it constitutes vol. 5 and brings the history up to yesterday.

In a characteristically unassuming preface Sir Thomas briefly alludes to the vicissitudes his self-imposed 'contract' underwent, and it needs but slight imagination to amplify his modest understatements and to conceive the real seriousness of the hindrances encountered: the absorption in administrative educational work in South Africa, the remoteness of European reference libraries, the perturbations of two wars. By 1915 the work had been brought only as far as vol. 2, and retirement at that date from the position of Superintendent-General of Education meant for the author, at seventy years of age, no tranquil retrospect but rather intensified activity. The achievement of the last fifteen years, with its fruit, vols. 3, 4, and 5, indicates a sustained vitality which evokes astonished admiration.

The present book is not so large as vol. 4, since eight chapters, each self-complete, are excluded and referred to separately, as we have mentioned. The sources quoted for these are, of course, readily accessible to all workers; and the restriction brings the book down to a convenient size for handling. The printing, on smooth white paper, is beautiful: and a scrutiny of hundreds of formulæ failed to disclose a single fault.

Concerning the arrangement, subjects, and style, little can be said which has not already been handsomely said by reviewers of earlier volumes. The various heads—determinants in general, axisymmetric, alternant, compound, and so on—fall une review in the self-contained chapters and sequence we now expect The style has Roman qualities of solidity, clarity, and conciseness, and the comments are as impartial and as illuminating as ever; a typical example is the summary (pp. 187-190) of a paper by Giambelli. The extent of the author's own personal contributions during the period may be gauged by the number of papers against his name in the index, 109, as compared with 108 in vol. 4.

A feature of outstanding value is the concluding 36-page subject-index of all five volumes. The inclusion of this cannot be too highly commended. With such wealth of reference as this provides, it is no longer, surely, a venial offence for writers to publish rediscoveries, as has so often happened before.

Nothing remains but to congratulate the distinguished author on these latest rewards of his long tenacity. The work is classic; if there exists anywhere a more detailed and comprehensive history of any branch of theoretical knowledge, one would be interested to hear of it. Yet one hesitates to use phrases like "the culmination of the work of a lifetime"; the energetic author is only eighty-six, and may yet bring it up to 1930! A. C. A.

Our Bookshelf.

The Scientific Achievements of Sir Humphry Davy. By Joshua C. Gregory. Pp. viii + 144. (London: Oxford University Press, 1930.) 6s. net.

It is always interesting to attempt to trace the origin of scientific work, and although the results are liable to error, they provide a key to much that otherwise would be obscure. In this book Mr. Gregory has tried to show how many of Davy's researches and speculations may have had some relation to the scientific knowledge of his day, and in this way the progress of Davy's work is seen to follow a course which makes it more intelligible to us at the present time. The book is more concerned with the scientific achievements than with the personal character of the great chemist, and although Mr. Gregory writes sympathetically, he has not raised some of the questions which have perhaps received too much attention in the past. Davy suffered by too much success on his own part and from too much sensitiveness on the part of others.

Apart from giving an excellent and clear account of Davy's researches, the book provides a useful picture of the state of chemistry in general at the beginning of the nineteenth century, when the theory of phlogiston still lingered in the minds of chemists even after they had been forced by experimental facts to abandon it as a working hypothesis. The new instrument of research, the voltaic pile, had just come into being, and in Davy's hands it opened a splendid chapter in the great story of chemistry. The relations between Davy and Dalton are discussed in an interesting manner, and the strange reluctance of Davy to use the hypothesis of atoms, a reluctance shared to the full by Faraday, is mentioned. At the same time, Davy was able to arrive at the correct formula for water, H_2O, whilst Dalton remained faithful to the simple HO which served chemists for so many years afterwards.

Mr. Gregory's book is one which can be recommended. It is not too long, but it contains a large amount of interesting materials. It is a pity that the appearance of the text has often been spoiled by the use of large capitals in the equations.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aero-Dynamik.* Teil 3: *Technische Anwendungen.* Herausgegeben von Ludwig Schiller. Bearbeitet von O. v. Eberhard, R. Emden, O. Flachsbart, W. Gaede, L. Hopf, F. Horn, W. Klemperer, W. Spannhake. Pp. x + 557. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 55 gold marks.

In this survey of the technique of hydro- and aero-dynamics, the editor has succeeded in attracting to his service a strong body of experts, who bring to it a long and intensive experience of their subject. The section on model ship tests is written by F. Horn, balloons by R. Emden, airship tests by W. Klemperer of the United States, experimental full scale flight by L. Hopf, turbines by W. Spannhake, air screws by O. Flachsbart, air pumps by W. Gaede, and ballistics by O. v. Eberhard, all well-known names in their respective fields.

The general plan that has been adopted in each section appears to be to give a critically connected non-mathematical account of the subject, with exceedingly useful and up-to-date details of experiments that have been conducted to test out the various crucial points. Diagrams indicate very clearly the lay-out of the experimental plant and the type of apparatus in use in the research institutions in different countries of the world.

As is to be expected from a work of this nature produced almost entirely by German writers, the sections deal very largely with the researches conducted in that country. It is a tribute, however, to workers in Great Britain that several of the sections enter very fully into the details of experiments conducted in British institutions, notably at the Royal Aircraft Establishment and at Teddington. The work is exceedingly rich in references. Incidentally, it is interesting to note the tendency in all countries for the centres of research activity to concentrate in the State-supported institutions.

The Subject Index to Periodicals, 1928. Issued by the Library Association. Pp. viii + 326. (London: The Library Association, 1930.) 70s. net.

We congratulate the Library Association on the publication of the "Subject Index to Periodicals" for the year 1928. The first volume of this valuable series was for the year 1915, so that these subject indexes now enter upon the sixteenth year of their existence. It has, however, not yet been found possible to issue the volumes for 1923, 1924, and 1925, although these volumes are in preparation.

The present volume, like its predecessors for 1926 and 1927, is arranged alphabetically by subjects, the headings being chosen from the alphabetical subject headings of the Library of Congress, with modifications and additions to suit British practice. When the titles of articles do not sufficiently indicate their contents, brief annotations are given. Under each heading the articles are arranged alphabetically by the author's name.

The subjects indexed cover a wide field, but magazine verse and fiction are not included.

The periodicals indexed are, for the most part, those published in the English language, but a certain number of journals in the French, German, Dutch, and Italian languages are included. The general editor, E. E. G. Tucker, has been ably assisted by the librarians of the chief public libraries in Great Britain.

Although the subjects indexed are by no means confined to science, yet science is so well represented among the headings that this subject index will be found to be a very useful work of reference in any scientific library. Important papers sometimes appear in periodicals where they stand a chance of being quite overlooked unless they are traced by reference to a "Subject Index to Periodicals".

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Anticipation of Wegener's Hypothesis.

THE question of the bodily displacement of continental masses on the earth's surface has been the subject of considerable discussion among geologists and geophysicists in recent years.

When first I heard this referred to as 'Wegener's Hypothesis', my memory went back to my schooldays and to a popular book on science which I then possessed entitled "The Playbook of Metals", by J. H. Pepper, the inventor of the optical illusion known as 'Pepper's Ghost'. The subject having recently come up again in the course of conversation, I took the opportunity of consulting the Library of the University of Cambridge, where I was fortunate enough to find a copy of this work, dated 1861. In it are to be found two diagrams, photographic reproductions of which were kindly made for me by Mr. W. H. Hayles, of the Cavendish Laboratory (Figs. 1 and 2). Pepper states that these diagrams are from a book entitled "La Création et ses mystères dévoilés", by A. Snider. It was necessary for me to go to the British Museum Library to find a copy of this latter work, the date of which I ascertained to be 1858.

It is interesting to compare these dates with those given by Prof. Wegener in his book, "Die Entstehung der Kontinente und Ozeane", where the following passage occurs (see p. 3):

"Die erste Idee der Kontinentalverschiebungen kam mir im Jahre 1910 bei der Betrachtung der Weltkarte unter dem unmittelbaren Eindruck von der Kongruenz der atlantischen Küsten, ich liess sie aber zunächst unbeachtet, weil ich sie für unwahrscheinlich hielt. Im Herbst 1911 wurde ich mit den mir bisher unbekannten paläontologischen Ergebnissen über die frühere Landverbindung zwischen Brasilien und Afrika durch ein Sammelreferat bekannt, das mir durch Zufall in die Hände fiel. Dies veranlasste mich, eine zunächst flüchtige Durchmusterung der für die Frage in Betracht kommenden Forschungsergebnisse auf geologischem und paläontologischem Gebiet vorzunehmen, wobei sich sogleich so wichtige Bestätigungen ergaben dass die Überzeugung von der grundsätzlichen Richtigkeit bei mir Wurzel schlug. Am 6. Januar 1912 trat ich zum erstenmal mit der Idee in einem Vortrag in der Geologischen Vereinigung in Frankfurt a. M. hervor, der betitelt war 'Die Herausbildung der Grossformen der Erdrinde (Kontinente und Ozeane) auf geophysikalischer Grundlage'. Diesem Vortrag folgte am 10. Januar ein zweiter über 'Horizontalverschiebungen der Kontinente' in der Ges. z. Beförd. d. gesamten Naturwiss. zu Marburg. Im gleichen Jahre 1912 folgten auch die beiden ersten Veröffentlichungen."

We thus see that the hypothesis of continental displacement had been put forward a full half-century before it first occurred to Prof. Wegener.

FIG. 1.—The earth before separation (Snider's diagram).

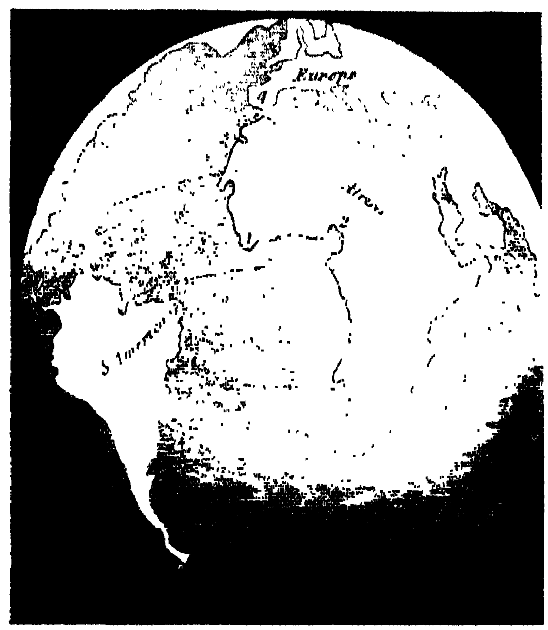


FIG. 2.—The earth after the separation (Snider's diagram).

On comparison of Snider's diagrams with those of Prof. Wegener, the essential similarity will at once be apparent; the main difference in detail being that Snider puts the junction of Australia with Africa somewhat farther north than does Prof. Wegener.

From the fact that it should have been mentioned in a popular book on science like Pepper's "Playbook of Metals", one would infer that the hypothesis must have been well known about this period, and it is highly probable that the pros and cons of it were pretty well discussed by scientific men.

I freely admit, from what I have seen of Snider's book, that I do not think it would be treated very seriously as a whole by men of science nowadays; but I need scarcely point out that a question of fact is quite distinct from any explanation thereof which may be put forward, and it seems quite clear that the hypothesis of continental displacement (be it true or false) dates at least so far back as 1858, if, indeed, it may not be possible to trace it still further. As regards evidence in favour, or otherwise, of the hypothesis (by whatever name it be called), we must still, of course, turn to the work of Prof. Wegener and other writers who have studied the subject in its various aspects.

ALFRED A. ROBB.

Cambridge, Oct. 24.

Polarisation of Electrons.

DR. RUPP[1] finds that if electrons of 80 kilovolts energy are reflected in succession from two gold surfaces at an angle of about one-third of a degree, there is a twelve per cent. difference in the intensity of the twice reflected beam according as the two deviations are in the same or opposite directions. I have attempted to repeat this result for electrons scattered in succession through two thin gold films. The films were thin enough to give good ring patterns and the method is to measure photometrically the diffraction pattern formed by the twice scattered beam. The result is negative. Eight plates were taken, each with two exposures; the mean difference between the two sides for seven of these plates was 1 per cent. Of the individual pairs of readings, half differed by less than 5 per cent on the two sides, which corresponds to about 2 per cent probable error on the mean of the seven plates. The eighth plate gave a mean effect of 20 per cent. in the reverse direction to that found by Rupp. I am unable to account for this plate, and as I have left Aberdeen, where the experimental work was done, I cannot attempt to repeat it. It is possibly due to uneven development.

In some cases the rays selected for the second scattering formed part of one of the diffraction rings formed by the scattering in the first film. In other cases they came from the part of this pattern between the rings. Since the regularly diffracted electrons are always in a minority, the polarisation might be greater than suggested by the above figures if it were limited to these electrons, but there is no sign of such an effect. The angles of scattering were of the order of 2°; the mean energy of the electrons was 65 kilovolts. The experiment is in agreement with the view that the detection of polarisation by such means is only possible with large angles of scattering. Since making the experiment I have seen a paper by Kirchner,[2] in which he mentions that he has satisfied himself that the effect, if any, is less than 10 per cent.

G. P. THOMSON.

Imperial College of Science,
London, S.W.7, Nov. 29.

[1] *Zeit. fur Phys.*, **61**, p. 158.
[2] *Phys. Zeit.*, **31**, p. 772.

Heredity and Predestination.

SOME of us are wont to ascribe a super-papal infallibility to the editorial notes in NATURE, and it is, therefore, with much diffidence that I suggest a certain misunderstanding in the issue of Nov. 15, p. 781, as to my Lloyd Roberts Lecture. The place of moral values in modern arguments for theism is so fundamental that possibly space can be found for a few sentences which may stimulate biological experts to consider afresh the relation of evil to the evolutionary process.

Mutations, I stated, appear to be the raw material of evolution: and they seem to be devoid of any ethical character whatever. Changes in the genes—call them simply inheritance factors if their localisation in the chromosomes is doubted—are as near as we can at present get to creative activity: but in such changes we can discover no moral quality. Good and evil, as judged by our standards, are equally likely to arise in the variations associated with heredity.

The note in NATURE says that the 'evil and good' of my argument "are simply adjustment or maladjustment to environment". I would that it were so, for then the theologian's difficulties would be at an end. All that is good would flourish because adapted to its environment. The evil would disappear under the operation of natural selection. We could then, indeed, affirm with Pippa, "God's in His heaven: all's right with the world". Huxley's war between man and the cosmic process would be unnecessary.

Unfortunately, however, the loathsome parasite is a result of the integration of mutations: it is both an exquisite example of adaptation to environment and ethically revolting. Civilised nations, as I emphasised, have of late been creating an environment to which the mental deficient can happily adapt himself: humane principles and social degeneration are thus conjoined. None the less—and here is the puzzle over which I ask biologists to ponder—out of the evolutionary process has come the progress which has led to man with his spiritual consciousness and moral loyalties. I reached the perplexing conclusion that, if we accept the moral argument for ethical theism, we must find Divine activity, albeit elusively, in the environment and not in the genetic changes through which apparently the creative process works. But, as I told my Manchester hearers, I was thinking aloud. My conclusion cannot claim the merit (or demerit) of orthodoxy; and I am willing to be converted to any other explanation for which better arguments can be adduced.

May I add, though it is a subsidiary matter, that I do not personally accept the notion that mutations "are causeless in the sense of being entirely fortuitous". It is part of my faith that the universe is rational for man. Belief in the possibility of successful scientific investigation rests upon such a faith. That faith has its difficulties: as we know, there are those who hold that science will always be limited to regions upon which man can impose his own sense of order. But, if the larger faith be true, the progress of research should in due course give us the 'causes' of mutations or, more accurately, sequences of which they are the end terms. But such sequences, as Hume pointed out long ago, will not lead us to efficient causation. For that we need some metaphysical postulate.

E. W. BIRMINGHAM.

Bishop's Croft, Birmingham,
Nov. 15.

THE letter of Dr. Barnes raises two difficulties in our mind. 'Good' and 'evil', as applied to the organisms which in his lecture he grouped as "animals and insects", and on which he relies for his genetic data, can only mean relative adjustment or mal-adjustment to environment, for the biological end of a creature is to multiply its kind. A parasite is biologically evil because it has renounced the power of initiative, replacing it by dependence upon the success of its host, and because the more successful the parasite is, the more precarious its existence as a species becomes. The 'good and evil' of humanity, in so far as they are conventions sanctioned by custom or law, are acquired characters and have nothing to do, if Dr. Barnes is right about the non-heritability of acquired characters, with inheritance factors, but biologically conventions may be good or evil, as they encourage or discourage the best continuance of the race.

Feeble-mindedness is a mal-adjustment which in Nature would meet its own fate, and the morality which protects and encourages feeble-mindedness is also a mal-adjustment which also will meet its fate.

The second difficulty is Dr. Barnes's firm belief in the 'non-morality' or fortuitousness of mutations. It is an uncertain hypothesis, unacceptable to many biologists, yet on it the argument of the Lloyd Roberts Lecture was based. Our notion is that environment may be more than a mere eliminator, but any further power it may exercise must depend upon the response of the organism. THE WRITER OF THE NOTE.

Agricultural Field Experiments.

IN the article with the above title which appears in NATURE of Oct. 25, p. 667, it is stated:

"Beaven's half drill strip method is described, but without pointing out its two serious but remediable defects: that the continued use of one half of the drill for one variety, and of the other half for the variety with which it is to be compared, may introduce a constant difference the magnitude of which cannot be estimated; and that the regular alternation of strips of the two varieties does not permit of a valid estimate of experimental error."

I submit that these defects are more theoretical than practical, and that any modification of practice in the application of the method, such as changing over seed boxes, would be a retrograde step.

To take the first, there are three possible ways in which one half of a drill may differ from the other:

(1) It may cover a wider breadth of ground; this would doubtless have an appreciable effect, but it would be detected and allowed for by the routine measurements taken across the stubble.

(2) The coulters may be less evenly spaced than those of the other, and

(3) Less seed may be drilled from it than from the other.

Now, cereal crops are wonderfully independent of the amount of seed sown. I have in mind two chess-board experiments, in one of which half the area was sown with seed 1 in. apart instead of the usual 2 in., and in the other, the rows in half the experiment were 3 in. apart instead of 6 in. In each case the heavier seeding only resulted in a gain of about 3 per cent, and it is not to be expected that such slight irregularities as occur between the two halves of a drill would have any measurable effect.

The second defect, owing to the peculiar shape of the half-drill strip, would only exist if the experiment were to be sited so that some periodic variation existed across the breadth of the drills: otherwise randomness is supplied by the soil. By taking care that the experiment is drilled across ploughman's 'lands', if they exist, and by bearing in mind the history of the last few crops, this danger can be avoided.

The pairs of strips fall naturally into two sets according as one or other variety is on the right hand, and in an analysis of the variance of the difference between varieties, one degree of freedom is taken up by these two sets. The estimate of the experimental error arrived at in this way is perfectly valid, provided the above precautions have been taken in siting the experiment.

It would be a pity to interfere unnecessarily with the simplicity of this very efficient method of conducting field trials.

STUDENT.

I FEEL that 'Student' under-estimates the importance of differences in the two halves of a seed-drill. I have repeatedly found significant differences between adjacent rows in respect of such characters as plant-height, number of tillers per unit length of row, and, finally, yield per unit length of row. This is sufficiently marked to make it definitely an advantage, for precise observations, to divide the observational unit of a metre-length of row into two half-metres, end to end but on adjoining rows. I suspect that depth of sowing (a factor which 'Student' does not mention) and amount per unit length play the important part in determining this individuality of the row. The results of a small-plot experiment which I examined recently showed that the yield of wheat per unit area was unaffected by changes in spacing, but was considerably lessened by increased depth of sowing, as also by decreased amount of seed per unit length of row. The number of rows in a 'half-drill strip' is small, so that a considerable difference may result from these causes, even with random distribution amongst the coulters of depth and amount of delivery. There is likely, however, to be a steady gradation in depth of delivery as one passes from one side of the drill to the other, and this would more certainly constitute a 'serious defect' in the half drill strip method.

'Student' is satisfied with the validity of the estimate of error, provided care is taken to drill across ploughman's 'lands'. There was an interesting series of uniformity trials carried out at the Danish station at Aaslev, in which an apparently uniform field revealed a periodicity in yield, of half-wave-length almost coincident with the width of the plots. Had this been a varietal trial, and had the half-drill strip method been used, the experimenters might have been sadly misled!

The method loses only slightly in simplicity and gains considerably in value if modified in one of the following two ways, as R. A. Fisher has pointed out. If there is any possibility of a steady fertility gradient at right angles to the length of the strips, the arrangement should be a set of 'sandwiches', but it should be decided at random for each whether variety *A* or variety *B* should occupy the two middle strips: if it is certain that no such gradient exists, then the more satisfactory arrangement is to take *pairs* of strips, deciding, again at random, whether *A* shall be on the left-hand or the right hand strip. The former arrangement gives as many degrees of freedom as there are sandwiches; and, for the same number of strips, the latter gives twice as many degrees of freedom. The strips should all be drilled with the same half-drill.

THE WRITER OF THE ARTICLE.

Relationship of the Oat Smuts.

TWO species of smuts—*Ustilago avenæ* and *U. levis*—occur commonly on cultivated oats. They differ from one another in the character of their spores and in the appearance of the spore masses produced on their host plants. The spores of *U. avenæ* are minutely echinulate; those of *U. levis* smooth. *U. avenæ* usually destroys the florets of the host plant, giving them a blackish, powdery appearance; *U. levis* causes less injury to the inflorescence and at maturity its spores may be entirely concealed by the glumes.

During the past year we have been investigating experimentally the relationship between the two species. Spores of the loose and covered smuts have been germinated singly in hanging drops, and their sporidia removed one by one and cultured separately on artificial media.

Young oat seedlings were inoculated with the following cultures or combinations of cultures: (1) Monosporidial cultures of *U. avenæ* used singly and in pairs. (2) Monosporidial cultures of *U. levis* used singly and in pairs. (3) Pairs of cultures, each one made by mixing together a monosporidial culture of *U. avenæ* with one of *U. levis*.

The seedlings were grown to maturity in the greenhouse, and observations were made as to the appearance of the smutted heads and the kind of spores borne in them. The results of the inoculations are of considerable interest and may be summarised briefly as follows:

(1) Plants inoculated with a single monosporidial culture of *U. avenæ* or *U. levis* did not produce smutted heads.

(2) Plants inoculated with two monosporidial cultures of opposite sex produced smutted heads. If the two cultures were of *U. avenæ* the infected

heads were 'loose' in appearance and their spores echinulate; if of *U. levis* the heads were 'covered' in appearance and their spores smooth; if one of the cultures was of *U. avenae* and the other of *U. levis* the infected heads were somewhat variable in appearance, but upon close examination they proved to be of the 'loose' type, and their spores were echinulate.

(3) The sporidia of *U. avenae*, like those of *U. levis*, are of two kinds, (+) and (−); the sporidia of one species mate without difficulty with sexually opposite sporidia of the other species.

These results indicate that *U. avenae* and *U. levis* are genetically distinct with respect to the characters by which they are differentiated, but the ease with which crosses can be made between them suggests that they are closely related species.

A full report of the investigation is being prepared for publication.

W. F. HANNA.
W. POPP.

Dominion Rust Research Laboratory,
Winnipeg, Canada, Oct. 21.

Synthesis of a Methoxyketose.

A 5-METHOXYKETOSE has been prepared by the condensation of dioxyacetone, $CH_2OH.CO.CH_2OH$, and α-methoxyglyceric aldehyde, $CH_2OH.CH(OCH_3).CHO$. The method of synthesis is proof of the position of the methoxyl group and such a structure cannot form a furan ring.

Pure dioxyacetone was obtained from nitromethane by the method of Henry and Piloty. Neither α-methoxyglyceric aldehyde nor its acetal had been prepared but the latter was obtained by methylating α-chlor-β-oxypropiondiethylacetal with sodium methylate, α-chlor-β-oxypropionacetal being formed from acrolein through the intermediary of β-chlorpropionacetal and acroleinacetal by a modification of the methods described by Wohl and Witzemann. The required acetal was obtained as a colourless liquid distilling at 100°-102° C./6mm. This was readily hydrolysed by dilute mineral acids and the aldehyde produced was converted into the bromphenylhydrazone derivative and into the condensation product with phloroglucinol. The preparation of these derivatives and the analysis of the acetal proved the identity of the aldehyde.

The conditions used by Fischer in his synthesis of α-acrose were modified to suit the condensation of dioxyacetone and α-methoxyglyceric aldehyde and the optimum results were obtained by allowing a 5 per cent aqueous solution containing 0·25 per cent of barium hydroxide to stand at room temperature for a period of three weeks.

Dioxyacetone is in equilibrium in aqueous solution with glyceric aldehyde, and hence, theoretically, it should be possible to obtain as a result of this condensation four inactive 5-monomethoxyketoses, the corresponding eight inactive 5-monomethoxyaldoses, and the twelve racemic forms of the non-methylated hexoses. The number of possible osazones is only eight and it was not considered likely that the non-methylated osazones would be formed in any quantity. Further, from analogy with the work of Fischer and Schmidt it was expected that the bulk of the product would consist of a single racemic form. These expectations were realised, but it may be noted that for the purpose in hand the actual identity of the substance produced was immaterial, the aim being to synthesise a ketose which could not possess a furan structure.

Treatment of the reaction mixture with phenylhydrazine under the usual conditions gave an impure, crystalline substance and a tarry mass. The former proved to be acetylphenylhydrazine, whilst from the latter a mixture of osazones was isolated with considerable difficulty. Repeated fractional crystallisations from ethyl acetate gave two main fractions of osazones, a larger fraction melting at 183° C. and a smaller fraction melting at 130° C. These gave analytical figures corresponding to a pure monomethoxyhexosazone. From analogy with the work of Fischer on α-acrose and on a consideration of the melting points of the known methylated and non-methylated osazones the former product was considered to be inactive 5-monomethoxyfructosazone and the latter inactive 5-monomethoxysorbosazone.

The monomethoxyhexosazone (m.p. 183°), of which 35 grams were obtained (from 5600 grams of acrolein), was converted through the osone into the corresponding monomethoxyketose by a modification of Fischer's method. Five grams of a crystalline material melting at 80°-85° C. were obtained which gave analytical figures corresponding to a pure monomethoxyhexose. Treatment at room temperature with methyl alcohol containing 1 per cent HCl showed that fructoside formation was complete only after 48 hours. This was evidence in favour of a sugar which cannot exist in the γ-form since the formation of γ-methylfructoside is complete after one hour. The monomethoxymethylhexoside was methylated by treatment with methyl sulphate followed by two successive methylations with Purdie's reagents. Towards alkaline permanganate this tetramethoxymethylhexoside behaved as a normal sugar derivative and the rate of hydrolysis also corresponded to that of normal tetramethoxymethylfructoside. Hydrolysis of the synthesised hexoside was complete on refluxing with 3 per cent aqueous HCl for three hours and the product was isolated as a syrup in the usual way. From this syrup tabular crystals were obtained by extraction with light petroleum which, after repeated crystallisations, melted at 95°-96° C. There was no depression of melting point on mixing with an authentic specimen of normal tetramethoxyfructose.

Nitric acid oxidation gave a trimethyl lactol acid which on further oxidation with alkaline permanganate yielded a trimethylarabonolactone. The curve of apparent specific conductivity plotted against time obtained by observations during the hydrolysis of the lactone derived from the synthesised tetramethoxyhexose was almost identical with the curve given under similar conditions by the lactone derived from normal tetramethoxyfructose but was sharply differentiated from that given by the lactone corresponding to tetramethoxy-γ-fructose.

From these experiments it is shown that the synthesised 5-methoxyhexose and its derivatives have exactly similar properties to those of the methylated derivatives of normal fructose, and that the synthesised hexose was in fact the racemic form of 5-monomethoxyfructose. Since the methoxyhexose produced by condensation could not possess a 5-atom ring, and of the other possible ring structures the pyranose is considered to be the most likely, this evidence, obtained from a field hitherto unexploited, proves conclusively that normal fructose and its derivatives cannot possess a furanose structure and lends support to the accepted pyranose constitution.

A parallel experiment is in progress with the object of synthesising a 6-methoxyhexose.

ERIC FRANK HERSANT.
WILFRED H. LINNELL.

Chemical Research Laboratories,
School of Pharmacy of the
Pharmaceutical Society of Great Britain,
University of London,
17 Bloomsbury Square, London, W.C.1,
Nov. 4.

Double Refracting Structure of 'Corex' Glass.

SOME years ago I found that silica glass showed a doubly refracting structure (*Proc. Roy. Soc.*, A, vol. 98, p. 284; 1920. Also *Proc. Optical Convention*, Part 1, p. 41; 1926). This structure is quite distinct from any due to bad annealing, and seems kindred to the 'liquid crystals' of Lehmann. Nothing of the kind could be found in the ordinary glasses consisting of silica with metallic oxides.

I now find that the ultra-violet transmitting 'Corex' glass of the Corning Co. shows a similar structure. This glass is said to consist in the main of calcium phosphate, though I have not seen an analysis. The subject evidently requires detailed examination, which I hope to make as opportunity allows.

RAYLEIGH.

Terling Place, Chelmsford,
Nov. 14.

Energy Levels of Atoms in an Electric Field.

ISHIDA has recently given clear experimental evidence that Stark levels with equal m values do not intersect (*Sci. Pap., I.P.C.R.*, Tokyo, No. 260; 1930). With increasing field, the levels approach to a limiting separation and then recede. This feature of the investigation was limited to levels with equal m but different n values.

I now notice on a plate which has been published (Neon; Foster and Rowles, *Proc. Roy. Soc.*, vol. 123, 80; 1929) a good illustration of this point for the case where the levels have the same principal quantum number. The diffuse line $2p_9 - 7d'_4$ approaches the sharp line $2p_9 - 7s_5$ as the electric field increases (Fig. 1). When the separation (25 cm.$^{-1}$) is but a

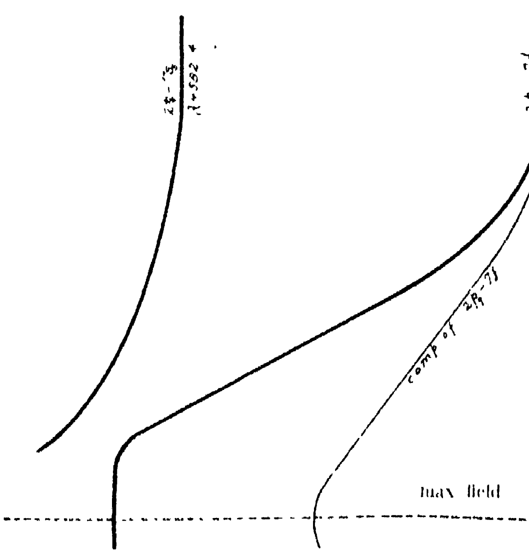


FIG. 1.

raction of the almost constant separation observed or the other components with (initial) $m_i = 0$, it turns bruptly and retains constant displacement up to maximum external field.

In the paper referred to, Ishida reproduces some remarkably fine plates which give strong support to the theory of the Stark effect in helium (Foster, *Proc. Roy. Soc.*, vol. 117, p. 137; 1927). On two points, however, his interpretations lead him to very striking conclusions at variance with the theory and with earlier experiments (Foster, *Proc. Roy. Soc.*, vol. 114, p. 47; 1927). I should like to suggest views which (if correct) will place the new results in harmony with previous work.

The conclusions reached by Ishida are (1) that the selection rule $\Delta m = 0, \pm 1$ is broken, and (2) that hitherto unknown series lines have been discovered in the helium spectrum. The selection rule is apparently broken by the appearance of a few weak π components having the same wave-length as corresponding members of the strongest group of σ components ($m = 2$ in initial state). This is not an effect due to the larger fields he employs, since in his photographs it persists in moderate fields. On any one plate it is found only where the corresponding σ component has extraordinary strength, yet it fails to appear on the plate showing the intense yellow line λ5876. This irregularity attracts one to the possible view that an imperfect adjustment of the double-image prism with reference to the axis of the Lo Surdo tube may account for all that has been observed, and allow the selection rule to apply here as elsewhere. But even with this adjustment correctly made, this phenomenon has been observed, and attributed to an occasional confusion of the fields in a Lo Surdo source (Foster, *Astrophys. Jour.*, vol. 62, p. 235; 1925).

The second point is concerned with π components which vanish or become very weak as they pass under the zero field position of the $P - P$ combination line (or $S - S$ or $p - p$ or $s - s$, as the case may be) of the group to which they belong. This phenomenon has been observed in many experiments (Foster, *Phys. Rev.*, vol. 23, p. 667; 1924; *Jour. Frank. Inst.*, vol. 209, p. 585; 1930). Nevertheless, Ishida regards the lines as entirely new at the point of reappearance. One can understand that the sloping lines are cut off vertically, and doubtless appear to point to zero field positions near those of the $P - P$ lines. But as Ishida observes, there are no terms in the well-known normal helium spectrum which can account for such origins. It is doubly difficult, therefore, to deny the theory which on this point has already received adequate experimental support.

J. S. FOSTER.

McGill University, Montreal,
Oct. 15.

Determination of the Abundance Ratios of Isotopes from Band Spectra.

I RECENTLY reported an intensity anomaly in the isotopic bands of boron monoxide (NATURE, Aug. 9, p. 203), which showed that the intensity ratio of isotopic bands does not always give directly the relative abundance of the isotopes. The following is an account of the determination of the correction to be made in order to obtain the relative abundance from the intensity ratio, and is an abstract from a dissertation presented to the University of Utrecht.

The intensities of the heads of all the bands of the $B^{11}O$ β-system which appear on plates with exposures of four hours have been measured; variations of plate sensitivity were corrected for by comparison with a lamp the spectral energy distribution of which was known. The intensity of each band was then divided by ν^4, ν being the frequency of the band in question, in order to obtain the square of the amplitude of the virtual oscillators, since it is the latter quantity which is additive. By adding up the values of I/ν^4 for all the bands having a common v', a figure was obtained which gave a measure of the number of $B^{11}O$ molecules in the v' state. This was done for the different v'' progressions, and so the number of molecules in the different v' states was determined. The graph (Fig. 1) shows $f(E'_v)$, the number of $B^{11}O$ molecules in these states, plotted as a function of the vibrational energy E'_v.

If it be now assumed that the same function holds for $B^{10}O$, then the ordinates drawn through the energy values of the vibrational states of $B^{10}O$ will give the number of those molecules in the various v' states;

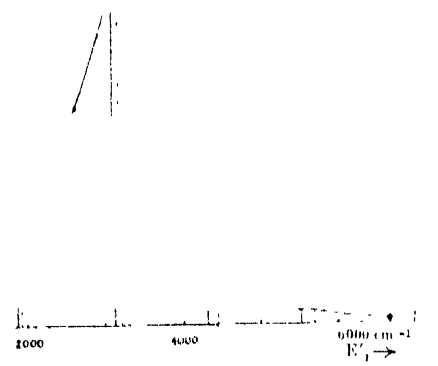


FIG. 1.

these states are shown by the dotted lines. It is evident that the isotope intensity ratio for bands from the v' 3 state will be considerably higher than that for the bands from lower v' states. The table

Band.		1-4	1-5.	2-5.	2-6.	3-7.
Intensity ratio of isotopic bands . *a*	..	..	..	3·34	3·50	..
	..	..	..	3 22	3·17	4 30
	.	..	.	3·49	3·45	4·38
a = from lines	..	3·49	3·41	3·42	3·49	4·05
b = from heads *b*	3·56	3·20	3·53	..	..	..
Average	3·56	3·35	3·47	3 37	3·40	4·24
Corrected for plate sensitivity . .	3·63	3·44	3 56	3·48	3·50	4·37
$f(E'_v)/f(E'_1)$.	1	0 985	0·985	0·95	0·95	1·21
Isotope ratio .	3·63	3·50	3·61	3·66	3·68	3·61

Mean Isotope Ratio = 3·63 ± 0 02.
Corresponding Atomic Weight (correcting for O^{17} and O^{18}) = 10 791.

shows the corrections $f(E'_v)/f(E'_1)$ obtained from this curve by which the measured intensity ratios must be divided in order to obtain the real relative abundance of the isotopes. More complete data (which refer to Chilian boron) are given than were contained in the previous communication, and a correction for change in plate sensitivity with wave-length has been made. The very good agreement of the corrected isotope abundances determined from different bands may be pointed out.

In a recent letter (NATURE, Oct. 25, p. 649), Stenvinkel has given an explanation of the high ratio for the 3-7 band, based on the supposition that Boltzmann distribution holds for the lower electronic level, and that the v' 3 level is fed chiefly by molecules from the $v''=1$ level, according to the Franck-Condon principle. It may be pointed out, however, that the number of molecules in the $v''=1$ state, calculated from the Boltzmann law at a temperature of 470° A. (found from intensity measurements on the rotation lines of BO), is 1/370 that of the number in the v'' 0 state. It is therefore difficult to imagine that the $v''=1$ level plays any important part in determining the distribution in the upper electronic state. Further, the assumption that the Franck-Condon principle applies to transitions caused by active nitrogen is open to question. A. ELLIOTT.

Physical Laboratory,
University of Utrecht,
Oct. 30.

The Red Coronal Line in Oxygen.

IN looking over my spectrum plates of oxygen I find some which show not only the nebular lines λ6300 and λ6364,[1] which had not been produced in the laboratory before, but also a strong line λ6374·29. The wave-length of this line seems to be identical with that of the strong, red coronal line λ6374·2.[2] Although this oxygen line is well known, I do not think that the above remarkable coincidence has been previously pointed out. This coincidence in the wavelengths of the oxygen and the coronal line, and also the fact that the line occurs in an isolated position in the oxygen spectrum when only lines of O I were present, would seem to indicate their identity, and is strong evidence of the presence of oxygen in the sun's corona.

This oxygen coronal line is still unclassified and its Zeeman pattern has not been observed. Possibly it represents a forbidden transition between terms still unknown. Such a study would be very interesting in throwing light on the spectroscopic nature of its end-terms and in helping to explain the nature of the solar corona. JOHN J. HOPFIELD.

University of California,
Berkeley, California,
Oct. 30.

[1] Paschen, *Die Natu[illegible]enschaften*, **34**, 752; 1930.
[2] Campbell and Mo[illegible], Publications of the Lick Observatory, *Bulletin* 318, 8; 1918.

The Compound SnSb.

DURING an investigation of the crystal structure o[f] the Sn-Sb alloys, the compound SnSb has been found to give an excellent X-ray powder photograph of the well known pattern common to sodium chloride structures. The atomic numbers of tin and antimony are 50 and 5[1] respectively, and as in potassium chloride having atomic numbers 19 and 17 respectively—odd order reflections from the 111 planes are absent. The results obtained from measurements on the film are given in the accompanying table. Observed and calculated values of the plane spacings are in very good agreement. The observed intensities of the lines on the film are also in agreement with calculated intensities.

DATA FROM POWDER PHOTOGRAPH OF SNSB.

Plane	Observed Intensity.	Calculated Intensity	Observed d/n.	Calculated d/n.
100 (2)	Strong	10	3·045 A.	3·046 A.
110 (2)	Strong	8·9	2·154	2 154
111 (2)	Medium	3·7	1·759	1·759
100 (4)	Weak	2·0	1·525	1·523
120 (2)	Medium	6·0	1·362	1·362
121 (2)	Medium	5·0	1·243	1·244
110 (4)	Very weak	1·7	1·076	1·077
100 (6) 122 (2)	Medium	3·8	1·016	1·015
103 (2)	Medium	2·7	0·964	0·963
113 (2)	Medium	2·4	0·918	0·918
111 (4)	Very weak	1·7	0·878	0·879
203 (2)	Very weak	2·0	0·845	0·845

Structure: NaCl Type.
Dimensions of Unit Cell: $a_0 = 6·092$ A.

The density of the compound is 6·94 gm./c.c.

giving four molecules of SnSb per unit cell as required by a sodium chloride lattice.

The arrangement of atoms into a sodium chloride type lattice would indicate that the compound is ionic in character. This requires the tin to be trivalent. From formulæ given by Pauling (*J. Amer. Chem. Soc.*, **49**, p. 765; 1927) the calculated ionic radii for Sn^{+3} and Sb^{-3} are respectively 0·75 and 2·45 A., which when built up into a sodium chloride structure, gives a lattice constant 6·40 A., in poor agreement with the observed value. However, the atomic radii for tin and antimony for co-ordination number 8 are 1·53 and 1·56 respectively (Goldschmidt; *Trans. Faraday Soc.*, **25**, p. 253; 1929), and for co-ordination number 6, these are reduced to 1·484 and 1·513 A. Such radii would give a lattice constant of 5·99, in good agreement with the experimental value 6·092 A.

The structure of SnSb is found to persist over the range 46 to 60 per cent tin with some change of lattice constant, showing that both tin and antimony are soluble in it. This agrees with the equilibrium diagram given by Broniewski and Sliwowski (*Comptes rendus*, **186**, p. 1615; 1928), although they thought a compound Sn_3Sb_2 existed at the end of this range—at 60 per cent tin. Our X-ray analysis, however, shows that the compound is definitely SnSb with a range of solid solution on either side. The solution of tin and antimony by the compound can be readily understood, since both metals have acidic and basic properties. In addition, their atomic numbers and atomic dimensions are practically the same, so that one atom of tin could be replaced by one of antimony, and vice versa. The solution of antimony up to 4 per cent causes a change of lattice constant from 6·092 to 6·106 A. Before annealing, the solution of 10 per cent tin causes a definite expansion to 6·124 A., but after annealing there is no measurable change.

A microphotograph due to Dr. J. E. Stead (*J. Inst. Metals*, **22**, p. 127; 1919) shows excellent cubic crystals of SnSb. Many of them were observed to be perfect cubes, having angles of 90° at each corner. The crystals have also been observed as the hard constituent of tin base bearing metals.

A full account of the investigation of the crystal structures of the complete system is to appear elsewhere.

W. MORRIS JONES.
E. G. BOWEN.

Physics Department,
University College,
Swansea, Nov. 5.

Cause of High Winds of Oct. 19-20, 1917.

THE remark on p. 633 of NATURE of Oct. 18 (Historic Natural Events. Oct. 19, 1920) that, "Owing to the unexpected development of a barometric depression . . . a very strong cold north-east wind sprang up at some height above the ground", does not state the facts correctly and gives a misleading impression of the cause of the high winds at an altitude of 10,000-20,000 ft. on the occasion in question.

The winds at those heights over south-east England and northern France on Oct. 19-20, 1917, were northerly and not north-easterly. These winds occurred over a region where the horizontal gradient of pressure was insignificant at sea-level. This insignificant gradient, however, became a steep west to east gradient at great heights owing to the fact that there was a steep horizontal gradient of temperature in the upper air also from west to east. The strong northerly wind was simply a thermal wind. Generally, the actual wind is compounded of the thermal wind and the wind arising from the horizontal gradient of pressure at sea-level. On this occasion, as the latter was practically nil, the actual wind was practically coincident with the thermal wind.

A reasonably complete account of the conditions at the time is given in Vol. 4 of Shaw's "Manual of Meteorology", p. 112, along with the explanation of the phenomenon. I find on looking up my records that I gave the facts and the explanation to the General Staff at G.H.Q., France, on Oct. 23, 1917.

E. GOLD.

8 Hurst Close, London, N.W.11,
Oct. 24.

COL. GOLD is no doubt fundamentally correct as to the cause of the high winds of Oct. 19-20, 1917. My version agrees with that in McAdie's book, "Man and Weather", p. 12, which runs: "But a depression developed in the Atlantic, west of the British Isles, and the light variable winds, characteristic of settled fair weather, were routed quickly by cold north or north-east winds of 20 metres or more per second. The airships from midnight until 7 A.M. were carried south and somewhat east, at a speed of fifty miles an hour." A closer examination of the facts, however, shows that this view of the mechanism is too superficial. THE WRITER OF THE NOTE.

Scientific Inexactitude.

IN NATURE of Nov. 8, p. 725, Mr. Darling criticises a certain sentence in a recent book on "Sound". The sentence in question, "A clamped steel bar electrically maintained is sometimes employed as a rough standard of frequency", is described as 'unfortunate' and 'incorrect', and is given as an example of a tendency towards scientific slang.

Mr. Darling is, in effect, suggesting that all statements must be *explicit* in every detail, nothing must be implied. The sentence to which he refers is taken from a section entitled "Transverse vibrations of elastic bars" and from a sub-section commencing (24 lines away) "Electromagnetic methods of maintenance of the vibrations". One might reasonably expect, therefore, that even "a reader not conversant with the subject" would understand that the words "in vibration" are implied after the word "maintained" in the sentence quoted. I consider his alternatives "operated" or "driven" no better than the word actually used.

If all statements were explicit and nothing implied, a scientific book, or any other class of book, would make very dull reading. Mr. Darling's method applied to such well-known expressions as 'an oscillating circuit', 'a reversing switch', 'a projector screen', and so on, would lead to extremely laboured and amusing English. Abbreviation is essential to progress, provided that it is not carried beyond the intellectual limits of the reader, and I consider that the abbreviation in the sentence Mr. Darling quotes is entirely justified.

Applying his views to the opening sentence of his letter, what does Mr. Darling mean exactly when he says "a reader . . . may be completely fogged"? Presumably he does not really mean the *reader* is fogged any more than the sentence quoted means that the *tuning fork* is maintained? Again, what is an "unfortunate sentence"? The English language is based on such 'slang'.

A. B. WOOD.

"Beaumont", Hampton Hill,
Nov. 13.

The Lochaber Hydro-Electric Power Undertaking.

By Dr. Brysson Cunningham.

The remarkable engineering enterprise known as the Lochaber Hydro-Electric Power Undertaking, the first and main portion of which was brought to a successful completion early in the present year, embodies a number of novel and interesting features which justify a more extended notice than could be given in the brief paragraph in Nature of Aug. 9, p. 213, describing the visit of H.R.H. the Duke of York to the works of the Lochaber Water Power Company. The scheme, which is one of the most remarkable of its kind and certainly unique in importance in Great Britain, was promoted by the British Aluminium Co., Ltd., under the direction of Mr. Murray Morrison, director and general manager, who, with the late Mr. C. S. Meik, realised the latent possibilities of water power contained in Loch Treig and Loch Laggan, and devised a plan for their exploitation for the production of aluminium in a factory at Fort William. The work has been executed to the designs and under the supervision of Messrs. Meik and Halcrow, civil engineers, of Westminster.

Lochs Laggan and Treig are two natural storage basins in the Lochaber district of Inverness-shire, with surface levels some 800 feet above the sea. The former is about seven miles in length, with widths varying from a quarter to five-eighths of a mile; the latter, located seven miles or so from Loch Laggan, has a length of five miles and a width of five-eighths of a mile in its widest part. Both lochs have considerable depths, of the order of three to four hundred feet. The catchment area of the district covers slightly more than three hundred square miles. The average annual rainfall reaches a maximum of 160 in. at the top of Ben Nevis and falls to about 40 in. at Laggan Bridge. The minimum and maximum recorded on the summit of Ben Nevis are 108 in. and 240 in. respectively. In records covering a period of nineteen years, the wettest month produced 48·3 in. and the wettest day 7·3 in.

So far, operations have been confined to the development of that part of the scheme which affects Loch Treig, and they have comprised the driving of a tunnel from the loch to a point just above Fort William, where the aluminium factory is situated, together with the building and equipment of a power house. The tunnel was a remarkable project. It has a length of almost exactly 15 miles, appreciably larger than the Simplon ($12\frac{1}{4}$ miles) or, in fact, any European railway tunnel. In length, it is only exceeded by the Shandaken tunnel for the water supply of New York, which is just over 18 miles long, but this has a smaller cross-section, measuring $10\frac{1}{4}$ ft. by $11\frac{1}{4}$ ft. The transverse section of the Lochaber tunnel, though composed of several different segments, may be described as roughly circular with a diameter of 15 ft., the height being 4 in. less than the width. The interior lining is of concrete, faced with carefully smoothed cement, in order to reduce skin friction to a minimum.

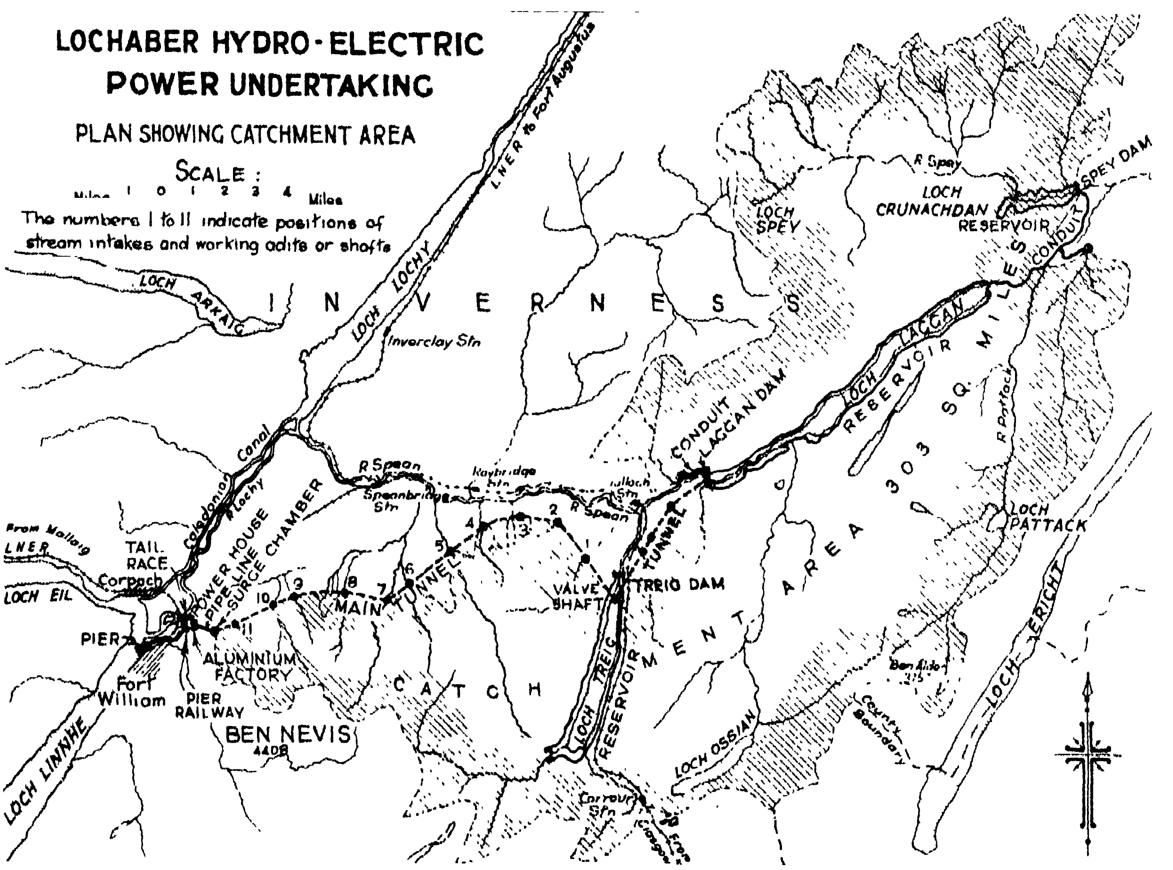


Fig. 1.

The strata along the route of the tunnel varied in character from grey granite of a very hard and compact nature at the Fort William end to schists (mica schist at Loch Treig) and porphyry with intervening layers of red granite, flagstone, etc. Such diverse material rendered drilling operations difficult and arduous, but happily there were no troublesome complications due to the presence of excessive water. Commenced in the summer of 1926, the bore was opened from end to end in February 1929. Driving was done from twenty-two faces: in addition to the end headings, there were seven horizontal adits from the mountain-side and three vertical shafts. The total length of the adits, which ranged individually from 400 ft. to 1440 ft., was 6360 ft.; and the aggregate depth of the shafts, which ranged from 145 ft. to 356 ft., was 1030 ft.

The tunnel undergoes two successive enlargements in its course for the purpose of receiving, as influents, eleven mountain streams, which are in this way incorporated in the main flow. The streams, or winter torrents, have been intercepted by dams and diverted into artificial conduits, rectangular in section with rounded corners. The water is abstracted over the crest of a weir in each dam, so as to cut off the passage of stones and heavy debris, while the weirs themselves are protected by grids, in order to intercept floating objects, tree branches, etc. The dams are also equipped with valve-controlled flushing pipes for dealing with silt accumulations, and spillways for the surplus flow in times of flood. The shafts by which the water is delivered into the tunnel are lined with concrete and are divided by a partition wall, extending from top to bottom, into two tubes, one of which is the water passageway, and the other, with a vent carried well above the top of the water tube, is a means of escape for the air sucked in by the water.

The pipe lines, 3200 ft. long, leading from the tunnel to the power house at the Fort William end, are to be three in number. For the present, however, only two are in service, the third line being blanked off. The two lines installed are formed of steel plating, from $\frac{1}{2}$ in. to $1\frac{1}{8}$ in. thick, and they vary in diameter from $70\frac{1}{2}$ in. to 65 in. They are in 30 ft. lengths, with lap-welded joints.

The power house on the left bank of the River Lochy is 270 ft. long by 65 ft. wide. Its position, half a mile from the river, has necessitated an exceptionally long tail race of a thousand yards, but the arrangement is justified by the corresponding saving in pipe line. For the present, less than half the generating plant contemplated for the full working of the undertaking is installed. There are five main turbo-generator units, of 10,000 horse-power capacity apiece. Each unit comprises a turbine of the Pelton wheel type, driving two generators on the same bedplate. The generators are direct current machines operating at 300 volts and 250 revs. per min. In addition, there are two subsidiary turbo-generators, each of 1250 kw. capacity, with alternators, triphase, 50 period, 400/440 volts at 600 revs. per min. The gross head available as yet is 764 ft., but when the surface of Loch Treig is raised as intended, the gross head will be increased to 800 ft.

As previously mentioned, the exploitation of Loch Treig is only a part (although as regards constructional difficulties the main part) of the whole scheme, which in its entirety envisages the inclusion of Loch Laggan in the supply service, and moreover proposes by the aid of artificial works to amplify and extend the resources of the whole catchment area. The minimum level of Loch Laggan in times of scanty rainfall is 818 ft. above Ordnance Datum, and by dredging the outlet it will be possible to draw it down to 804 ft. In times of heavy rainfall, however, the surface level rises to 820 ft. above O.D., and it is proposed to maintain it normally at that level by the construction of a dam, not actually at the extremity of the lake, but some distance down the River Spean, which drains the loch into the River Lochy, and so, in turn, into Loch Linnhe and the sea. The dam, which will be 700 ft. long and 130 ft. high, will, therefore, form an additional reservoir, to be known as the Spean Reservoir, which, linked up with Loch Laggan, will afford a combined area of 2440 acres and enable a depth of 16 ft. to be utilised for power purposes.

The surface level of Loch Treig is also to be raised from its present normal level of 783 ft. to 819 ft. above O.D., that is, 1 ft. below the impounded level of Loch Laggan and the Spean Reservoir, with which it will be connected by means of a tunnel 16 ft. in diameter. The tunnel will have a length of nearly three miles and a fall of 41 ft., so that the full available supply from Loch Laggan and the Spean Reservoir will flow into Loch Treig and the whole system be unified.

There are other sources which it is intended to utilise in succeeding stages, including the River Spey and its tributary, the Mashie. By building a weir across the former, its level will be raised during flood time by about 30 ft., resulting in the formation of a reservoir nearly two miles long, attaining a width of just under half a mile at its widest part. The crest level of the weir will be 880 feet above O.D., and in times of flood the excess over the normal flow of the river will be conducted through a conduit, nearly three miles in length, to the River Pattack, one of the influents of Loch Treig. An interesting point about the arrangement is that while the River Spey flows eastward and discharges into the North Sea, by the formation of this reservoir and conduit some of its water will be diverted westward, via Loch Treig, into the Atlantic.

This does not by any means exhaust all the potential sources of supply. There are several other streams the waters of which will be controlled and directed into the general storage reservoir of Loch Treig, which, by reason of its minimum net head of 695 ft., enables one horse-power to be realised for every five gallons of water per minute falling therefrom into the power house at Fort William.

Such in brief outline is the present position and the programme of future development. The completion, in due course, of the undertaking will crown an enterprise which, even in its present stage, is a unique and outstanding achievement in the annals of British water power development.

The Tercentenary of Cinchona in Medicine.

IN the dispensary of the Hospital de Santo Spirito in Rome, there is preserved a quaint fresco which bears the inscription :

Aegrotat Limae coniux Chinconia febrim
Cortice mirando pocula tincta fugant.

It depicts the Countess of Chinchon receiving from the hands of an Indian warrior the rare and wondrous bark which cured her of her fever. Probably the South American Indians knew the virtues of this bark long before the advent of the Spaniards, but apparently they attached little importance to it. Their story is that a native drank from a pool of water into which a cinchona tree had fallen and so was cured of his fever.

In 1630 Juan Lopez Canizares, Spanish *corregidor* of Loja in Ecuador, proved the efficacy of the bark of the fever tree (*Palo de Calenturas*). He is said to have recommended it to the Countess, and his is the first known instance of the use of quinine or cinchona bark in medicine. Quinine has now come to be highly valued and used throughout the world as indispensable for the cure and combat of malarial fever. So the tercentenary of the first use of quinine in medicine is this year being celebrated in Britain, America, and elsewhere, and it is appropriate to recall the outstanding incidents in the history of its utilisation and production.

The Countess of Chinchon, wife of the Viceroy of Peru, returned to Spain from Lima in the year 1640. She brought with her a supply of the precious bark and, soon thereafter, the valuable properties of 'Countess's Powder' became widely known in Europe. Nine years later, and for the ensuing twenty years, considerable quantities of the bark were sent from Peru to Spain by Jesuit fathers. Their brethren at home were responsible for its distribution throughout their own and neighbouring countries, and thus the powdered bark came to bear the name of 'Jesuits' Powder'. There is evidence to show that by the end of the seventeenth century the use of the bark had spread to France, Italy, and Holland. In England, Robert Talbor used the drug with great effect, and King Charles II., whom he had rid of a quartan fever, honoured him with knighthood.

We owe our first definite knowledge regarding quinine-yielding species and their geographical distribution to various French and Spanish scientific expeditions which visited South America between 1735 and 1852.

Linnaeus in 1742 named the genus *Cinchona* in memory of the great service to humanity rendered by the Countess of Chinchon. Misinformed as to her name, he spelt the word *Cinchona*, and unfortunately died before the error was pointed out by the Spanish botanists Ruiz and Pavon.

There are sixty-five species in the genus, but only three are worth consideration from the medical point of view, and these are *Cinchona officinalis*, *C. succirubra*, and *C. Ledgeriana*. The genus is indigenous only in South America and the various species are found scattered through primeval forests in Colombia, Ecuador, Peru, and Bolivia. They are to be found on the slopes of the Andes, in roadless and uninhabited regions at elevations between 2500 ft. and 9000 ft. on the eastern side of the main range. The Loja region in Ecuador is the home of *C. officinalis* and other 'crown barks', so called because they were reserved for the use of the royal pharmacy at Madrid. *C. succirubra*, the red bark, is found on the western slopes of Mt. Chimborazo, while the seed of *C. Ledgeriana* was obtained from Coroico province in Bolivia.

For many years the collection of bark in the forests was uncontrolled. Ruthless methods of exploitation by which the trees were killed long before they had yielded their full quota of bark made supplies more and more difficult to obtain. By 1847 no good bark was available within a ten days' march of inhabited country. Protests were raised and measures for protection and planting were suggested, but no safeguarding legislation was enforced. Meanwhile, the demand for the bark in Europe had greatly increased, and scientific men in various countries, perturbed by the difficulties of obtaining supplies and the extravagant methods of collection, began to urge their governments to introduce cinchona to their own colonies. Dr. Royle, curator of the Botanic Garden at Saharunpur, recommended that cinchona should be planted in India, and the Dutch botanist, Dr. Blume, made a similar proposal with regard to Java.

The distinguished French botanist, Dr. Weddell, whose monograph, "Histoire naturelle des Quinquinas", is one of the most important contributions to the literature on this subject, made two expeditions to Bolivia, in 1847 and 1852. He brought seed of *C. Calisaya* to Europe, from which plants were raised both in the Jardin des Plantes in Paris and in the Royal Horticultural Society Garden in London. Some of these plants eventually reached both India and Java.

For the extensive plantations contemplated, further supplies of plants and seed were necessary, and in 1851 Justus Karl Hasskarl, then superintendent of the Botanic Gardens at Buitenzorg, sailed for Peru. After many adventures he succeeded in reaching Java in 1854 with a number of plants of a species which, unfortunately, turned out to be of very little value and was given the name *C. Pahudiana*.

Sir Clements Markham with his fellow labourers, Dr. Spruce, Mr. Weir, Mr. Cross, Mr. Pritchett, and Mr. Ledger, were successful in introducing cinchona into India, in various consignments of plants and seeds, sent between the years 1861 and 1878.

Markham and Weir set out for the Caravaya forests in the spring of 1860 and reached the valley of the Tambopata River in May. On their return journey they met with considerable opposition, for the local government, fearing the ruination of their monopoly in the supply of bark, did their utmost to prevent the export of cinchona plants.

By following a devious route the explorers arrived at the port of Islay on the coast of Peru in June with a supply of plants which were placed in Wardian cases and shipped to India via Panama and the Red Sea.

Spruce and Cross were successful in collecting seed and plants of *C. succirubra*, the red bark, from the slopes of Mt. Chimborazo, and these were shipped from Guayaquil in January 1861. Cross made several subsequent expeditions; he went to the Sierra de Cajamuma from Loja in the autumn of 1861, bringing back seeds of *C. officinalis*; twice he visited the forests of Pitayo in the extreme south of Colombia to gather seed of *C. pitayensis*; and finally, in 1877, he travelled to the upper reaches of the Caqueta River to obtain the seed of *C. Calisaya* and the soft Colombian barks. Pritchett collected plants and seed of the grey barks, *C. nitida*, *C. micrantha*, and *C. peruviana*, from the Huanuco forests to the north of Lima.

Charles Ledger was engaged on his own account in the bark and alpaca wool trades in Peru. He had made several expeditions to obtain bark, in one of which his partner, Mr. Backhouse, was murdered by the Chuncho Indians and Ledger had only escaped with his life. Knowing the desire of the British and Dutch Governments to obtain seeds of the best species, Ledger sent his old Indian servant Manuel Mamani to the cinchona forests in the region of Coroico. Mamani, faithful to his trust, persevered and at length, after several years of search, delivered seeds from the best (the *roja*) trees to his master. But he had roused the enmity of the Bolivians and soon afterwards was thrown into prison, beaten and half starved. Robbed of all he possessed, he died of the ill-treatment he received. Manuel Mamani deserves be remembered, for to him we owe the seed of *Ledgeriana*. It is this species which in cultivation yields the highest percentage both of quinine and of the other alkaloids, and the productiveness of the plantations both in India and in Java is due mainly to the richness of its bark.

In the introduction of cinchona to India, the Royal Botanic Gardens, Kew, played an important part, not only by raising plants from seed, but also by tending those which arrived from Panama so that they might recuperate ere they faced the perils of their further journey through the Red Sea. Although there were many casualties among the plants which were dispatched from South America, some eventually arrived safely in India. From small beginnings made in 1861 the large plantations in the Nilgiris and in the Darjeeling district of Bengal were gradually established. To Mr. McIvor, of the Government Gardens in Ootacamund, and to Dr. Anderson, of the Royal Botanic Gardens, Calcutta, the task of developing the plantations was entrusted, and Dr. Anderson was succeeded by Mr. C. B. Clarke, Sir George King, and Sir David Prain. We owe to them, too, a debt of gratitude. They have built up a great enterprise. In India we have now under cinchona some 3500 acres, yielding about 40,000 lb. of quinine each year. India, however, is the only country within the Empire in which cinchona is seriously cultivated.

Much has been accomplished, but there is still much to be done. The potential demand for quinine is far in excess of available supplies. India provides only about one third of the amount of quinine she herself at present consumes. It has been estimated that in order to have any effect upon her malarial problem, she would have to increase her production by eighteen times; and what of the needs of the rest of the Empire and the 800,000,000 people who suffer from malarial fever?

There can be no more fitting manner in which to mark the tercentenary of the first use of quinine than by reviving and renewing our efforts to increase the production of cinchona, the principal agent in the combat of malaria. The problems to be faced are the finding of further areas of suitable land and the application of scientific research to increase the output from existing plantations. May we look forward hopefully to the time when the united efforts of the administrator, the medical officer, the planter, the manufacturer, and of those responsible for distribution and propaganda have brought the scourge of malaria well under control—when Sirius no longer

"O'er the feebler stars exerts his rays;
Terrific glory! for his burning breath
Taints the red air with fevers, plagues, and death."

Obituary.

COL. J. W. GIFFORD.

COL JAMES WILLIAM GIFFORD, whose death occurred at his home at Chard, Somerset, on Oct. 27, in his seventy-fourth year, was one of that select band of scientific workers of whom Sir William Spottiswoode, Warren De La Rue, and others were brilliant examples; men who, in addition to their ordinary occupations, found time and opportunity to follow the pursuit of pure science for the love of it. Col. Gifford was by profession a lace manufacturer, and at his death was managing director of the firm of Messrs. Gifford and Fox, of Chard.

The present writer was first brought into touch with Col. Gifford in connexion with an inquiry into the so-called musical properties of some sands that are found on the coasts of Scotland and elsewhere; these sands, when trodden upon, emit a musical note or squeak which becomes fainter and is soon lost altogether if the same specimen is used repeatedly. Col. Gifford found, by the simple operation of rolling the sand down an inclined board several times, that the musical property was restored evidently by the removal of the fine dust of silica that was produced by the rubbing together of the grains of quartz.

On the discovery of X-rays by Prof. Rontgen in 1895, Col. Gifford entered with enthusiasm upon the new field of research and became an active member of the Röntgen Society, which was founded

by the late Prof. Silvanus P. Thompson, and he soon became an authority on the subject. He gave his services to the members of the medical profession at Chard and made many radiographs for them in the early days of the science.

Col. Gifford's chief activity was, however, in the field of optics, and he was the author of many valuable papers dealing with the construction and improvement of telescopic lenses. He was an active fellow of the Royal Astronomical Society, the Optical, Microscopical, and other kindred Societies, and communicated several important papers to the Royal Society, in the *Proceedings* of which the following are published: "The Refractive Indices of Fluorite, Quartz, and Calcite", "The Refractive Indices of Water and Sea Water", "The Refractive Indices of Benzene and Cyclohexane", and "The Existing Limits of Uniformity in producing Optical Glass".

Col. Gifford was the author of a book on "Lens Computing by Trigonometrical Trace". In a foreword to the book, Prof. F. Cheshire, formerly director of the Technical Optics Department of the Imperial College of Science and Technology, pointed out that "Col. Gifford never relied upon the glass-makers' catalogue for the optical constants of the glasses, but determined these data for himself, and the excellency of the systems that he produced was undoubtedly due to this fact". In the old Volunteer Force he held the position of hon. colonel of the Fifth Somersets, and when the War broke out he took an active part in military matters. He was sent to the front by the War Office to report upon the proposed introduction of giant periscopes for use in the trenches, and later on produced a convenient short high-power telescope for the use of officers.

Taking an active part in local affairs in Chard, Col. Gifford was chairman of the Board of Governors at Chard School, of which he was an old boy; and for many years he maintained at his own expense a nurse for the district. He will be greatly missed there by all who knew him. In 1883 he married Emma, daughter of Mr. Ernest Rossiter, of Taunton, to whose assistance in his scientific work he pays grateful tribute in many of his papers. He had one son and four daughters, all of whom survive him.

J. H. GARDINER.

WE regret to announce the following deaths:

Dr. J. W. Evans, C.B.E., F.R.S., a past president of the Geological Society and of Section C (Geology) of the British Association, on Nov. 16, aged seventy-three years.

Dr. E. R. Frazer, a distinguished pathologist and benefactor of the University of Oxford, on Nov. 17, aged sixty-three years.

Dr. G. H. K. Macalister, formerly principal of the Singapore Medical College and editor of the *Malaya Medical Journal* on Nov. 2, aged fifty one years.

Dame Mary Scharlieb, D.B.E., a pioneer in medical education for women, on Nov. 21, aged eighty-five years.

Prof. J. H. Teacher, St. Mungo (Notman) professor of pathology at Glasgow University, on Nov. 21, aged sixty-one years.

News and Views.

DISSATISFACTION with the Government's decision to allow the Dyestuffs (Import Regulation) Act to expire on Jan. 15 next is not confined to circles associated with an industry of exceptional national importance; it is shared by all those who have a care for chemical education and research in Great Britain. The intimate relation which connects the existence of a flourishing dyestuffs industry on one hand with the acquisition and application of knowledge in many other branches of organic chemical science and on the other hand with the supply and facilities for training of competent organic chemists has already been pointed out in the columns of NATURE. This relation is patent to members of the scientific community, and it should not be difficult of appreciation by those responsible for the oversight of our economic and educational destinies. It is not our desire to enter into the polemics of the political aspect of the matter, although it would indeed appear from reports of Mr. Graham's answers and Sir P. Cunliffe-Lister's question in the House of Commons on Nov. 19 that prejudice to the dye-user could easily be avoided. The substance of our protest is rather that, so far as the evidence at present available appears to indicate, the decision rests entirely on political opinions and ignores facts which relate both to the progress of science and to the maintenance of British scientific standing. Until scientific education is more widespread than at present, it would be unreasonable to expect our political leaders themselves always to exercise appropriate judgment in scientific matters, but they are not thereby absolved from the duty of basing their actions on questions of fact ascertained judicially or otherwise.

ORIGINATING with Sir William Perkin's classic researches, the coal-tar dyestuff industry in Great Britain was an early victim to German scientific enterprise and organisation. A tardy realisation of the place of chemical science in the national economy born of war conditions, followed by effective political action during the past ten years, has resulted in the home production of dyes rising to so much as 93 per cent of the consumption; coincidently there have grown up in the universities of Great Britain and in industrial laboratories active schools of research directed towards a strengthening of the foundations of the chemical industries in general. This fundamental work has been in large measure rendered possible by direct assistance and by offers of employment by the industries concerned. Even were it possible to ignore the incidence of these developments on intellectual momentum, on future employment in parallel branches of manufacture, and on health and comfort, there still remains the fact that a million pounds is spent annually in the purchase of foreign

dyes. Deprived of effective protection and encouragement, and exposed to the full blast of world competition in home markets, the industry may survive, but it can scarcely be expected to develop in the way which our national security demands. It is earnestly to be hoped that the decision which has been announced is amenable to modification on reconsideration, and that in the event of its being confirmed, alternative means to encourage progress in organic chemical industry and education will be immediately substituted.

AT the anniversary meeting of the Royal Society one hundred years ago, a new president had to be elected as a successor to Mr. Davies Gilbert, who had resigned office. Other changes were also necessary at the time, choice having to be made, respectively, of a new treasurer, secretary, and foreign secretary. The considerations attending an appointment to the presidential chair were, in many aspects, peculiar, yet apparent. At the period in question dissensions and breaches were rife in the scientific hierarchy, due, it may be, partly to transmitted differences, partly to lack of adaptability to current movements in science. The relevant history of this perplexing era remains, however, to be written. Two candidates for election were put forward: (1) no less a personage than H.R.H. Augustus Frederick, Duke of Sussex, and (2) J. F. W. Herschel, the distinguished astronomer and physicist, designated in influential circles as eminently qualified by his varied and profound knowledge, and as one acceptable to men of science in England and in foreign countries. Weld, the compiler, records that the selection of a president was left in the hands of the general body of fellows coming to the anniversary meeting. The public journals announced that in the ballot the Duke received 119 votes, Herschel, 111. It is of interest to note here that Herschel had been elected into the fellowship in 1813 and when twenty-one years of age; also, that Faraday was a member of council in 1830.

IT was resolved that a deputation should wait upon the newly elected president and inform him of the decision taken. Further, it is recorded (in the same public manner) that His Royal Highness had afterwards addressed the fellows, assuring them that he would use every endeavour to advance the interests of science and of the Society. He stated that it was his intention to throw open his house alternately on the forenoons and evenings of Wednesdays for the reception of the fellows and men of science; those who could not do him the pleasure of breakfasting with him, might be able to attend from half-past eight to eleven at night. The Duke maintained the duties of office until Nov. 30, 1838, and we are told that during his tenure of the presidency he constantly presided at all meetings of the council and Society. It was to Davies Gilbert, the president referred to above, that the eccentric Earl of Bridgewater, who died in 1829, left by will the sum of £8000, placing upon him the responsibility of nominating some person or persons to write, print, publish, and expose to public sale one thousand copies of a work "On the Power, Wisdom, and Goodness of God, as manifested in the Creation". The 'Bridgewater Treatises' were published in 1833–35, Whewell, Charles Bell, Buckland, and others providing the essays.

IN the year 1830 the Royal Society did not allot its Copley medal; neither, by the way, had it done so in the two previous years. Also, the gift of the Rumford medal was intermitted in 1830. Medals were given only to David Brewster and Prof. Antoine Jérôme Balard, of Montpellier, who each received a Royal medal, the former "for his communications to the Royal Society on the Polarization and other properties of Light"; the latter "for his discovery of Brome". Brewster was elected into the Royal Society in 1815; in the same year he was awarded the Copley medal, a double distinction probably in character without any parallel. Antoine J. Balard was born at Montpellier in 1802, and he died in Paris in 1876. Originally Balard had worked in his native town as a pharmacist, but, later on, researches in various branches of applied chemistry claimed his undivided interest. In 1826 he succeeded in isolating from sea-water the chemical element bromine, whilst he studied its compounds in sea-water, particularly from the point of view of production for industrial purposes. A wider sphere offered itself in Paris as successor to Thenard at the Faculté des Sciences; in addition, in 1851, he was appointed professor of chemistry in the Collège de France. Balard was elected a member of the Paris Academy of Sciences in 1844, but his name does not appear on the foreign membership roll of the Royal Society.

THREE fellows of the Royal Society, all of them distinguished by long and notable scientific activity, have celebrated birthdays during the past week. They are, respectively: Prof. J. Cossar Ewart, a graduate and formerly Regius professor of natural history of the University of Edinburgh, who, on Nov. 26, entered on his eightieth year; Prof. Horace Lamb, a graduate of Trinity College, Cambridge, and formerly professor of mathematics in the University of Manchester, who, on Nov. 27, reached the age of eighty-one; and Sir J. Crichton-Browne, also a graduate of Edinburgh, past president of the Medical Society of London, the Neurological Society, and the Medico-Psychological Association, and for many years treasurer of the Royal Institution, who attained the age of ninety on Nov. 28. To all three our hearty congratulations are extended.

"BIOLOGY in Education and Human Life" was the subject of the Henry Sidgwick Memorial Lecture for 1930, delivered at Cambridge by Prof. A. V. Hill. It was a strong plea for a wider appreciation of the interest and value of biology in human affairs. At present, biology is unfairly handicapped. At school, classics and sciences like mathematics, physics, and chemistry usurp the time-table to the exclusion of biology, biasing the outlook of youth before it can decide the course of its own likings, and forming an anchorage of knowledge which the student fears to leave on a voyage into the unknown. "As a practical

step biology must demand that, with all its intellectual interest and its importance in human affairs, it should be brought sufficiently to the notice of boys and girls to enable them to decide with their eyes open whether that, or something else, is what they wish to study." It is, indeed, a strange thing that a science fundamental to an understanding of the world around us and of the workings of the human body and mind should be regarded as a sort of cultural embellishment, when the reasonable position is that ignorance of the nature of living things should be looked upon as a real lack of education. The pity is the greater because children in general, regardless of their upbringing, find the world of living Nature vastly interesting, and so far from finding it beyond their grasp, they display ample evidence in their biological studies of ability to classify facts, recognise relations between ideas, make generalisations, and formulate results.

PROF. HILL proceeded to illustrate from current problems in human affairs the necessity of a sound biological point of view. The incidence of feeble-mindedness and the limited extent by which it may be reduced by the methods generally urged by eugenists, the impossibility of amalgamating social notions and race improvement based upon the type of selection and breeding common to the development of domestic animals, the fallacies of sense observation and mental processes—these and many other problems can be understood only when brought into relation with the known facts of biology. There is something to be said for the creation in the universities of professors of conjuring, so that proper emphasis may be placed upon the extreme fallibility of the senses. In the wider study of humanity, also, biology must play an important part. It offers the most humane and charitable approach to the study of human conduct: its exploration of mankind as a biological unit may become a field of extraordinary fertility and significance for the future of the race; and perhaps its most important service would be to give man a reasonable attitude towards life. The address should be read by all educationists, and not least carefully by the exponents of classics, mathematics, physics, and chemistry. Prof. Hill has kindly consented to its publication shortly as a Special Supplement to NATURE.

MR. ARNOLD BENNETT, in the course of an article in the *Evening Standard* of Nov. 20 on Sir James Jeans's book, "The Mysterious Universe", pays NATURE a compliment which we gratefully acknowledge. He says, "I regard NATURE as perhaps the most important weekly printed in English, far more important than any political weekly. My esteem for NATURE is enormous, for I have learnt a tremendous lot from it. But the writing of it is considerably inferior to the matter of it." As examples of this inferiority, Mr. Bennett quotes two sentences from an article in our issue of Nov. 8. We suggest to him, however, in all humility, that similar examples of careless construction could be selected from the pages of any issue of any literary periodical, and that his generalisation is scarcely just to us. We cannot pretend that the highly specialised subjects of modern science can always be described in words of common speech, but we do endeavour to maintain a high standard of English in contributions generally, and we regret as much as anyone when slipshod or ambiguous phrases escape our notice. It would be easy, however, to find on almost every page of every issue of the *Evening Standard* worse examples of hasty or clumsy writing than the two quoted by Mr. Bennett from a single article in NATURE; but no doubt he assumes that our literary standard should be higher than that of an evening newspaper—as indeed it is.

THE Association of Scientific Workers, in spite of the financial stringency with which it, like other good causes, is afflicted, still adds to its record of achievement. During the past few months it has prepared, and submitted to the Royal Commission on the Civil Service, a formidable body of evidence dealing with the position of the scientific Civil servant *vis-à-vis* his administrative colleague, and advocating the unification of all the State scientific services under a Ministry of Science. At the same time, the Association has prepared an index of references to science and cognate matters in the Parliamentary Debates, and through its general secretary, Major A. G. Church, M.P., has formed a Parliamentary Science Committee. This Committee, consisting of members of both Houses and all parties, meets periodically to hear the views of acknowledged experts on scientific questions which bear on public affairs.

SOME years ago the Association issued an appeal for members, in the form of a letter signed by some of the most prominent men of science in Great Britain. This letter was sent to about 20,000 scientific workers, and resulted in a large increase of membership. At the present time the Association is sending out another such appeal, on a much more elaborate scale. It consists of a sixteen-page booklet entitled "The Profession of Science", containing articles by Sir Richard Gregory, Prof. Julian Huxley, and others, with messages from Sir Ernest Rutherford, Sir William Bragg, the Rt. Hon. W. G. A. Ormsby-Gore, and Prof. Donnan, and a preface by Sir Daniel Hall as president of the Association. The booklet is being sent to 25,000 scientific workers, and at the same time a card index of qualified scientific men is being prepared, with the intention of preserving it and keeping it continually up-to-date. In this way, as a by-product of the Association's own propagandist activities, information is being collected which will prove invaluable when it becomes possible to create an authoritative register of the profession of science, such as the professions of law, medicine, dental surgery, and teaching already possess. Work on this card index has been in progress for four weeks, and it is already clear that the figure of 25,000 falls considerably short of the total of qualified workers in Great Britain.

AT the annual general meeting of the British School of Archæology in Jerusalem, which was held on Nov. 21, Prof. J. L. Myres, chairman of the Council, made the first public announcement of an important archæo-

logical enterprise which is to be undertaken on an international basis. Harvard University, which has been considering an intensive investigation of the important site of Samaria, excavated in part only by Dr. Reisner, has invited the co-operation of the Palestine Exploration Fund, the British School of Archæology in Jerusalem, and the Hebrew University of Jerusalem. The British Academy has also consented to co-operate and has promised a contribution of £1000 from the accumulated income of the Scheiwz Fund towards the expenses of the British wing in the first year. The work will be under the direction of Mr. J. W. Crowfoot, who will leave England shortly to make the preliminary survey and organise the labour required. It is expected that the actual work of excavation will begin in March or April next and continue until well into the summer as weather permits. An undertaking has been given to provide about £1000 a year for the next three years to meet the liberal proportion which Harvard and its friends are providing.

THE Electricity Commissioners have issued a 'return of the fuel consumption and units generated' in Great Britain for the year ended Mar. 31, 1930 (London: H.M. Stationery Office). The first return was issued for the year 1921 and the comparison of the results is very satisfactory. In 1921 there were 463 power stations and 3·32 lb. of coal and coke were used per kilowatt hour generated. Last year's return covers 568 power stations, the average consumption being 1·97 lb. per unit, or only a little greater than a half that of nine years ago. The most economical station was that at North Tees, which had a consumption of 1·28 lb. of fuel per electrical unit generated. At twelve very large power stations the consumption was less than 1·5 lb. per unit. In 1921 the most economical station consumed 1·7 lb. per unit. The total electricity generated last year increased ten per cent above that of the preceding year, while the total fuel consumed increased only six per cent. During the year 33 stations were closed, 13 new stations were put into operation, and returns for 24 more are given for the first time. The North Tees station of the Newcastle-upon-Tyne Electric Supply Company obtained an average thermal efficiency of 23 per cent taken over the whole year. These figures prove that the provisions of the Electricity (Supply) Act, 1926, are beginning to act beneficially for the country. Whilst water power stations only produced 1·38 per cent of the total, the utilisation of waste heat from blast furnaces, etc., produced 2·06 per cent of the total.

IN a previous issue (Aug. 9, p. 220) we gave a preliminary account of the recent descent in the Atlantic Ocean to a depth of 1426 feet by Dr. William Beebe and Mr. Otis Barton in the 'bathosphere'. An article by Mr. Barton in the October issue of the *Scientific American* gives further details of this remarkable apparatus. The bathosphere, which was designed by Mr. Otis Barton and Mr. J. H. J. Butler, is a single spherical steel casting 4 ft. 9 in. in diameter, with walls more than $1\frac{1}{2}$ in. thick, and weighing 5000 lb. Access is gained by a 400 lb. door which can be screwed down on a special gasket and packed with white lead to be waterproof under a test submersion to 2400 ft. There are three projecting windows, each of which will take a cylinder of fused quartz 8 inches in diameter and 3 inches thick. In the dive in question, only two of the quartz cylinders were in place, the third window having been closed with a steel plug temporarily owing to damage to the quartz in fitting. These windows withstood submersion to a depth of 2400 ft. The breathing apparatus was designed by Dr. Alvan Barach, of New York, and consisted of two oxygen tanks fitted with special valves. A valve was set to allow 2 quarts of oxygen to escape per minute for the two divers. Under these conditions, each tank would last about three hours. Soda lime and calcium chloride held in wire mesh trays were used to absorb the carbon dioxide and moisture respectively from the air. The divers were in the tank for more than an hour and a half and felt no untoward effects beyond a slight excess of pressure. The bathosphere was operated by a 5-ton winch holding 3500 feet of $\frac{7}{8}$ in. steel centre non-spinning cab capable of sustaining 29 tons.

THE Annual Report of the Director describes the activities of the Meteorological Office during the year ended Mar. 31, 1930, the seventy-fifth year of its existence and the tenth year since it has been a department of the Air Ministry. The year was one of great activity in international co-operation, and, as well as meetings of several commissions, the report includes accounts of three important conferences—the International Conference on Safety of Life at Sea, in London in April and May 1929; the Conference of Empire Meteorologists, in London in August; and the International Conference of Directors of Meteorological Services, at Copenhagen in September. These conferences led to the recognition of marine meteorology in international treatises, to a radical improvement in the interchange of meteorological data throughout the world, and a much closer connexion between the meteorological services of the British Empire. During the year a new international code for the transmission of the meteorological messages, approved at the Copenhagen Conference, was adopted. Among other matters in the Report it is of interest to note that at the Copenhagen Conference the proposals for a second Polar Year in 1932–33, fifty years after the first in 1882–83, was adopted with enthusiasm. The proposals now under discussion are that a number of small observing stations should be established around and within the Arctic regions, and similarly so far as possible in and around the Antarctic regions, where observation of terrestrial magnetism, aurora, weather, upper air currents, and temperature should be carried out during twelve months according to an international plan.

IN the issue of NATURE for Aug. 16 (p. 259) we published a brief résumé of certain observations by Dr. Harry L. Shapiro on the physical characters of the descendants of the mutineers of the *Bounty*, which had appeared in the *Memoirs of the Bernice P. Bishop*

Museum of Honolulu. The well-authenticated origin of these people and their prolonged isolation give them an especial importance in anthropological science. Studies of hybrids based upon well-attested data in which the component factors can be distinguished with any certainty have not often been made. Although we dealt with physical characters only, Dr. Shapiro went on to record further impressions which are of considerable psychological and sociological import. A correspondent has written to us stressing this aspect of Dr. Shapiro's work in relation to the discussion of the "so-called 'inherent defects' of 'half-castes'". The writer quotes the following passage in particular from Dr. Shapiro: "This study of race mixture on the whole rather definitely shows that the crossing of two fairly divergent groups leads to physical vigour and exuberance which equals if not surpasses either parent stock. . . . This conclusion regarding the physical vigour of the Norfolk hybrids applies also to their social structure, which on Pitcairn was not only superior to the society instituted by the Englishmen themselves but also contained elements of successful originality and adaptability". So far, then, as Dr. Shapiro's observation goes, neither cross-breeding nor in-breeding has produced any evidence of degeneration in these people, but it is obvious that certain reservations would have to be made before this conclusion could be given extended application It is to be noted, however, that the Pitcairn Islanders are an instance of hybridisation in which no allowance has to be made for the social factor of an adverse environment which so often vitiates argument concerning cross-breeds.

THE Report of the Scottish Marine Biological Station for the year ending Mar. 31, 1929, shows very satisfactory progress. Before their departure to the Great Barrier Reef, Miss M. Marshall and Mr. A. P. Orr continued in the spring their plankton investigations on the diatom increase in Loch Striven and the physical and chemical conditions accompanying it. This was much less regular than usual, owing mainly to the strong winds mixing the water down to a considerable depth and carrying the diatoms below, where photosynthesis was impossible. Cultures of diatoms were sunk at different depths at the same time and their photosynthesis measured by the oxygen production. The results showed that the depth limit of growth was much affected by the presence of diatoms in the water, the water becoming more and more turbid as the diatoms increased, the turbidity decreasing again as the diatoms sank. Experiments showed that an actively growing diatom culture adds no perceptible quantity of soluble organic matter to the culture fluid. Mr. J. Mitchell, working on the food of the copepod *Pseudocalanus elongatus*, concludes that it feeds mainly on diatoms, for although no skeletal remains were found inside the gut, a green fluid was present in half the specimens examined and a similar green fluid was in the guts of *Pseudocalanus* living in a persistent culture of the diatom *Coscinosira polychorda*. Mr. H. B. Moore and Mr. R. G. Neill have been analysing the Clyde mud from various stations and find significant difference between the muds of different levels. Miss Lloyd has investigated the marine bacteria of the Clyde area, and Mr. A. C. Stephen has continued his researches on the biology of *Tellina tenuis*.

THE Department of Geology of the British Museum (Natural History) has received a plaster cast of the skull of Peking man. The skull has been described in NATURE by Prof. G. Elliot Smith (Mar. 22, p. 448, and Aug. 9, p. 210.) Recent accessions in the Department of Entomology of the Museum include more than 1400 specimens of two-winged flies (Diptera) from Mt. Kinabalu (13,455 ft.), British North Borneo. Many plants and animals (including even birds) found there do not occur anywhere else in the world, and possibly represent old forms of life which have persisted on the mountain during successive ages. Some species show affinities with the mountain fauna of the Philippine Islands. Similar interest attaches to the presentation by Dr. K. H. Barnard of five species of the remarkable African stagbeetles of the genus *Colophon*, including the types of four species discovered by the donor and new to the collection. These insects are confined to mountain summits in the south-western area of the Cape Province, South Africa. They are unable to fly, and each form is completely isolated from the other species. Stagbeetles are woodfeeders, and the occurrence of representatives on treeless South African mountain-tops is at present unexplained. The Rev. J. W. Spreckley has presented to the Department of Botany three bundles of the Chinese fungus, *Cordyceps sinensis*. This fungus attacks the larva of an insect which eventually dies, and its interior is gradually absorbed until it is practically a solid mass of mycelium though it retains its shape. Out of one end the fertile part of the fungus grows. It is a celebrated drug and is found apparently only on the Tibetan border. It is said to bestow energy and to be partaken of with stewed duck. Another interesting gift is a quantity of hazel nuts of immediate post-glacial date, from Loch Treig, Inverness-shire, presented by the North British Aluminium Co., Ltd. This year, owing to an unusual spell of dry weather, the level of the lake was reduced and a thick bed of dark-coloured hazel nuts was seen at the north (exit) end of the lake at 741 ft. above sea-level.

DR. C. S. MYERS, who has been Director of the National Institute of Industrial Psychology since its inception nine years ago, has asked to be released from the duties of directorship, and has been appointed Principal in order that he may devote the whole of his time to the Institute's research and educational activities. Dr. G. H. Miles, who has been Assistant Director for several years, has now been appointed Director of the Institute and will take charge of the whole of its practical activities. The number of firms requesting advice from the Institute has been a record one this year, and the number of young people applying to the Institute for recommendations as to the careers to which they are best suited has increased by 50 per cent on last year.

AT a Congregation held at Oxford on Nov. 22 the degree of D.Sc. was conferred on Mr. J. J. Manley, research fellow of Magdalen College. Dr. Manley's work, extending over thirty-five years, includes papers concerned with the preparation of 100 per cent. nitric acid (with V. H. Veley, *Phil. Trans.*, 1898), devices for increasing accuracy in weighing (*Phil. Trans.*, 1910), the apparent change in mass during chemical reaction (*Phil. Trans.*, 1912), and the union of helium with mercury (NATURE, Dec. 13, 1924, p. 861; *Phil. Mag.*, 1927). His work upon the law of conservation of mass is a distinct advance upon that of Landolt, due to the greatly increased accuracy in weighing, and the simplicity of the reaction studied (barium chloride and sodium sulphate). Dr. Manley is now engaged upon a study of the change in physical properties (other than boiling point) of benzene and its homologues when submitted to prolonged drying.

AT a well attended meeting of medical men and women representative of the study and practice of physical methods of treatment, held on Nov. 14 under the chairmanship of Sir Leonard Hill, it was resolved to form a Society of Physical Medicine. A sub-committee under the chairmanship of Sir Leonard Hill was appointed for the purpose of drafting a constitution and dealing with other urgent matters. The acting honorary secretary is Dr King Brown, 69 Grove Park, Denmark Hill, London, S.E.5.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Dec. 8). Temporary assistants under the Department of Agriculture for Scotland for, respectively, work on virus diseases of the potato and for field work in connexion with potato culture—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Dec. 9). A part-time physics demonstrator at the London (Royal Free Hospital) School of Medicine for Women—The Warden and Secretary, 8 Hunter Street, W.C.1 (Dec. 10). A professor of education in the Rhodes University College, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Dec. 15). A resident lecturer in fruit and vegetable preserving at the Swanley Horticultural College for Women, Swanley—The Secretary, Horticultural College, Swanley, Kent (Dec. 15). An assistant in botany in the University of Glasgow—The Professor of Botany, The University, Glasgow, W.2. A head of the Chemistry Department in the Chulalongkorn University, Bangkok, Siam—The Siamese Legation, S.W.7. A part-time physics demonstrator at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8.

Our Astronomical Column.

Comet 1930 g.—*Circ.* No. 304 of the I.A.U. Bureau, Copenhagen, announces the discovery of a comet of magnitude 13·5 by Prof. Nakamura at Kyoto, Japan, at $13^h\ 50\cdot0^m$ U.T. on Nov. 13, its position being R.A. $3^h\ 40^m\ 41\cdot5^s$, N. Decl. 18° 53′ 25″. The comet is 1930 *g*, being the seventh discovery this year, but the eighth to pass perihelion this year. The above circular wrongly assigns the letter *f* to it; that letter was assigned to Tempel's periodic comet.

Mr. Sibata has deduced the following parabolic elements for the new comet:

$$\begin{array}{lll} T & \text{1930 Aug. 21·370 U.T.} & \\ \omega & 40°\ 19' & \\ \Omega & 231\ \ 26 & \Big\} \ 1930\cdot0 \\ i & 8\ \ \ 7 & \\ \log q & 9\cdot3071 & \end{array}$$

The following ephemeris for 0 h. U.T. is calculated from these elements:

	R.A.	N. Decl.	log r.	log Δ
Nov. 28.	$3^h\ 6^m\ 10^s$	16° 14′	0·3353	0·0792
Dec. 2.	2 59 35	15 42	0·3477	0·1082
Dec. 6.	2 53 57	14 58	0·3595	0·1433

The comet is well placed for observation, being not far from opposition; the distance from both sun and earth is increasing, so it will fade fairly rapidly. The small inclination suggests that it may prove to be periodic.

Fireball.—Mr. Denning writes: "A brilliant fireball was observed by the Rev. F. H. Carr-Gregg of Nuneaton, on Nov. 16, at $9^h\ 44^m$ P.M. It moved slowly, being visible for 5 seconds, and gave a strong outburst of light before it disappeared. Its flight was from 165° + 55° to 135° + 35° and its probable radiant point was in the south-west region of Hercules or near the star alpha Capricorni. Another observation would be valuable for the purpose of computing its real path. It must have been a very lustrous object as seen from the north-western counties of England."

The Leonids.—A few Leonids appeared on Nov. 16–17, but they were less in number than the meteors which are usually seen during an ordinary display of the Perseids. They were, however, more active than in several preceding years, and gave promise that in 1931 and 1932 they may be observed in greatly increasing numbers.

Pluto.—An article by E. C. Bower and F. L. Whipple in *Publ. Astr. Soc. Pacific* for August 1930 states that the Mount Wilson plates of December 1919 were taken with the 10-inch refractor specially to search for the Lowell planet; this was, however, so much fainter than was expected that the images were not detected until last June, when a fairly accurate ephemeris was available derived from the positions of 1927 and 1930: they were then located with the aid of a blink microscope. The final orbit of Messrs. Bower and Whipple represents the observations as follows;

Date.		Place	Observed R.A.	Tabular Decl
1919	Dec.	Mt. Wilson	+0·8′	+2·8′
1921	Jan.	Yerkes	+13·6	3·4
1927	Jan.	Yerkes	+0·2	2·1
1927	Jan.	Uccle	+3·5	+2·2
1930	Jan.	Flagstaff	-2·3	2·9
1930	Feb	Flagstaff	.	-0·5
1930	Mar. 26	..	0·0	0·0
1930	April 24	..	+0·3	+0·1
1930	May 24	..	0·0	+0·2
1930	Aug 21	Yerkes	-0·5	-0·1
1930	Aug 22	Yerkes	-0·6	+0·6
1930	Sept. 1	Yerkes	+0·2	+0·2

The revised Uccle position of 1927 January has been used.

The nearest approach to Neptune in recent years was 19 units in 1892; that to Uranus was 30 units in 1853. The Gaussian constant in the investigation was taken as 0·017213628; this is derived by adding the masses of all the planets to that of the sun.

Research Items.

Hawaiian Feather Cape. A remarkable feather cape, practically in mint condition, is figured and described in *Man* for November, by the owner, Mr. H. Beasley. The cape, which had hitherto not been recorded, was presented to Admiral Otto von Kotzebue, of the Russian frigate *Rurik*, by Namehana, wife of Kamehameha I., in 1816, and remained in the possession of the family until 1928. The cape measures 32½ inches across the top, and 27 inches in depth. It is therefore of more than average size. The main groundwork is of Red Iiwi, while the border, a double crescent, and six pointed panels along the top are all of yellow 'oo'. The second half of the six panels, as well as the semilunar details in the double crescent, are in black.

Geophagy. The interesting but obscure custom of earth-eating, which has been recorded among a number of peoples in various parts of the world, is studied by Dr. Berthold Lauffer in a monograph published by the Field Museum of Chicago (*Publication* 280, Anthropological Series, Vol. 18, No. 2). Geophagy is not a universal custom, yet it may occur almost anywhere, among civilised peoples as well as primitive tribes. Nor is it general in any particular tribe or group. It is recorded in China, Indo-China, Malaysia, Melanesia, Polynesia, Australia, India, Burma, Siam, Central Asia, Siberia, Persia, Arabia, Africa, Europe, and America. Not every kind of earth is eaten; colour, odour, flavour, softness, and plasticity determine the choice. The most important from the point of view of edibility is the so-called diatomaceous earth or kieselguhr, known as 'fossil meal', 'mountain meal', or in China 'stone meal' or 'earth rice', which resembles chalk or clay and consists of siliceous remains of very minute aquatic organisms or diatoms. Earths used for medicine or enjoyment are fine, fat, and usually ferruginous clays. They are consumed in their natural state or lightly baked. Although geophagy has been characterised as a vice or depraved appetite, this is meaningless. Earth is eaten as a substitute for food in time of scarcity, as a relish, medicinally as by pregnant women, or as a part of a religious rite. In practice it appears to have nothing to do with climate, race, creed, culture areas, or higher or lesser degrees of culture. Dr. Lauffer gives a great many new facts which have escaped previous investigators, and the Chinese and American data are fully treated for the first time.

Coloration of Insects and Plant Pigments. Well-known experiments by Poulton, Linden, and others appeared to have proved definitely that green and yellow colours of caterpillars are due to the absorption of plant pigments in the intestine. Later investigations suggested that at least certain insects are able to produce green pigments synthetically. The whole problem has now been very thoroughly revised by P. F. Meyer, who has published an interesting and well documented account of his experiments (*Zeitschr. vergl. Physiol.*, vol. 11, 1930). He experimented with caterpillars of various species, which were raised on white bread, with or without the addition of the respective plant pigments, and the hæmolymph was then examined chemically for the pigments. It was found that neither chlorophyll nor any of its products is absorbed in the intestine of insects, and the green pigment in the hæmolymph of insects has no relation to chlorophyll, but represents an oxidation product of a protein. Carotin was found in the hæmolymph, but it was present in the caterpillars bred on food free of carotin as well. The experiments proved also that the absence of chlorophyll and of carotin in the food did not affect the coloration, growth, or reproduction of the insects.

Colloidal Particles in Water as Food for Mosquito Larvæ.—Larvæ of *Anopheles* obtain their food mainly by filtration of water through their highly specialised mouth-parts. It was usually thought that in this way only certain Protozoa, algæ, and generally particles not less than 5μ in size are ingested and serve as food. Investigations carried out by N. K. Shipitzina in the Zoological Laboratory of the University of Perm (*Bull. Biol. Institute*, Perm Univ., **7**, No. 4) prove that the larvæ are capable of catching and retaining even colloidal particles, as for example, those of collargol, Chinese ink, and carmin. Larvæ of all stages placed in water with the above substances in colloidal solution filled their guts with them. This shows that their filtering apparatus is a kind of ultra-filter capable of retaining colloidal particles. The retention is not selective and any particles suspended in water are collected in the gut. Experiments with rearing larvæ in pond water without any other food except the colloidal substances proved that they can develop only up to the fourth stage, when they died.

Physiology of Digestion in *Sabella*.—Edith A. T. Nicol (*Trans. R. Soc. Edin.*, **56**, 1930) describes in detail the branchial crown of *Sabella pavonina*, a tube-dwelling polychæte which occurs in estuarine mud in great numbers in some localities. The pinnules of this crown are ciliated and cause a current of water to flow between the filaments. Particles in suspension are caught by the cilia and carried to a groove on each filament, down which they pass to a pair of basal folds. Here they are sorted into three grades according to size; the largest particles are carried to the palps and rejected, the medium-sized are carried to a pair of ventral sacs and stored there until required for tube building, and the finest particles are conveyed to the mouth. Particles from the ventral sacs are mixed with mucus, laid, like a rope, along the edge of the tube, and cemented into place by the mucous secretion of the first body segment. The fine particles, including flagellates, algal spores, and diatoms, pass into the gut. The food takes an average of twenty-two and a half hours to pass through the gut at 16° C. The enzymes present in the gut are an amylase, a protease, and a lipase. The reserve materials are stored in the body as fat and glycogen; the latter occurs in large quantities in the eggs but not in other tissues. An account is given of the anatomy and histology of the branchial crown and of the alimentary tract.

Effect of Sunlight on Aquatic Organisms.—In the *Canadian Journal of Research* (Vol. 3, pp. 104-106; 1930) Dr. A. Brooker Klugh gives data of experiments to study the effect of the ultra-violet component of the sun's light on certain aquatic animals which live at or near the surface of the sea or in shallow fresh water. Dr. Klugh dealt with young eels (*Anguilla rostrata*), an amphipod (*Gammarus locusta*), and a ctenophore (*Bolinopsis infundibulum*) which lives near the sea surface. Under the filter transmitting ultra-violet light only, eels were killed in 18-24 hours; amphipods, young and adult, in 2-4 days; and the ctenophore appeared little affected. These results were in marked contrast to those previously published for animals which live at some considerable depth in the sea or come to the surface only when the illumination is very weak; such forms were readily killed by exposure to ultra-violet radiation. In the experiments three filters were used, the first transmitting both the visible and the ultra-violet regions, the second only the visible, and the third the ultra-violet only.

Venom of an Australian Snake.—In the Cape York Peninsula, one of the two most common venomous

snakes is *Pseudechis australis*, from a living example of which was obtained the venom used in experiments described by C. H. Kellaway and Donald F. Thomson (*Australian Jour. Exp. Biol. and Med. Sc.*, vol. 7, p. 133). The venom was collected weekly, and gave a low yield during sloughing, and a high yield after the snake had fed when sloughing was over. Its secretion is a relatively rapid process. Subcutaneous injections were made in sheep, monkeys, cats, rabbits, guinea-pigs, rats, and mice, and the assured lethal dose varied from 3·0 mgm. per kgm. weight of the animal, in mice, to less than 0·6 mgm. per kgm., in sheep. The poison has a powerful hæmolytic action and a more marked anticoagulant action than the venom of any other Australian snake. There is little evidence of any neurotoxic action, the only hints of such action being afforded by the ptosis which occurs as an early symptom in monkeys, the effects on the blood pressure of rabbits, and the failure of respiration which in some species is the final event following its injection. Unlike most Australian venoms, it has a striking action on the heart muscle. Possibly the venom contains a hæmorrhagin; but even if present, this plays no striking part in causing death.

Caribbean Land Molluscs. A short expedition to the Caribbean islands, made by the yacht *Mary Pinchot* between April 16 and 27, resulted in the collection of a series of land molluscs, of which twenty-seven are regarded by Henry A. Pilsbry as new forms (*Proc. Acad. Nat. Sci. Philadelphia* vol. 82, p. 221; 1930). Of the general results of the analysis of this collection the most striking is that 78·26 per cent of the shells from Grand Cayman are Jamaican in their affinities. The possible explanations are either that Grand Cayman was formerly a block of a greater Jamaica, or that the fauna has been carried across the intervening sea from Jamaica by hurricanes or by the ocean current. Both suggestions meet with difficulties. There is no definite set of current in the direction required, even if the molluscs were adapted for marine transport, which some are not. Transportation by birds has been observed in the case of *Succinea*, and *Cerion* and *Helicina* may have been carried by ocean currents, but the most credible explanation of the high similarity is that Grand Cayman, never connected with Cuba, which has a different assemblage of molluscs, had a land connexion with Jamaica in early Tertiary times.

Chromosome Numbers in certain Legumes. A cyto-taxonomic study of the related leguminous genera *Medicago*, *Melilotus*, and *Trigonella* has been made by Prof. J. R. Fryer (*Can. Jour. Research*, Vol. 3, No. 1). The number of chromosomes and their morphology has been recorded for 25 species of *Medicago*, 4 of *Melilotus*, and 3 of *Trigonella*, from a study of the root tips. The chromosomes are grouped as of six lengths, ranging from about 5 μ to 1 μ. All the chromosomes of each species are usually of the same size in some sections of the genus *Medicago*, but in the subsection Pachyspiræ there are usually two sizes present in the chromosome group. Satellites are also present on certain chromosomes, and tetraploid cells or sectors sometimes occur in otherwise diploid roots. In *Medicago* the somatic numbers found are 14, 16, and 32. The same numbers have been found in different species of the related genus *Trifolium*. In the genera *Melilotus* and *Trigonella* the only number found was 16. The Falcago section of *Medicago* contained some species with 16 chromosomes and others with 32, suggesting that the tetraploid species may have arisen directly from related diploid species. There is found to be no relation between tetraploidy and the perennial habit, since some diploids are perennial and some tetraploids annual. Both diploid and tetraploid strains were found in *Medicago falcata*, and reasons are given for regarding *M. media* as a hybrid between *M. sativa* and *M. falcata*.

Origin of Coal. – A readable and well documented account of recent work upon this question will be found in the *Naturwissenschaftliche Umschau* of the *Chemiker-Zeitung*, **19**, No. 9/10, by Dr. Fritz Rosendahl. Coal obviously arises from plants, and the different types of plants responsible for lignite and coal respectively can, to a considerable extent, still be recognised by the microscope. But, although attacked in various ways – by analysis of the end products in the earth, by laboratory experiments upon the behaviour of present-day plants when left to decompose under various conditions, etc. – the factors responsible for the production of peat, lignite, and coal are still in dispute. It now seems fairly clear that cellulose constituents disappear before the lignin constituents in the plant walls; fatty and waxy deposits such as plant cuticles, probably vary in importance in different deposits, varying particularly with the content in these substances of the original plant material. Lignite and coal have probably developed from peat-like deposits, and Dr. Rosendahl makes it clear what an important influence the theories of Taylor have had upon recent developments in investigation of this subject. Taylor has directed attention to the great influence the nature of the mineral covering layer will have upon the further chemical changes proceeding in buried deposits of peat-like plant material.

Geology of the Shetlands. Continuing his investigation of the Old Red Sandstone of the Shetlands, Dr. T. M. Finlay describes in the *Trans. Roy. Soc. Edin.*, Vol. 56, Pt. 3, No. 27, 1930, the sedimentary and igneous rocks lying to the west of the metamorphic series that forms the backbone of the islands. The sediments turn out to be quite unlike those of the same system from other areas, partly because of the metamorphism they have suffered and partly because they represent fine grained sediment slowly accumulated in a deeper basin. Plant remains are the only fossils, and they are quite untrustworthy for detailed correlation. The assemblage of igneous rocks, however, bears so close a resemblance to those of the Lower Old Red Sandstone in Scotland that the balance of evidence supports the view that here, too, the rocks are of the same age. Andesitic lavas and tuffs underlain by rhyolite and basalt are strongly developed. This volcanic phase is succeeded by an intrusive complex ranging from gabbro to granite. A third phase is represented by dykes of three series; the earliest is lamprophyric; the second is of quartz-porphyry, chilled against the first and including xenoliths derived from them; the third consists of highly acid granophyres containing spherulites with fibres of riebeckite. It is suggested that those latest dykes may possibly be of Tertiary age.

Production of Low Temperatures. The apparatus usually employed to produce liquid hydrogen is elaborate and costly, with the result that it is available for low temperature researches in very few laboratories, although quite small quantities of liquid would often suffice. A small and inexpensive liquefier is described by M. Ruhemann in the *Zeitschrift für Physik* for Oct. 8, which, it is claimed, can be assembled in a few days by any laboratory workshop. It operates on the Linde principle, hydrogen drawn at high pressure from a cylinder, after purification, being first circulated through a tube immersed in liquid air, and then subjected to valve expansion with

regenerative cooling in the usual way. The main part of the system is supported in a Dewar flask. The temperature of liquid hydrogen (20° absolute) is attained in from five to eight minutes with an initial pressure of rather more than 100 atmospheres and a flow of a few litres per second, whilst liquid helium can be equally readily produced if liquid hydrogen is available in quantity. The use of the apparatus is obviously limited by the small volume of the vessel into which the valve opens, but, with this restriction, it makes the production of very low temperatures feasible in any place when liquid air can be obtained.

Variation of 'Flashover' Characteristics.—The use of a pressure of 132,000 volts for the transmission of electric power on the English network has brought prominently to the front many new problems in connexion with high voltages. In *World Power* for November, S. Whitehead and W. D. Owen discuss the influence of altitude on the flashover characteristics of electrical equipment. It is well known that sparks occur more readily between electrodes the smaller the density of the surrounding gas and the higher its temperature. At high altitudes also, the brush discharge, which is called the corona and is due to the high electric pressure, makes its appearance more readily. The authors discuss the formulæ from which the flashover and corona can be predicted and state that they give accurate results. The standard density and temperature of the atmosphere in engineering work is 760 mm. and 25° C. respectively. Experimental results for sparkover and flashover are reduced to this standard density and pressure. It is pointed out that this temperature is too high for general use in Great Britain. For rating machinery it is most convenient to use the standard conditions at sea-level. But the mean sea level temperature is only 11° C., and this introduces a four per cent error in the rating. They suggest that this temperature should be taken as the standard. It is important that the rating of all the machinery and devices for very high voltages should be done for the same temperature.

Low Temperature Oxidation.—Some experiments on the lag in ignition (the interval of time between the rapid heating of a combustible mixture to, or above, the ignition point and the appearance of flame) in the case of mixtures of hydrocarbons and air are described by J. S. Lewis in the October number of the *Journal of the Chemical Society*. The lag may, in certain cases, terminate in rapid oxidation unaccompanied by flame, examples of which are given in the paper. The experiments were conducted in glass bulbs of 125 c.c. capacity with a long narrow neck, which were maintained at the desired temperature, and the liquid introduced in small wide-mouthed tubes of thin glass. Experiments with petrol freed from aromatic hydrocarbons showed that removal of the lighter constituents caused an appreciable drop in lag and in ignition temperature, and such fuel would probably 'knock' more readily. The effects of powdered glass, charcoal, metals, etc., were studied.

Replacement of Castings by Weldings.—In a paper read before the Institution of Welding Engineers on Oct. 16, Mr. P. L. Roberts discussed the possibilities of replacing iron castings by welded structures built up from rolled steel. Among the advantages which are claimed are an increase of strength of 2·5 times or a corresponding reduction of weight; economies in material used, in the workshop accommodation required, and in machining, the latter being due to increased accuracy of dimensions. Among the examples given the two extremes may be mentioned. In the first case a casting weighing 1750 lb. was replaced by a 'welding' the weight of which was 850 lb. The cost per lb. was much the same in each case, with the result that a saving of 52 per cent was effected. The largest part recorded was a casting weighing 16,000 lb. The corresponding welding weighed only 9300 lb. and cost but a little more per lb. In the aggregate a saving of 32 per cent was obtained. The greatest saving, 66 per cent, was effected on a part which as a casting weighed 5576 lb. and as a welded structure but 1920 lb. It is pointed out that if welded parts are to be as economical as possible, their design should be treated *ab initio*. The mere modification of the design of the casting means the retention of many features—such, for example, as arrangements for coring and withdrawal from the mould which, though necessary in the casting itself, are of no importance in the welding.

Preparation of Catalysts.—Dr. R. Dankoff, of the State Physical-Technical Institute, Leningrad, has sent us a communication on this subject. The method he uses consists in depositing metals from the vapour form on cold surfaces, since it was expected that such surfaces should possess a very fine structure and great capacity for adsorption. Previous experiments of Gauger with nickel and platinum so deposited, with a mixture of ethylene and hydrogen, showed that no reaction occurred, but Dr. Dankoff states that deposits of nickel, platinum, and iron produced by condensation in vacuum of 10^{-5} mm. on glass at 0° C. showed considerable activity. No great variation in the results was found with metals deposited at −180°. A mixture of hydrogen and ethylene introduced into the apparatus reacted energetically at 0°, in the case of nickel two-thirds of the mixture reacting during the first minute. The initial pressure was 55 mm., the volume 200 c.c., and the catalyst surface 100 cm.^{2}. Platinum was more active, iron less active, than nickel. In the case of nickel a dependence on the thickness of the deposit was found, indicating the porous character of the surface, as found in adsorptive experiments. A curve accompanying the communication shows the dependence of the rate of reaction on the thickness of the layer expressed as the number of layers of atoms in the deposit, but it is not suitable for reproduction.

Hydrolysis of Di- and Poly- Saccharides.—The determination of the relative ease of hydrolysis of disaccharides and of polysaccharides such as starch and cellulose has recently received attention by several experimenters. Since the structure of cellulose as a long chain of cellobiose units is now established on a reasonably firm basis, and since it may be assumed that starch is presumably derived in a similar manner from maltose, the interrelation of the reactions involving both the analysis and synthesis of these products is of interest. In the October number of the *Journal of the American Chemical Society*, Hibbert and Percival describe the hydrolysis of cellulose, cellobiose, cellodextrin, starch, inulin, and levan (from the action of *B. mesentericus* on sucrose), using zinc chloride dissolved in hydrochloric acid as a medium. A single unimolecular velocity constant is assumed. It is concluded that the slow hydrolysis of cellulose is, in a large part, due to the slow hydrolysis of cellobiose; that cellobiose is not a reversion product; and that there seem to be no grounds to suppose that starch and cellulose are essentially different, except for the α-linkages in the former and the β-linkages in the latter. The rates of hydrolysis of sucrose, levan, and inulin in 0·1 N oxalic acid at 65° are almost the same, and it is concluded that this behaviour is related to the γ-fructose residue present in each.

The Antiquity of Civilised Man.

THE Huxley Memorial Lecture for 1930 of the Royal Anthropological Institute was delivered on Nov. 19 by Prof. A. H. Sayce, who took as his subject "The Antiquity of Civilised Man".

One of the leading obsessions of the historian has been the belief in the recent evolution of civilisation and the shortness of the period during which it has endured, an obsession derived from medieval tradition. Another tradition derived from medieval belief was that of the decline instead of the progress of civilisation and culture. The belief in a 'Golden Age' had been fostered by the manifest relapse into barbarism which characterised medieval Europe. Civilised man, it was held, had had but a brief existence, and the documents which ascribed to him an earlier date were unworthy of credence. The heroes of the old legends became 'solar myths' and 'the ancient empires of the east' were stripped of their antiquity.

A new era has dawned upon us. The scientific method, aided by the spade, has opened up a new world and furnished us with facts instead of theories. The result is that the story of the antiquity of man which is being told by geology is being retold of civilised man by archaeology. The age of civilised man must be pushed back through the centuries like the age of uncivilised man. The last hundred years have unfolded a new world—that of the civilised past.

Historical Egypt now has its lessons to teach us. While the literary historians have been vying with one another in the endeavour to minimise its antiquity, the spade of the excavator has made discoveries which have rightly been termed revolutionary. At Saqqara Mr. Firth has laid bare a complex of buildings without parallel anywhere else in the country. In the art and architecture of these buildings, and in the work of artists of the Third Dynasty in the time of King Zoser, described so recently as 1895 as a 'mythical' king, Egypt would seem to have reached its climax. Architecture, art, and glazed tiles all testify to long centuries of development which must have preceded the period of perfection to which they belong. The same impression is made upon us when we come to examine the hieroglyphic script. It is already as complete and conventionalised by use as in the days of Rameses and Darius. The alphabets are there by the side of the syllabary and ideographs; and there are indications that the hieratic or cursive hand was already employed. The smaller objects of daily life the furniture of the house, the jewellery and garments that were worn, or the articles of the toilet the discoveries made by Dr. Reisner in the tomb of the mother of Kheops prove that at the beginning of the fourth dynasty the culture and art of Egypt were still at their highest level.

When we turn to Babylonia, there also the latest discoveries have pushed back the highest development of its art yet known to us to an undetermined but remote antiquity. Hitherto ancient Babylonia, whether Sumerian or Semitic, has seemed artistically deficient and inferior; its inhabitants were primarily men of business and trade, the initiators of banking and international commerce, but with little artistic sense. The Royal and other tombs found by Mr. Woolley at Ur have revolutionised our judgment on this matter. The gold and silver work, the inlaid designs in shell, have revealed an art of the first order. Yet the tombs and their contents actually belong to Babylonian pre-history rather than history. The few inscriptions found with them are not yet in the fully developed cuneiform or linear script which already had a long history behind it when Sargon of Akkad founded the first Babylonian empire in 2700 B.C. They are in fact still the pictographic designs out of which the first semi-linear and then the cuneiform signs developed. With them goes another remarkable fact. This advanced art and culture exhibited in the tombs is accompanied by human sacrifice on a vast scale, which reminds us of Dahomey rather than of the Near East. Human sacrifice was not only unknown in historical Babylonia, but also its very existence in any period of the past history of the country was ignored. Yet the Royal tombs by no means belong to the earliest period of Babylonian history. Mr. Woolley tells us of five further layers all necessarily older than the cemetery into which the Royal tombs were sunk. By them we are taken back to the times when the alluvial plains of Babylonia were only beginning to be formed at the head of the Persian Gulf.

It may be that the Royal tombs of Ur, modern as they are when compared with the strata below them, belong to a pre-Sumerian time and a pre-Sumerian race. The Sumerian people called themselves "the black headed race". This implies that there was also a blond race in the country, an inference confirmed by the fact that Sumerian art represents them as broad skulled, whereas most of the early skulls discovered at Ur and examined by Sir Arthur Keith prove to be dolichocephalic. On the Egyptian monuments the Amorites of Palestine are depicted as blonds with fair hair and blue eyes. In these blond Murru we must see the Mesopotamian Mitannians of later history, the Murrian or Amorite predecessors of the Sumerians. At Tepe Gawra Dr. Speiser has discovered two strata of cultural remains below the stratum which belongs to the Bronze age and the appearance of the Sumerians. In this last the copper objects resemble those found at Ur and El Obeid, which are dated to the period of the first dynasty of Ur (about 3100 B.C.), whereas the earlier strata ta[ke] us back to the aeneolithic period and the painte[d] pottery of Jemdet Nasr.

The tombs of Ur, however, testify to more than an advanced art and human sacrifice. They indicate a wide international trade and the working of mines. Gold, silver, and lapis lazuli are all found in them in profusion as well as copper. Gold came from the Persian Gulf, but silver was probably brought from the mines of the Taurus. This fact is in harmony with the discoveries recently made in China and north-west India. Both at Mohenjo-Daro and at Harappa a civilisation has been brought to light which was in close touch with Elam and Sumerian Babylonia. In China, Prof. Andersson has found painted and polished pottery of the neolithic and chalcolithic age which is related to the neolithic pottery discovered in Susa; similar ware has been found in Babylonia and at Sakche-gozu, north of the Gulf of Antioch; while the recent excavations of Prof. Li at Yin in Honan have shown not only that the Shang Dynasty (1766 1154 B.C.) was historical, but also that the account of its sculpture and script, with the long preceding development and commercial intercourse implied by them, was based on fact.

point to the Third Dynasty of Ur (2400 2300 B.C.).

It is unnecessary to dwell upon the length of time presupposed for the rise and development of all this trading activity, with the means of traffic and use of writing which it implies. Civilised man is far older than the purely literary scholar has dreamed.

Caledon Meeting of the South African Association for the Advancement of Science.

THE twenty-eighth annual meeting of the South African Association for the Advancement of Science was held at Caledon on July 7-12, 1930, under the presidency of Mr. H. E. Wood, Union Astronomer. The meeting was well attended and eighty-two papers were read. The South Africa Medal and grant were presented to Dr. A. L. du Toit at the close of the presidential address. A popular illustrated lecture was given by Dr. G. H. Skaife on heredity. There was a reception by the Mayor and councillors and visits to various places of interest in the neighbourhood.

The presidential address by Mr. H. E. Wood was entitled "Recent Astronomical Developments". In it he pointed out that astronomical observatories throughout the world are about to combine to redetermine the mean distance of the sun from the earth, the unit in terms of which all astronomical distances are measured. This is being undertaken now because the minor planet No. 433, Eros, makes a near approach to the earth early in 1931. Mr. Wood also indicated that in many cases he enumerated, while the actual object has not been attained, many other highly important astronomical discoveries have resulted. Problems of the determination of the distances of the stars were discussed and the various methods compared. The constitution of interstellar space in the light of recent work was described. Recent advances in knowledge of the nature of light and Millikan's work on high frequency radiation were noted. The address closed with a review of man's conception of the universe at various stages of his history.

The presidential address to Section A was delivered by Prof. H. H. Paine, who dealt with "The Motion of Ions and Colloid Particles in an Electric Field". The alliance of physics, chemistry, and mathematics was indicated, with a possible extension to biology. Research in electrical specific conductivity of solutions was discussed, as were the possible effects of neighbouring ions on each other's mobilities. The rôle of the ionic atmosphere and the work of Debye and Hückel were set forth. Onsager's work, eliminating the use of Stokes's law for the movement of ions, and the Brownian movement of ions were discussed. Evidence was given from personal work that the initial rise in mobility so often observed is due to the residual electrolyte impurities in a colloidal solution. The analogy between ions and colloidal particles, so far as their electrical structures are concerned, was the chief argument of the address.

Prof. W. F. Barker chose "Some Effects of Light" as his presidential address to Section B. He first set forth the relationships of the various kinds of radiation and the effect of the excited atom or molecule. Photochemical processes were discussed in relation to photography, vision, and carbon assimilation in plants. The photochemical association in rhodopsin was briefly outlined. The far-reaching importance of photosynthesis of plants was indicated. The synthesis of sugars by plants and the decomposition products of activated carbonic acid, especially the possible intermediate production of formaldehyde, were discussed. The work of Baly, Porter, and Ramsperger was analysed and the importance of surface reactions indicated. The reactions of activated formaldehyde with simple inorganic nitrogenous compounds, with the synthesis of proteins in the daytime and their transport at night, probably as asparagine, were discussed. The nitrate supply as the limiting factor in the synthesis of proteins in plants and the practical application to the fertiliser problem were indicated. The chemistry of chlorophyll and vitamins was described and also the effects of ultra-violet light on living organisms.

The president of Section C, Dr. E. P. Phillips, gave "A Brief Historical Sketch of the Development of Botanical Science in South Africa and the Contribution of South Africa to Botany" as his address. It comprised a review of botanical progress over two hundred and fifty years. Three periods were set forth. The first commenced with the early botanical collectors from the Cape, to the time of W. H. Harvey and his "Genera of South African Plants". At the close of this period, about 1868, the first South African botanists appeared, and the second period, ending about 1903, was marked first by quiescence and then by renewed activity. The third period, from 1903, marked the development of botanical science in the universities. The collectors, botanical literature, and trends of each period were detailed. The first period was marked by much taxonomic work and at its end by publications. The second period saw great extension of this work, and the influence of Bolus at the Cape and of Medley Wood in Natal was marked. The activities of many other collectors were detailed and the vast amount of work on systematic botany and plant geography indicated. The third period, from 1903 onwards, was marked by university developments, plant biology studies, economic botany in many phases, plant embryology, and the institution of the Union Botanical Survey.

"Some Aspects of Bird Life" was chosen by Dr. E. L. Gill as his presidential address to Section D. Adaptations were discussed. It was pointed out that the reaction against adaptation to environment has almost certainly overshot the mark, though correlation of structure and way of life are not necessarily close. Wading birds were discussed in relation to their feeding habits, bills, and legs. The avocet's turned-up bill "may be the result of some phase of racial pathology perhaps not just disastrous enough to lead to the extinction of the stock". Plumage and its relation to flight were also discussed. The subject of subspecies and races of birds was introduced and the time-factor for the development of subspecies indicated with reference to Moreau's work on crested larks in Egypt. Bird behaviour and patterns of behaviour in courting, play, and leisure were noted, and migration of birds as affecting South Africa discussed. South Africa has few islands and on the mainland dispersal is rapid. South Africa is the terminus for the great migrations from the far north. Great numbers of European birds winter at the Cape, and many African birds come to breed and then return to tropical Africa for the southern winter. The movements of the purely African birds are still largely a mystery. The birds of the Southern Ocean need more investigation—a matter of difficulty. The physiological effect of migration and the unknown stimulus that moves birds to such unaccustomed feats of endurance were also mentioned.

The subject of "South Africa's Place in Prehistory: A Plea for Organised Research and the Better Preservation of Historic Remains", formed the presidential address to Section E given by Mr. C. van Riet Lowe. The early history of archaeology was briefly reviewed, the South African work dating roughly from Dale, 1866, since when a number of workers have appeared. The reasons for differences in nomenclature in South African and European cultures were detailed, and also the relationship of European and African Stone Ages. The importance

of geology and geography in relation to ethnology was stressed. Various aspects of African prehistoric art were detailed and stress laid on the value of rock engravings or petroglyphs, the evolution of numerous styles and four probable successive phases being outlined. The need of correlation of all associations and of detailed search for such associations was urged. The address concluded with an appeal for greater study and better preservation of archæological objects.

"Some Problems of the Transition from Subsistence to Money Economy" was the subject of the presidential address of Mrs. M. Palmer to Section F. The transition is inevitable and many South African natives are now in the transition stage. The conservatism of subsistence economy is because of its guidance by customs and absence of markets, competition, and profits; and communal tenure of land is correlated with such economy. The social and economic reactions to be expected under the extremely rapid transition in the African and eastern areas of the world were discussed. Private ownership of land has caused misunderstandings repeatedly among primitive peoples and the commercial use of land is incomprehensible to them. The widely divergent accounts of the economic position of the native were explained. Even when individual peasant tenancies are established, an unemployment problem appears in the second generation. Commercial agriculture requires commercial development to balance it. The teaching of primitive crafts by out-of-date means to natives was deplored, for it gives them false ideas of successful livelihood that cannot materialise in competition with machinery. Artificial means of inducing natives to take up wage-labour have been necessary, and taxation and organised recruiting have supplied these. At first the native, who only works in town about half the year, separated from his land and family, regards wages as tax money or as a means to luxury. Later, as his needs increase, subsistence in the reserve largely disappears and his town wages are his real support. Under such conditions, under-cultivation of the reserves, inefficient and casual labour, a lessened market for the products of industry, and numerous evils due to lack of supervision and separation of families result. The system of 'native treasuries' and of co-operative credit societies was explained and recommended as a great aid in bridging this transition period.

In Section A, meteorological work in the Transvaal and in Mozambique was described. The effects of oil on the coefficient of restitution and the electrical field of the atmosphere are of interest to physicists; astronomers dealt with the origin of meteorites and the apparent orbit of a spectroscopic binary. A new method of deducing borehole capacity was propounded; and the veteran mathematician, Sir Thomas Muir, made his tenth contribution to the bibliography of determinants.

In Section B, soil chemistry in connexion with the potash requirements of South African soils, base exchange in the Malmesbury shale series, soil acidity, sticky point water, and hard pan formation produced a number of papers. Slangbos oils and the antimony electrode were discussed. The state of natural water supply and the effect of destruction of vegetal cover received serious consideration, as did also a paper on the medicinal waters of South Africa in international measurements.

In Section C, systematic work on the Virosæ division of the Euphorbiaceæ, on new *Liliaceæ*, Hydrocharitaceæ, Dianthaceæ, and Lobostemon was detailed by various workers. Economic botany was represented by work on barley diseases, South African fungi, root nodules, abnormalities in the composition of oranges and seed formation in pears, and effects of fire on biotic communities. Ecological work dealt with 'Gifblaar' (a stock poison), flora of a lamsiekte farm, bush groups, and floras of individual areas. The physiological side was represented by work on hydrolysis in the vine and the influence of soil water around roots on the hydrogen ion concentration of tracheal sap.

In Section D a number of interesting topics were discussed. A series of papers by members of the University of Stellenbosch dealt with Amphibian osteology, osteogeny, and ontogenesis in regard to various forms, including *Heleophryne*, and there was discussion of Noble's dictum in relation to the latter form. Ecological notes were given on the Acrididæ of the Cape Peninsula. Seasonal variation in the coat of common domestic mammals and density in variation of the fleece of the merino are of economic importance. Animal ecologists also dealt with the methods of studying numbers of terrestrial animals and numbers of tsetse fly in Tanganyika Territory. A modification of the rapid agglutination test, of use to the veterinary profession, was set forth. Descriptions were given of a number of new species of Protozoa, including new and economically important Myxosporidia of fish and new Protoopalinidæ. Cases of physical inheritance and of racial admixture, including Chinese crosses with various natives and Indians, were described. Variations in the skulls of vervet monkeys, ovine schistosomiasis, and social hydrology were also discussed, and a morning was devoted to a discussion on provision for marine biology. The centenary of the death of Lamarck was commemorated.

In Section E a human skull was described. The chronology of the Mossel Bay industries was detailed and illustrated, as were implements found in a cave at Tafelberg Hall. Interesting accounts of cattle magic and medicines in Bechuanaland and of Bantu customs in relation to widowhood and lobola formed important contributions to social anthropology.

In Section F, the historical side was interestingly represented by short papers on an eighteenth century MS. on agricultural improvement at the Cape and on the first leper settlement in South Africa. The psychology of mysticism and of personality were discussed, and a reasoned account of the psychological factors affecting the attitude of black to white was presented. The crisis in our present civilisation was given a fine exposition. The progress of Portuguese children in Lourenço Marques and in Portugal were compared.

The next annual meeting of the Association will be held in July 1931 at Grahamstown, under the presidency of Prof. J. W. Bews, professor of botany at the Natal University College, Pietermaritzburg, Natal.

H. B. F.

University and Educational Intelligence.

CAMBRIDGE. - J. C. P. Miller, of Trinity College, has been elected to an additional Isaac Newton Studentship tenable for one year.

The General Board has recommended that a readership in statistics shall be established as from Jan. 1 next, and that it should be authorised to appoint as first holder of the readership Mr. G. Udney Yule, of St. John's College. It is recommended that the readership shall be assigned primarily to the Faculty of Agriculture and Forestry.

The Faculty Board of Archaeology and Anthropology has appointed C. B. Humphreys, of Christ's College, to

be honorary keeper of the Melanesian Collection in the Museum of Archaeology and Ethnology.

The Gedge Prize for original observations in physiology has been awarded to H. Barcroft, of King's College, who gained first-class honours in the Natural Sciences Tripos Pt. II., 1927.

LONDON.—The following doctorates have been awarded: *D.Sc. Degrees in chemistry* on K. R. I. Krishnaswami (University College) for a thesis entitled "A Revision of the Atomic Weight of Tantalum" (*Jour. Chem. Soc.*, June 1930), and (2) "The Atomic Weight of Antimony from different Sources" (*Jour. Chem. Soc.*, 1927); and H. L. Riley (Imperial College—Royal College of Science) for a thesis entitled "Studies in Complex Salts" (*Jour. Chem. Soc.*, 1928–30, *Phil. Mag.*, 1924, 1927). *D.Sc. Degrees in physics* on J. H. Brinkworth (Imperial College—Royal College of Science) for a thesis entitled "On the Measurement of the Ratio of the Specific Heats of Gases" (*Proc. Roy. Soc.*, 1925, 1926, 1930); and Prof. H. Dingle (Imperial College—Royal College of Science) for a thesis entitled "The Successive Spectra of Fluorine" (*Proc. Roy. Soc.*, 1926, 1928, 1929, 1930). *D.Sc. Degree in zoology* on H. Mukhopadhyay (Imperial College—Royal College of Science) for a thesis entitled "On the Development of the Vertebral Columns of Urodela and Anura" (*Phil. Trans.*, 1930). *D.Sc. Degree in geology* on G. Sheppard, for a thesis entitled "The Geology of South-West Ecuador", together with thirteen subsidiary contributions.

PROPOSALS have been made for the formation of an Association of Examiners for the adequate discussion and ventilation of the problems with which examiners are faced. It is suggested that the inaugural meeting be held early in January. Further particulars and information may be had from Mr. B. C. Wallis, 345 Stag Lane, London, N.W.9.

REFERRING to the note in NATURE of Nov. 15, p. 791, we are informed that while it is true that Prof. R. Robinson (Oxford) has received an invitation to act as the non-resident lecturer on the George Fisher Baker Foundation of Cornell University during the second term of the academic year 1933–34, he has not yet intimated his acceptance of this invitation.

THE Harvard Engineering School is offering this year a new course on vibration problems, a subject which is growing in importance in the design of high-speed machinery, although it has been neglected in most American engineering schools. The course will deal mainly with the physical and mathematical basis of mechanical vibration and is being given by outside lecturers, Messrs. J. Ormondroyd and A. L. Kimball, the general direction of the course being under Prof. Arthur E. Norton, of the Harvard Engineering School. Mr. Ormondroyd is manager of the Experimental Engineering Division of the South Philadelphia Works of the Westinghouse Electric and Manufacturing Co., and has had wide experience in vibration problems. Mr. Kimball is Associate Head of the Mechanics Section of the General Electric Company Research Laboratory at Schenectady; he has made a special study of photoelastic methods of stress analysis and is an authority on vibration damping.

A PRELIMINARY programme has been issued of the nineteenth annual Conference of Educational Associations, to be held at University College, London, W.C.1, on Dec. 31–Jan. 7, under the presidency of Sir Richard Gregory, whose presidential address, entitled "The Worth of Science", will be delivered on the first day of the Conference. Among the papers and discussions arranged are the following: Learning how to study, by Prof. T. H. Pear (British Psychological Society—Education Section); efficiency of first school examinations and their relation to matriculation, by Sir Philip Hartog (New Education Fellowship); "The Beauty and Wonder of the World", by Sir Arthur Thomson (School Nature Study Union); vocational guidance, by Dr. Macrae (Training College Association); individual work in mathematics, by Mr. G. W. Spriggs (Dalton Association); discussion on experimental phonetics, Prof. E. W. Scripture and Prof. P. Menzrath (Modern Language Association); educational handicap of the deaf from the psychologist's point of view, by Dr. J. Drever (National College of Teachers of the Deaf); and a joint conference on the teaching of geography, at which the speakers will include Sir Richard Gregory (chairman), Mr. J. Fairgrieve, Sir William Furse, Miss B. Hosgood and Mr. C. B. Thurston. Exhibitions of books, handwork, and school equipment will be open during the Conference, the B.B.C. is arranging a lecture and demonstration on school broadcasting, and Prof. Winifred Cullis is giving a lecture demonstration on teaching biology by wireless. Full particulars of the Conference can be obtained from the Secretary, Miss M. A. Challen, 29 Gordon Square, London, W.C.1.

Historic Natural Events.

Nov. 30, A.D. 60. St. Paul's Storm. St. Paul, being carried for trial at Rome, was taken on board a ship at Cæsarea. The ship touched at Sidon and was then forced by northerly winds to pass south of Cyprus to the south coast of Crete. By this time "the Fast was already past" [probably that of Expiation, Sept. 25], and Paul advised the master of the ship to winter in harbour. This advice was disregarded, however, and the ship set out for a more commodious harbour. The account continues: "But not long after there blew from the shore a tempestuous wind, called Euroclydon. And when the ship was caught, and could not bear up against the wind, we let her drive." Neither the sun nor stars appeared for many days, and there was "no small tempest". On the fourteenth night, "falling into a place where two seas met", they ran the ship aground on an island called Melita, where she was broken up by the violence of the waves, but all were saved. This is believed to be the island of Malta, but Dr. William Falconer, who prepared a dissertation on the voyage, identified it with Melada in the Adriatic. The date of the shipwreck is not known accurately, but Dr. Falconer calculated that it was most probably at the end of November or beginning of December.

Nov. 30, 1645. Earthquake in the Philippines. The greatest earthquake known in the Archipelago. From Manila to the northern provinces of Cagayan and Ilocos Norte, few stone buildings escaped destruction, some native villages completely disappeared, while there were many changes in the surface features and in river-courses.

Nov. 30, 1775. Destruction of Fish. An account of the drought of 1775–76 in Sumatra (*Philosophical Transactions*, Abridged Ed., Vol. 15, p. 127) states that: "In the month of November, the dry season having then exceeded its usual period and the S.E. winds continuing with unremitting violence, the sea was observed to be covered, to the distance of a mile and in some places a league from shore, with fish floating on the surface. Great quantities of them

were at the same time driven on the beach or left there by the tide, some quite alive, others dying, but the greatest part quite dead. The fish thus found were not of one but of various species, both large and small, flat and round, the cat-fish and mullet being generally the most prevalent. The numbers were prodigious, and overspread the shore to the extent of some degrees. Their first appearance was sudden; but though the numbers diminished, they continued to be thrown up, in some parts of the coast, for at least a month, furnishing the inhabitants with food, which, though attended with no immediate ill consequence, probably contributed to the unhealthiness so severely felt. No alteration to the weather had been remarked for many days previous to their appearance. The thermometer stood as usual at the time of year at about 85°."

Dec. 1, 1607. Frost in Lake District. The Watermillock Register in the English Lake District records "a marveillous great frost which contynued from the first day of December until the 15th. day of February after. Ulles water was frozen ower and so continued from the 6th. day of December untill the 22nd. day of February followinge. So stronge that men in great companies made a common way up the same . . . with horses loaden with corne. Upon the 6th. day of January the younge folkes of Sowlby went unto the midst of the same water and had a Minstrell with them and there daunced all the after Noone. On . . . the 9th. day of February, at Weathermeallock was a Boone fire builded on the Ise and matches of Shotinges Shott. . . ."

Dec. 4, 1495. Tiber Flood.—One of the greatest floods of the Tiber, remembered as the "deluge of Rome", is described at length in a pamphlet reprinted by Dr. G. Hellmann in No. 12 of his "Neudrücke von Schriften und Karten über Meteorologie und Erdmagnetismus", with a rough wood-cut showing the flooded streets and drowning citizens. A torrent of water ran through the city, and many houses were destroyed.

Dec. 4, 1879. Low Temperature in British Isles. Throughout the greater part of December 1879, intensely cold weather was experienced. The coldest day was Dec. 4, when a minimum of −23° F. was reported at Blackadder in Berwickshire, the lowest known shade temperature in the British Isles. Temperatures below 10° F. were registered over southern Scotland and northern England as far as the Valley of the Trent, and over almost the whole of England, Scotland, and Ireland temperature fell below 20° F. Many persons were frozen to death, and evergreens were killed, including a holly nearly a hundred years old.

Dec. 5, 1922. Mirage.—At about 10.30 A.M. the lightkeeper at Cape Wrath lighthouse, in the north of Scotland, observed in the sky above a conical hill to the southward a mirage of land and sea, giving a perfect representation of the whole of the coast line from Cape Wrath to Dunnet Head, as it would have been seen from a distance of about ten miles. There were three repetitions of the mirage, one above the other, with sea separating each pair. The appearance lasted about 30 minutes, but was only visible through a telescope. It was attributed by Mr. Brunt to double refraction from two nearly vertical surfaces of discontinuity between warm and cold air.

Dec. 5, 1927. Hurricane in Pacific.—A violent hurricane struck Butaritari in the Gilbert and Ellice Islands shortly after 2 A.M.; nearly all the houses were blown down or damaged and many trees destroyed. Butaritari is in only lat. 3° N., and hurricanes so near the equator are very rare.

Societies and Academies.

LONDON.

Royal Society, Nov. 20.—**Lord Rayleigh**: Iridescent colours of birds and insects. The reflection spectra have been examined in the ultra-violet. *Morpho* butterflies and *Urania* moths show ultra-violet maxima in general agreement with the theory of interference. In *M. achilles* the blue colour is due to a reflection of the second order. No *Morpho* butterflies show their blue colour by transmission. Iridescent beetles showing a deep red colour at normal incidence may be made to pass through all the colours of the spectrum to violet, provided that arrangements are made to annul refraction at the air-chitin surface so as to obtain very oblique incidence without. Some of the golden beetles show transmission spectra of bands which vary continuously in position with the part of the specimen examined. It seems impossible to interpret this reasonably except on the theory of interference. Moist chlorine gas does not destroy the colours of *Morpho* or of *Urania*, though the black background is bleached; nor does chlorine decolorise the metallic beetles. Peacock feathers undergo a progressive change of colour in ultra-violet light or long continued sunlight, the colours becoming more refrangible. Other feathers are slowly decolorised without change of refrangibility. Fading under light or chlorine is attributed to the breaking down of an interference structure. The generalisation seems to hold good that colour which is stable in chlorine is certainly *not* due to pigments.—**C. R. Bailey, A. B. D. Cassie**, and **W. R. Angus**: Investigations in the infra-red region of the spectrum (1, 2). The infra-red absorption spectrum of sulphur dioxide has been re-examined in the region 1-22 μ with a prism spectrometer fitted with quartz, fluorite, rocksalt, and sylvine prisms. The partial resolution of most of the bands has rendered possible the determination of a number of the molecular constants, in particular the size and shape of the molecule, the moments of inertia, and the fundamental vibrational frequencies.—**J. K. Roberts**: The exchange of energy between gas atoms and solid surfaces. Experiments on the accommodation coefficients of helium with tungsten and nickel surfaces have been carried out under conditions in which the surfaces could be freed from films of adsorbed gas. The values obtained were 0·05-0·07 for tungsten and 0·08 for nickel, and are considerably lower than the values ordinarily obtained for gas-covered surfaces.—**G. N. Watson**: The use of series of Bessel functions in problems connected with cylindrical wind tunnels. Various Fourier-Bessel and Dini series are encountered in problems concerning cylindrical wind-tunnels, and the convergence of these series in certain parts of the tunnel is slow. The object of the paper is to transform these series into more rapidly convergent series in order to make it possible to compute their sums.—**A. J. Allmand** and **R. B. King**: The sorption of water vapour at low pressures by activated charcoals (1). Isothermals of water vapour have been determined for six different and typical activated charcoal specimens, at 25° C. and over a pressure range of 10^{-1} mm. down to 10^{-3} mm. Undisplaced gases on the charcoal surface cause 'drift', as in other cases. When this displacement had proceeded to its limit under the experimental conditions, the isothermals were apparently reversible. No sign of the validity of 'Henry's Law' was observed. Water vapour is apparently relatively ineffective as a displacing agent for adsorbed oxygen. Heat of adsorption increases as the quantity sorbed decreases. No definite evidence of discontinuity in the isothermals was discovered.

DUBLIN.

Royal Irish Academy, Nov. 10.—**J. J. Nolan**: The effect of water vapour on the mobilities of negative ions in air. A series of values of mobility ranging from 2·4 to 1·5 cm./sec. is found corresponding to certain favoured sizes of ions. At least two such discrete sizes of ions are present in considerable quantity at each value of the humidity. In addition it is shown that high mobility ions are present in small quantities; for example, at vapour pressure 0·87 mm., ions of mobility 12 cm./sec. constitute about 0·1 per cent of the total ionisation.

PARIS.

Academy of Sciences, Oct. 27.—The president announced the deaths of Pierre Termier and Paul Appell.—**Maurice de Broglie**: A possible conception of nuclear phenomena. **E. Bataillon** and **Tchou Su**: Abortion of gametogenesis in hybrids of *Molge marmorata* and *M. cristata*, two years old. **A. Buhl**: Wave geometry. Explicit developments. **V. Romanovsky**: The continued doubly connected chains of Markoff.—**Marcel Brelot**: A generalised problem of Dirichlet. **V. G. Siadbey**: The motion of large meteors. An analysis of a collection of data recently published by Hoffmeister. For large meteorites the average height of appearance (545 cases) was 131·9 km. and of extinction (553 cases) 53·5 km. Classifying in three classes, large meteors, detonating meteors, and meteorites, the geocentric velocities were respectively 42·5, 38·8, and 25·7 km. per second. **Henri Mineur**: The explanation of some anomalies presented by the proper motions of the stars. **Lyot**: The polarisation of Mercury compared with that of the moon; results obtained at the Pic-du-Midi in 1930. The clearness of the sky at the Pic-du-Midi enabled 26 observations to be taken under excellent conditions, the results of which are given graphically.—**Louis Kahn**: The methods of navigation employed by Costes and Bellonte. The method proposed by the author in earlier communications was used with success by Costes and Bellonte in their flight from Paris to New York. **A. Dauvillier**: The application of the diffraction of electrons to the study of organic substances. The structure of cellulose. Diffraction diagrams of organic substances can be obtained provided that extremely thin films, with a thickness of the order of 100 A., can be prepared. Diagrams are given for films of nitrocellulose: these are entirely different from those given by the X-rays and are not due to the crystalline network.—**Mlle. Foret**: Calcium chloro-, bromo-, and iodoaluminate. **H. Muraour**: The influence of radiation in the combustion of (explosive) colloidal powders in closed vessels. In a previous communication, as an explanation of the observed diminution in the area of the pressure-time curve, it was suggested that energy was contributed under the influence of the calorific radiation of the gas: further experiments now described prove that this hypothesis is insufficient to explain the experimental results.—**Justin Dupont** and **Jean Jacques Guerlain**: The dry distillation of Tolu balsam. This distillation gives rise to notable quantities of the monomethyl esters of pyrocatechol and its homologues, identical with those extracted by Béhal and Choay from wood tar creosote. **Georges Mignonac** and **Charles Hoffmann**: The ketene-imines and the tautomerism of the nitriles.—**St. Pavlovitch**: The metallographic study of some metallic minerals of Yugo-Slavia.—**Jacques Bourcart**: The stratigraphy of the Atlantic zone of the Spanish Protectorate in Morocco.—**L. Margaillan**: The vitamins and refining olive oils. Comparative curves of growth of rats are given, the diet being the same except that unrefined olive oil was added in one set and refined olive oil in the other. Contrary to the view generally held, olive oil contains vitamins, but these are reduced or eliminated by the process of refining. **E. Chemin**: The action of ultra-violet radiations on the spores and germination of the Florideæ. Arrest of development and cell alteration is always produced by the action of ultra-violet light.—**H. Colin** and **E. Bougy**: The characters of some hybrids of beetroot.—**Mme. L. Randoin** and **R. Lecoq**: The possibility of producing experimental rickets in the guinea-pig. Although very sensitive to a deficiency of the antiscorbutic vitamin, the guinea-pig does not appear to react to a deficiency of the antirachitic vitamin and presents no true rickety lesions.—**Aversenq, Jaloustre**, and **Maurin**: The neutralisation of the toxic power of various poisons by thorium-X. Either by its radioactivity or by its metallic ions, thorium X is capable of exercising in the animal or plant a certain amount of protective action against various poisons (sparteine, picrotoxin, potassium cyanide). The mechanism of this neutralisation is doubtful. **Fontaine**: Modifications of the internal medium of river fishes in the course of reproduction.—**S. Metalnikov, B. Hergula**, and **Miss Strail**: The utilisation of micro-organisms in the fight against *Pyralis* of maize. An account of field experiments carried out at Zagreb, with emulsions of cultures of micro-organisms isolated from dead or dying insects. The results were satisfactory.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 13, 1930.—**I. Kurbatov** and **V. Kargin**: Chemical composition and properties of the Crimean keffekilite.—**G. Frederiks**: The Palaeozoic deposits in the Urals. During the whole of the Palaeozoic period up to the end of the Carboniferous, only vertical movements occurred in the area of the Uralian geosynclinal. In the early Permian the first phase of the vertical folding occurred, while the second coincided with the end of the Chussov period.—**B. Kupletskij**: A contribution to the mineralogy of the Khibin tundras. Descriptions of a number of minerals. **B. Gavrusevich**: A new find of palygorskite in the Ukraine. **G. Laemmlein**: Corrosion and regeneration of quartz-porphyrites. **A. Saukov**: Antimony and molybdenum deposits near Novotroitzk, on the River Unda, Transbaikalia.

Comptes rendus, No. 14, 1930.—**N. Zelinjski**: Chemical nature of the Petchora bitumen.—**B. Galerkin**: A contribution to the investigations of tensions and deformations in an elastic isotropic body.—**V. Barovskij**: A description of two new species of the genus *Dictyoptera* Latr. (Coleoptera, Lycidæ) from eastern Asia. *D. motschulskii* and *D. miranda*, spp. nn., from the South Ussuri region.—**L. Jakubova** and **E. Malm**: The phenomena of the temporary anærobiosis in some representatives of the Black Sea benthos. Experiments in the aquarium showed that the majority of benthonic animals, particularly the less mobile or sedentary animals, can live for a long time (more than a month) at very low concentrations of oxygen—for example, at 0·2-0·4 c.c. per litre at 12° C. **N. Kuznecov-Ugamskij**: A contribution to the study of the factors of the evolution of faunistic groups. The evolution of faunas is due not only to the evolution of the environmental conditions, but also mainly to the interaction of different component elements of the fauna.—**N. Filipjev**: Lepidopterological notes (7). A new genus of Tortricidæ from the mountains of the Ussuri region. *Eurydoxa advena*, gen. and sp. n.—**V. Rylov**: A preliminary communication on the plankton of Lake Kardyvatch, north-west Caucasus.

Official Publications Received.

BRITISH.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 45: A Soil Survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria. By J. K. Taylor and F. Penman. Pp. 41+4 plates. (Melbourne: H. J. Green.)

Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1928–29. Pp. 100. (London: H.M. Stationery Office.) 1s. 6d. net.

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1926, under the direction of Dr. B. N. Banerji and Dr. K. R. Ramanathan. Pp. iv+135+5 plates. (Calcutta: Government of India Central Publication Branch.) 10.12 rupees; 17s. 6d.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 3, 21st October. Pp. 221-362+plates 15-28. (London: Edward Stanford, Ltd.) 5s.

The Gardens Bulletin, Straits Settlements. Vol. 6, Part 3: The Medical Book of Malayan Medicine. Translated by Inche' Ismail, Munshi, possibly in Penang, circa 1886. Now edited with Medical Notes by J. D. Gimlette, and Determinations of the Drugs by I. H. Burkill. Pp. 323-474. (Singapore: Botanic Gardens.) 2.50 dollars.

British Cast Iron Research Association. Ninth Annual Report for the Year ending June 30th, 1930. Pp. 27. (Birmingham.)

The Quarterly Journal of the Geological Society. Vol. 86, Part 3, No. 343, October 21st. Pp. 331-462+22 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Factors. By Dr. W. R. G. Atkins and E. Wyllie Fenton. Pp. 533-547. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 27: The Kinetics of the Formation of Malonamide from Ethyl Malonate and Ammonia in Homogeneous Solution. A Reaction of the Third Order. By Dr. Kenneth C. Bailey. Pp. 567-573. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

Department of Scientific and Industrial Research. Report of the Building Research Board: with the Report of the Director of Building Research for the Year 1929. Pp. viii+121+10 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Development Commission. Twentieth Report of the Development Commissioners, being for the Year ended the 31st March 1930. Pp. 247. (London: H.M. Stationery Office.) 3s. 6d. net.

Annals of the (Mededeelingen van het) Transvaal Museum. Vol. 14, Part 1, 30 October. Pp. 48. (Cambridge: Printed at the University Press.)

Proceedings of the Cambridge Philosophical Society. Vol. 26, Part 4, October. Pp. 429-574. (Cambridge: At the University Press.) 7s. 6d. net.

Transactions of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne. New Series, Vol. 7, Part 1. Pp. 150. (Newcastle-upon-Tyne.) 4s. 6d.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 44, Part 2, October. Pp. xx+45-148+41-62. (Edinburgh: Douglas and Foulis.) 7s. 6d.

Journal of the Indian Institute of Science. Vol. 13A, Part 11: i. The Physical Properties of Pure Triglycerides, by R. B. Joglekar and H. E. Watson; ii. The Preparation and Properties of α-Monoglycerides, by R. S. Rewadikar and H. E. Watson; iii. The Solidifying Points of Binary Mixtures of Fatty Acids and Esters, by L. A. Bhatt and H. E. Watson (with Z. H. Patel). Pp. 119-146. (Bangalore.) 2 rupees.

Proceedings of the Royal Irish Academy. Vol. 39, Section A, Nos. 6, 7: Notes on Resolving Power, by Dr. R. W. Ditchburn; The Uncertainty Principle in Quantum Mechanics, by Dr. R. W. Ditchburn. Pp. 58-81. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

FOREIGN.

United States Department of the Interior: Geological Survey. Bulletin 815: Geology and Mineral Resources of Northwestern Alaska. By Philip S. Smith and J. B. Mertie, Jr. Pp. viii+351+34 plates. 1 dollar. Water-Supply Paper 630: Surface Water Supply of the United States, 1926. Part 10: The Great Basin. Pp. v+145. 25 cents. (Washington, D.C.: Government Printing Office.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 1, August 15th. Pp. 74+7 plates. (Tokyo: Maruzen Co., Ltd.) 2.00 yen.

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 5, September. Pp. 323-367+5 plates. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.00 yen.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Results of the Pinchot South Sea Expedition. 1: Land Mollusks of the Caribbean Islands, Grand Cayman, Swan, Old Providence and St. Andrew. By Henry A. Pilsbry. Pp. 221-261. (Philadelphia.)

Field Museum of Natural History. Botanical Series, Vol. 9, No. 1: The Differential Analysis of Starches. By James B. McNair. (Publication 275.) Pp. 44. Botanical Series, Vol. 9, No. 2: A Study of some Characteristics of Vegetable Oils. By James B. McNair. (Publication 276.) Pp. 45-68. Botanical Series, Vol. 8, No. 1: Studies of American Plants, III. By Paul C. Standley. (Publication 277.) Pp. 74. Botanical Series, Vol. 8, No. 2: Spermatophytes, mostly Peruvian, II. By J. Francis Macbride. (Publication 278.) Pp. 75-130. Botanical Series, Vol. 3, No. 3: Flora of Yucatan. By Paul C. Standley. (Publication 279.) Pp. 155-492. Anthropological Series, Vol. 18, No. 2: Geophagy. By Berthold Laufer. (Publication 280.) Pp. 97-198. Botany Leaflet No. 15: Spices and Condiments. By James B. McNair. Pp. 64. 25 cents. Zoology Leaflet No. 12: The Salamanders of the Chicago Area. By Karl P. Schmidt. Pp. 16+4 plates. 25 cents. (Chicago.)

Bulletin of the Vanderbilt Museum. Vol. 2: Scientific Results of the Cruises of the Yachts *Eagle* and *Ara*, 1921–1928, William K. Vanderbilt, Commanding. Crustacea: Stomatopoda and Brachyura. By Lee Boone. Pp. 298+74 plates. (Huntington, L.I.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 2, August. Pp. 213-505. 40 cents. Vol. 5, No. 3, September. Pp. 507-779. 40 cents. (Washington, D.C.: Government Printing Office.)

Stanford University Publications: University Series. Medical Sciences, Vol. 2, No. 3: Lane Lectures on Experimental Pharmacology and Medicine. By Prof. Rudolf Magnus. Pp. 108. (Stanford University, Calif.: Stanford University Press.) 1 dollar.

Baltic Geodetic Commission. Special Publication No. 1: Measuring of Seven Base Lines of the Baltic Polygon, executed in the Year 1929. By Ilmari Bonsdorff. Pp. 21+236+5 plates. (Helsinki.)

United States Department of the Interior: Geological Survey. Bulletin 822A: Geology and Mineral Resources of parts of Carbon, Big Horn, Yellowstone and Stillwater Counties, Montana. By R. S. Knappen and G. F. Moulton. (Contributions to Economic Geology, 1930, Part 2.) Pp. iv+70+5 plates. 25 cents. Water Supply Paper 655: Surface Water Supply of Hawaii, July 1, 1925, to June 30, 1926. Pp. v+115. 25 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

A Catalogue of Important and Rare Books on Zoology, Geology and Paleontology. (No. 440.) Pp. 144. (London: Bernard Quaritch, Ltd.)

Hawaiiana. Pp. 20. (London: Francis Edwards, Ltd.)

Accessories for Radiology. (Publication No. C30.) Pp. 48. (London: Newton and Wright, Ltd.)

The Nickel Bulletin. Vol. 3, No. 11, November. Pp. 345-376. Nickel, D2: Nickel in Light Aluminium Alloys. Pp. 24. (London: The Mond Nickel Co., Ltd.)

The Book Window: a Guide to Book Buying and Book Reading. Vol. 2, No. 5, Christmas Number. Pp. 149-188. (London: W. H. Smith and Son, Ltd.) 3d.

Diary of Societies.

FRIDAY, NOVEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish District) (at County Buildings, Paisley), at 2.—T. Somers: The Sixth International Road Congress at Washington, D.C.

GENETICAL SOCIETY (at Linnean Society), at 3.—A. E. Gairdner and Dr. C. D. Darlington: The Theory of Ring-formation exemplified by *Campanula persicifolia*.—J. Philp: An Explanation of the Inheritance of Double Flowers in *Matthiola incana R.Br.* based on Cytological Evidence.—At 3.45.—Prof. A. H. R. Buller: Sexual Phenomena in the Higher Fungi.—C. Diver: Studies in the Genetics of the Common Garden Snail, *Helix aspersa*.—A. A. Moffett: Cytology of Pomoideae.

ROYAL SOCIETY OF MEDICINE (Children Section), at 5.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Hinde: The Ocean-going Tramp Steamer from the Owner's Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. H. E. O'Brien: Electric Traction (Students' Lecture).

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6.30.—W. T. Benslyn and S. Willis: Steelwork in Cinema Construction.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.—R. Humphries and others: Discussion on Colorimetration in Textiles.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—E. Batten and others: Discussion on Export Trade Emancipation.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Society of Dyers and Colourists and Institute of Chemistry) (at 235 Buchanan Street, Glasgow), at 7.15.—F. W. Lake: Dyeing and Cleaning: Some Problems of the Industry.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—F. W. Rowe: The Selection and Treatment of Materials for Gears.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. H. Willett: Photography applied to Science.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. J. M. Hamill: Food as a Preventive of Disease.

INSTITUTION OF CHEMICAL ENGINEERS.—S. Mayne: The Sources of Published Technical Data and how they should be used.

SATURDAY, NOVEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: Verse in Song.

MONDAY, DECEMBER 1.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. G. Bond: The Stem-endodermis in the Genus *Piper*.—A. Graham: On the Morphology, Feeding Mechanisms, and Digestion of *Ensis siliqua*.—Dr. L. Mirskaia and Prof. F. A. E. Crew: On the Pregnancy Rate in the Lactating Mouse, and the Effect of Suckling on the Duration of Pregnancy.—Dr. B. P. Wiesner: Further Observations on the Mechanism of the Diphasic Sex Cycle.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Sir Ambrose Fleming: Adaptation in Nature as Evidence of Purposive Thought.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—W. R. Baldwin-Wiseman: Some Ground Aspects of Aviation.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (Annual General Meeting) (at London Day Training College), at 6.—Miss S. Clement Brown: Some Case Studies of Delinquent Girls described as Leaders (From Social Study made in the County of Los Angeles, California.)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. R. Leathart: Modern Cinema Design.
ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: Modern Domestic Scientific Appliances (Cantor Lectures) (2).
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J. H. Coste: Analytical Chemistry, its Past, History and Future Development (Lecture)
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Rev. J. W. Hubbard: The Isoko Country, Southern Nigeria.

TUESDAY, DECEMBER 2.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5.10.—Prof. J. F. Spencer: Magneto Chemistry.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. A. Milne: Stellar Structure and the Origin of Stellar Energy (1)
INSTITUTION OF CIVIL ENGINEERS, at 6
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.—Dr. R. S. Morrell: The Oxidation Products of Drying Oils.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—P. B. Bannatt: Ten Thousand Miles with Two Babies
INSTITUTE OF METALS (Scottish Local Section) (jointly with Institution of Engineers and Shipbuilders in Scotland) (at 39 Elmbank Crescent, Glasgow), at 7.30.—W. Lambert: Non-ferrous Alloys used by Engineers.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—J. Bradley and S. A. Wood: Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen: Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.
ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—Dr. L. Bohler: The Treatment of Fractures of the Upper Extremity.

WEDNESDAY, DECEMBER 3.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. P. Tesch: The Riss Glaciation in the South-Eastern Parts of England.—H. Dewey: The Palæolithic Deposits of the Lower Thames Valley.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—T. Walmsley: Beam Arrays and Transmission Lines.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—E. G. Phillips: The Cost of Operating Industrial and Private Electric Generating Sets compared with Public Supply.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—J. C. Dixon: Wharf Cranes for the Handling of Cargo.
ROYAL SOCIETY OF ARTS, at 8.—S. Perks: The Building of the Mansion House.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—G. Middleton: A Storage and Delivery Apparatus for Antimony Chloride Solution and other Corrosive Reagents.—G. Middleton and F. C. Hymas: Tests for Impurities in Ether. Parts II. and III.—N. Evers: The Determination of Small Quantities of Calcium in Magnesium Salts.—Dr. F. K. Rose: A New Method for the Detection of Nitro-Group in Organic Compounds.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Discussion on Surgery in Diabetes. Openers: Prof. G. E. Gask, Dr. G. Graham, and Dr. Lawrence.

THURSDAY, DECEMBER 4.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. J. McLuckie: On a Natural *Grevillea* Hybrid.—B. Storrow: Some Fluctuations in Zoological Populations during the Nineteenth Century.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir John Russell: The Agricultural Development of the Empire (1): Reclaiming the Wastes.
CHILD STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Kimmins: The Changes in the Child's Attitude to Life during the School Period.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—S. G. Brown: Loud-Speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus (Lecture)
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. Glauert: The Four-Foot Wind Tunnel.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—E. Potter: Patents.
CHEMICAL SOCIETY, at 8.

FRIDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. G. Riddoch, Dr. A. B. Rosher, and others: Discussion on Intracranial Complications of Otitic Origin: Neurological and Pathological Investigation.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. L. C. Martin: The Theory of the Microscope.—M. Fahmy: A Point of Analogy between the Equations of the Quantum Theory and Maxwell's Equations.—B. K. Johnson: Sources of Illumination for Ultra-violet Microscopy.—W. A. Wood: The Influence of the Orientation of the Cathode on that of an Electro-Deposited Layer.—Demonstration by Prof. G. B. Bryan of some Stroboscopic Effects.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—U. R. Evans: The Protection of Metals by Painting.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. S. Turner: Machinery and Methods of Manufacture of Sheet Glass.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. T. Callan: The Estimation of Minute Traces of Copper.—Dr. F. C. Wood: (*a*) The Reaction of Formaldehyde Derivatives with Cellulose; (*b*) The Formation of Mono-cellulose Methylene Ether; (*c*) The Action of Grignard Reagent on Cellulose.—C. M. Whittaker: Some Notes on Viscose Dyeing.—J. M. Preston: A Skin Effect on Viscose Rayon.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7.—O. Howarth: The Metering of Three-Phase Supplies.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. L. Mayston: Oil Burning for Domestic Central Heating.
GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College) at 7.30.—A Journey through South and West Africa, with special reference to Igneous Phenomena (Lecture).
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—G. F. O'Riordan: Recent Developments in Chemical Engineering.

SATURDAY, DECEMBER 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (1): The Country and its History.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 5.30.—Sir Robert Philip: The Outlook on Tuberculosis: Changing Orientation (Malcolm Morris Memorial Lecture)

SATURDAY, NOVEMBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Some Mediæval Beasts, Real and Otherwise.

MONDAY, DECEMBER 1.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—F. W. Twort: Diseases of Bacteria. (Succeeding Lectures on Dec. 3, 5, 8, and 10.)
UNIVERSITY OF LEEDS, at 5.15.—Prof. F. O. Bower: The Morphology of the Leaf.

TUESDAY, DECEMBER 2.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Industry, Export and Import.—At 5.30.—Miss Hilda D. Oakeley: The Approach to Reality: Through Art.

WEDNESDAY, DECEMBER 3.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. D. B. Blacklock: The Prevention of Disorders and Disease in Tropical Countries.
BELFAST MUSEUM AND ART GALLERY, at 8.—Dr. A. Mahr: A Bygone Craft: Making an Old Style Coracle on the River Boyne.

THURSDAY, DECEMBER 4.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. F. J. McCann: Medical Arguments against Contraception.

SATURDAY, DECEMBER 6.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—Dr. Cyril Norwood: The Value of Exactness (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Prehistoric Man in Minorca.

CONGRESSES AND EXHIBITION.

DECEMBER 3, 4, AND 5.

BRITISH INSTITUTE OF RADIOLOGY (at Central Hall, Westminster).
Wednesday, Dec. 3, at 2.30.—Sir Humphry Rolleston, Bart.: Official Opening.
At 3.30.—Major C. E. S. Phillips: Presidential Address.
Thursday, Dec. 4, 10.30 to 12.30.—F. D. Owen King: The Multix Tube; a Self-Protected Tube for Therapy and Diagnosis with Twin Focus.
W. E. Schall: Limitations of the Single Valve Unit.
A. C. Gunstone and E. J. W. Watkinson: (*a*) The Milli-Ampere Second Relay; (*b*) A New Type of Control for X-Ray Apparatus.
At 5.—Prof. G. P. Thomson: Some Recent Experiments on Cathode Rays (Mackenzie Davidson Memorial Lecture).
Friday, Dec. 5, 10.30 to 12.30.—Dr. H. A. Harris: The Growth of Bone as illustrated by Radiography.
Dr. D. Hunter: Changes in the Bones in Hyperparathyroidism and Hyperthyroidism.
At 4.30.—Dr. A. E. Barclay: The Danger of Specialisation (Silvanus Thompson Memorial Lecture).

DECEMBER 4 AND 5.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—The Utilisation of Trade Wastes.
Thursday, Dec. 4, at 10.30 A.M.—J. B. C. Kershaw: Industrial Wastes.
A. T. King: The Treatment of Suint Liquors from Wool Scouring.
B. A. Smith: The Treatment and Disposal of Wool washing Effluent.
At 2.30.—R. J. Marx: Whitewater in Paper and Pulp Mills and its Utilisation.
M. Schofield: The Distillation of Wood Waste and the Utilisation of the Products.
R. W. Griffith: The Utilisation of Industrial By-Products, with Special Reference to the Pulp Industry of the United States of America.
Friday, Dec. 5, at 10.30 A.M.—Dr. D. J. Lloyd: The Problem of Tannery Waste.
O. Wans: The Use of Wood Waste for Heating and Generation of Power.
At 2.30.—E. B. Busenburg: The Utilisation of Waste Rubber.
Prof. J. W. Hinchley: The Recovery of Metal from Waste Materials.

SATURDAY, DECEMBER 6, 1930.

CONTENTS.

Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3188, Vol. 126]

The Neglect of Scientific Method.

THE address by Sir William Pope, at Goldsmiths' Hall on Nov. 13, the sixth of the annual Norman Lockyer lectures instituted by the British Science Guild,* must be accounted one of the most weighty of recent scientific pronouncements, as well as most opportune, in its bearing upon two subjects of special interest at the moment —the extension of the Dyestuffs Act and the school-leaving age. It is to be hoped that, without delay, the printed lecture may, in some way, be brought under the notice of every headmaster and of every member of Parliament: as the girls to-day are even more victimised than are the boys at school and college by the imposition of a burden of inconsequent, undigested learning, headmistresses might also be induced to understand the implications of the address.

Sir William Pope does well to lay stress upon the fact, that modern man is in no appreciable degree the intellectual superior of his forerunners in the far fringe of historic time: he differs from them only in having other weapons. As he truly says, the forms of intellectual expression we recognise as the arts and literature, even moral philosophy, were worked out thousands of years ago, to the utmost limit of the capacity of the human mind. No convulsive revolutionary change could affect our outlook, our powers and our achievements, except the discovery and exercise of some unsuspected faculty of our intelligence. Such a faculty is now to be recognised as operating in the background in the modern development of the natural sciences *by experimental study*, wherein we may see a most wonderful fulfilment of Shelley's far-seeing foresight:

> A mighty Power, which is as darkness,
> Is risen out of earth and from the sky
> Is showered and, from within the air,
> Bursts, like eclipse which had been gathered up,
> Into the pores of sunlight.

The Power is no longer "as darkness" but a sublime light. The intensive work which has been done in science, largely during the last fifty years, has launched us, says Sir William Pope, well beyond the shore of a new era in the world's history, an era which may be described as the scientific age. Unfortunately, the process is in no way understood even by the superior politician, let alone the public. The words science and scientific as yet have no properly defined meaning in the public mind; even in scientific journals they

* "Science and Modern Industry." By Sir William J. Pope. Pp. 16. (London: British Science Guild, 1930.) 1s.

are often inconsistently used and rarely with forethought. We have no right to confine the word science to any particular branch of knowledge; moreover, all exact and logical users of knowledge and experience are entitled to be spoken of as scientific. The modern advance, in all fields, is due to our considered application of knowledge and our constant verification of whatever conclusion we may draw: only the verified is science. Much that so passes at the moment is mere speculation. In days gone by, conclusions were based upon first principles, without verification.

The great Helmholtz tells us, in his biography, how the philosophers, in his early days, regarded the introduction of experimental verification as unnecessary; in fact, as almost an insult to their dignity. Our use of the Latin word science, in place of knowledge, as if it meant something different and peculiar, is at the root of the difficulty: as a people, we cannot suffer Latin; much as we use it in our spoken language, we seem rarely to grasp the full meaning of Latin words. Until we study English, we never shall - unfortunately, this subject is still all but unknown in the schools, whatever stopped the way in the past, 'science' now crowds it out! Much of Sir William Pope's address is devoted to a criticism of the general literary ignorance of young people coming up to the university from the schools. He also complains bitterly of the neglect of modern languages. Being himself gifted with most remarkable linguistic ability, no one has greater right to speak upon the subject.

That a leading professor at a leading university should so speak out is a more than welcome sign that, at last, we are beginning to appreciate the danger of our position—that at last we see that the vicious circle in which youth is forced to revolve must in some way be broken and teaching made the free and considered practice of the greatest of all arts—an art nothing short of sacred. Research will soon be its own executioner, if we do not bring under effective consideration the methods of training used in school and university leading up to such work. What is now done is mainly by way of compensating for the absence of a proper educational foundation upon which a scientific superstructure may be built. The present situation is farcical. Trained at school and, say at Oxford, up to the end of his third year, to remain ignorant of method, suddenly the student is called upon to study 'the methods of research'—usually by working out an additional example after a well-known rule: in the main, he merely raises his value as an artificer. The art of logical inquiry and study—scientific method should be inculcated from the cradle upwards: it is not to be learnt from the conventional 'research'.

This is really the meaning to be read into Sir William's address: and Brutus is an honourable man. He is a man who has shown supreme general business ability, having recently passed through the high City office of Prime Warden of the Goldsmiths' Company with great distinction. He is therefore a double first. His complaint is that most of the men in business and the politicians—I suppose he would say without exception—have no scientific training: they are empiricists, members of a class who have done in late years and are doing to-day, with alarming efficiency, everything possible to wreck our national fortune. It is in the hands of such men that the fate of our dyestuff industry rests: theirs not to reason why, the decision is likely to be one taken without any intrusion of scientific method: the more as the industry is pre-eminently scientific, in origin and development.

In fact, our era is not yet to be spoken of as 'scientific', whatever the Norman Lockyer lecturer may assert. So few among us have any use for scientific method that the vast mass perish for want of such knowledge. Knowledge we have—a vast knowledge: only the knowledge how to use knowledge profitably is wanting among us. Our great present need is to appreciate the depth of our ignorance, especially in education.

Sir William Pope in and by his address sounds the trumpet call for action in the universities: it behoves the few who are alive to our educational peril to be up and doing, in remedy of his indictment. The headmasters will not move—they have not the courage nor any leader: the schools examining bodies will be opposed to all action; the public always leaves school to 'mother'. A colossal burden of responsibility rests upon the few at the universities who are aware of the straits into which education has drifted, through entire lack of scientific control, left as it has been in bureaucratic, unpractical hands. The universities, whatever may be said, *are* the prime source of all evil as well as of the little good in the prevailing chaos of teaching: they must cure themselves, in the first instance. Educationally they are unco-ordinated. We *must* exorcise the competitive lust that is within us, to the extent that we cease from treating education as if it were a branch of sport and our schools racing stables. In some way, we *must* take the money out of the examination purse and put 'morality' into its

place. In some way, education must be made real and of general avail—not the entirely fortuitous, inhibitory process it now too often is.

So little scientific is our era, that the chief use we have made of our great knowledge has been to squander natural resources in a blind and selfish pursuit of wealth. Industry, to-day, is entirely inconsiderate of the future. We cannot continue at present rates. The solution of the nitrogen problem by Crookes has brought us nearer to destitution rather than saved us, as the blind worshippers of mechanical success assert it has, by hastening the rate of depletion of irreplaceable phosphatic stores. We can clearly foresee in phosphorus the limiting essential factor to the world's progress:

Ohne Phosphor kein gemixte Pickles

stands written upon the wall. If we have any regard for the future, without loss of time we must learn to submit ourselves to scientific control. Unless we overcome the demagogue, there will be no health in us.

Sir Norman Lockyer, I am sure, would indeed have been more than satisfied to hear an address delivered in his memory such as that just given under the auspices of the Guild he founded. Never has the existence of the Guild been so fully justified: still, we cannot rest content with talk, however eloquent. The red flag of revolt must now go forward; the time for mercy to the incompetent is over.

HENRY E. ARMSTRONG

Persia and the Persians.

A History of Persia. By Brig.-General Sir Percy Sykes. Third edition with Supplementary Essays. Vol. 1. Pp. xxxix + 563 + 15 plates. Vol. 2. Pp. xx + 616 + 16 plates. (London: Macmillan and Co., Ltd., 1930.) 2 vols., 42*s.* net.

LORD CURZON'S classic work on Persia, published in 1892, went out-of-print a few years later, and was never reprinted. Sir Percy Sykes made his debut in Persia in the following year, and but for interludes in South Africa and Turkestan was, until December 1918, on duty in that country as a consular official, representing His Majesty's Government and the Government of India. He has travelled very extensively, and to good purpose: he has written four other books on various aspects of life and manners in Persia, and is unquestionably the leading authority in Britain on the matters dealt with in the present work. That he should have found time, in the midst of his travels and official labours, to compile this history (the first edition was published in 1915) is a tribute to his versatility and to his pertinacious industry, for to write a standard historical work in a consulate in a remote provincial town on the borders of Central Asia is a task at which few men would persevere. That a third edition should be called for within fifteen years is a tribute to the widespread interest displayed by the English-speaking world in Oriental history.

"Official duty", said Lord Rosebery in 1898, "is only a very small part of public duty, and public work is by no means incompatible with other professions and other callings." The great historians of the East in the English language have with few exceptions been soldiers and administrators, who have been at pains to follow the precept of Habakkuk and to read as they ran. Sir Percy Sykes is the worthy successor in the field of Middle Eastern history of such men as Malcolm, Morier, Rawlinson, and Curzon.

The history of Persia is of unique importance to the student of past times, for, thanks to the discoveries of the last century, it constitutes a longer and more continuous record than that of any other country or nation. A few salient facts, as disclosed by the work under review, of special interest to readers of NATURE, relating to ethnography and to the Persian people and their contributions to the progress of the human race, are worth mentioning.

In no eastern country is 'national' sentiment stronger; yet in no country has there been a greater admixture of extraneous elements. Persia has in the last two thousand years been overrun repeatedly by foreign invaders—by Arabs in the seventh century, by Mongols in the thirteenth, by Turks in the seventeenth, by Afghans in the tenth, and Russians in the nineteenth; at least six different racial strains are apparent amongst the population to-day, and as many languages are currently spoken, namely, Arabic in the south-west, Baluch (Brahui) in the south-east, Kurdish in the west, Turkish almost everywhere except in the centre, to which must be added the Tajik of the Caspian provinces, and Luri—which has strong affinities to the ancient Pehlevi tongue—in the south-west. Yet the Persian kingdom has had a continuous and unbroken existence since the dawn of history, and has extended at different times to Cairo and Delhi, to Samarkand and to the Hijaz.

The extensive conquests made by the armies of successive rulers entailed further great admixture of blood, for the Persian soldiery were wont to

bring back strange wives, and slaves not a few. Yet the Persian racial traits were far less impaired than were, for example, those of the Greeks, amongst whom, as W. G. Clarke points out ("Peloponnesus", p. 328), Miltiades, Thucydides, and Demosthenes were notoriously of mixed race, and contemporary arts and crafts, which reached their highest development in the ancient world within the confines of Persia, as the forthcoming International Exhibition of Persian Art in Burlington House will show, retained all the characteristics of the soil that gave them birth.

The Persian plateau, alternately frozen by bitter winds and scorched by a pitiless sun, is one of the most ancient land surfaces of the Old World: it may yet prove to have been one of the cradles of the human race, and it has incontestably been shown to be one of the most ancient of civilisations. Its fauna and flora have little affinity with those of India, but are closely allied to those of Europe; some indeed hold that it is to Persia that we owe the prototypes of the vine and the genus *Prunus*, and several other trees now widely spread over the world.

Arduous but not intolerable climatic conditions, and the predominance over considerable areas of limestone formations, have probably played on the Persian plateau an important part in forming and fixing types of human beings, animals, and plants alike, but this interesting subject has as yet not, so far as the reviewer is aware, formed the subject of systematic inquiry or informed speculation.

Persia may well have been the home of astronomy, ere Nineveh was built, as it was of the most philosophical of ancient beliefs which Zoroaster reduced to a system: it gave birth to kings such as Cyrus and Darius, to poets such as Firdausi, Hafiz, and Sadi, and to doctors such as Avicenna. Yet Persia, in more modern times, was the first of eastern nations to associate itself with international agreements such as those relating to posts and telegraphs; it was the first eastern power to take an active and useful part in the deliberations of the League of Nations, the first to take European advisers into the service of the State, and the first, also, to dispense with them. These matters, and much else, are dealt with fully in this closely packed and well-written work, which, up to and including Chapter lxxxiv., will for this generation be the standard work on the history of the country, to the study of which for forty years Sir Percy Sykes has devoted his talents.

A. T. W.

Bacteriology and Medicine.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 5. By W. Bulloch, S. L. Cummins, F. W. Eurich, J. T. Duncan, A. Fleming, S. R. Gloyne, W. Fletcher, A. Stanley Griffith, R. T. Hewlett, J. C. G. Ledingham, J. A. W. McCluskie, A. D. McEwen, J. McIntosh, F. C. Minett, E. Muir, C. C. Okell, R. St. John-Brooks, A. W. Stableforth, W. H. Tytler, L. E. H. Whitby. Pp. 506. (London: H.M. Stationery Office, 1930.) 21s. net.

THIS volume deals with glanders, melioidosis, diphtheria, tuberculosis, Johne's disease, leprosy, Malta fever, anthrax, and a few other less important diseases.

The short historical notes which appear at the beginning of several of the chapters are written by Prof. Bulloch, and this at once guarantees their accuracy and their interest. In the chapter on glanders he pays very just tribute to the work of Löffler. He writes: "Four years after Löffler's first paper with Schutz he published another (Löffler, 1886), in which he gave a masterly account of the bacteriology of glanders and practically without an error. Little has really been added to the pure bacteriology of glanders since Löffler gave us his account." An examination of the whole chapter, written by F. C. Minett, amply confirms this statement. There is really nothing new, nothing which has not been written over and over again in various text-books. The chapter is an account, and really a very good account, of the facts we have known for a very long time about this disease.

The short chapter on melioidosis caused by *B. Whitmori* is well written, and as it comes from the pen of William Fletcher it naturally emphasises many facts brought out by his own work. Bacteriologists generally, but particularly those working abroad, will welcome this chapter. It is a very valuable contribution.

Chapter iii., on *C. diphtheria* and diphtheroid organisms, is by Dr. Hewlett. It is stated in the introduction by Dr. Hewlett that in this article he has in a large measure epitomised the work published in 1923 by the Medical Research Council in its monograph on "Diphtheria". It is a very good epitome, and gives in a very readable form all the main facts which are of value in connexion with these bacteria. In regard to the laboratory diagnosis, there are some very pertinent remarks on p. 101—remarks which are very much needed in these days when the laboratory is so often regarded

as a mere diagnostic institution. As Hewlett says, "The only justification for awaiting a laboratory report is when the presumption is, on the whole, against diphtheria". The portion of this chapter dealing with the diphtheroid organisms and the avirulent strains of *C. diphtheriæ* gives a very accurate account of the present position of these organisms in relation to diphtheria.

Chapter iv., on tuberculosis, is, in our opinion, easily the best chapter in this volume. Dr. Griffith and those who have been associated with him in the production of this chapter are to be heartily congratulated. Naturally, the portions written by Dr. Stanley Griffith stand out as the work of a man who has devoted the greater part of his medical life to a careful study of the pathology and bacteriology of tuberculosis. It is marked by very many original observations. The author is not merely satisfied to give the opinions of other workers, but his discussion of their observations and their deductions brand this chapter as the work of a man not merely of keen observation but also of real critical power. We feel sure it will stand out as one of the very best summaries, and true critical summaries, on tuberculosis which have been published.

S. R. Gloyne deals with the distribution of tubercle bacilli and their resistance to destruction, and W. H. Tytler with allergy and immunity. The former part is interesting from the public health point of view, but somewhat indefinite; the latter is a very useful and valuable contribution. It gives all the main facts as to immunisation by living and dead bacteria and bacterial products. Naturally, the author does not commit himself to definite conclusions, but he gives an accurate report on experimental results and discusses them with great fairness. The treatment by tuberculin is dealt with by Dr. Fleming, the preparation and standardisation of tuberculin by Dr. Okell, chemotherapy in tuberculosis by Prof. Cumming, and the laboratory diagnosis by Prof. McIntosh and Dr. Whitby.

There is a short but interesting chapter on "Tuberculosis in Cold-Blooded Animals" by Dr. Stanley Griffith.

Johne's disease is discussed in Chapter vi. by Mr. A. W. Stableforth. This is a record of all the main facts in relation to the bacteriology and morbid anatomy of this disease, well put together but lacking in any originality or critical discussion.

Leprosy is dealt with in Chapter vii. by Dr. Ernest Muir. One expects from a writer who has had a wide practical experience with leprosy, and has done a great deal of experimental work both in relation to its bacteriology and its treatment, a very full account of the pathological and bacteriological aspects of this disease. The author certainly does not fail us. His facts are well marshalled, and though he gives the views of almost all the workers on the subject, he is careful to draw conclusions only from facts which have been fully established. Thus, reviewing the work which has been done on the cultivation *in vitro* of *B. lepræ*, he does not criticise adversely the statements of the various experimenters, but he gives careful notes for guidance, notes which, had they been followed, would have prevented some of the writers from drawing their erroneous conclusions.

Chapter viii., on the non-pathogenic acid-fast bacilli, by R. St. John Brooks, is useful as an addendum to the chapters on tuberculosis, Johne's disease, and leprosy.

Dr. J. T. Duncan and L. E. H. Whitby contribute Chapter ix., on the Brucella Group. On this group a considerable amount of experimental work has recently been done, and the writers have done full justice to it. To those who wish a very good account not only of the pathology and bacteriology but of the chemotherapy, prevention, etc., of the diseases due especially to the *B. melitensis* and paramelitensis, we commend this chapter. The relation of *B. abortus* in the milk of cows to undulant fever is dealt with and all the relevant facts noted. This is a very useful article to the bacteriologist and the public health officer.

Chapter x., on *B. anthracis*, is by Dr. F. W. Eurich and R. T. Hewlett. This is simply a statement of known facts. The article does not call for special comment. It is a useful summary, dealing with the bacteriology, the pathology, and serum therapy of the disease. In the portion dealing with practical diagnosis, the estimation of the opsonic index, it is said, may prove useful in the hands of one who has acquired the necessary skill. One wonders how many times the opsonic index has been found useful in the diagnosis of anthrax.

In Chapter xi., R. St. John-Brooks writes on the non-pathogenic spore-bearing aerobic bacteria. This naturally follows the chapter on anthrax. It is a compilation of views of various authors and leaves the reader rather confused than otherwise. In the classification, the writer claims to follow Ford and his co-workers. It is difficult to see any reason why this classification was followed at all, if, as is the case, it was not followed completely. There is nothing in the chapter to indicate any reason for this. To take one example—the Cohærens-simplex

group; the writer gives three organisms, whereas Ford gives five. If the three were considered the only important ones and some mention made of them in the later text, one could have understood the omission, but they are not mentioned. If the whole classification had been omitted—for it serves no useful purpose in this article—the chapter would have been improved.

Chapter xii., on tularæmia, and Chapter xiii., on Bartonella and allied diseases, are useful additions which had necessarily to be included in some part of the series.

Throughout the volume the nomenclature is irregular, and we think it would have been wise either to adopt the recent American method throughout or not at all. Thus we find *Brucella melitensis*, *Corynebacterium diphtheriæ* alongside *Bacillus mallei* and *Bacillus tuberculosis*.

Taken on the whole, the volume is good, but scarcely up to the standard of the ones previously issued. With the exception of the chapters specially noted in the review, we do not think that by the issue of this volume any valuable addition has been made to bacteriological libraries.

J. M. BEATTIE.

German Work on Silicates.

Veröffentlichungen aus dem Kaiser Wilhelm-Institut für Silikatforschung in Berlin-Dahlem. Herausgegeben von Prof. Dr. Wilhelm Eitel. Band 3. Pp. 134. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 36 gold marks.

EDITED by Dr. W. Eitel, director of the Kaiser Wilhelm Institute for Silicate Research in Berlin, the third volume of publications issued from the Institute comprises a collection of twelve papers and reports, eight of which have previously appeared in various German technical journals during 1929. Among the contributors are W. M. Cohn, B. Lange, E. Kordes, and C. Gottfried, each of whom is concerned (alone or in conjunction with a fellow-worker) in two or more of the articles.

W. M. Cohn is responsible for two papers, the first being an illustrated account of a new self-registering apparatus for determining the thermal expansion of solid bodies. By the use of this contrivance, the expansion curves of solid rods can be obtained photographically up to temperatures beyond 800° C., so that even small effects, such as those representing transformation points, can be clearly perceived. Cohn's other paper relates to the expansion behaviour of new stoneware bodies, studied with the aid of the appliance described in his first paper. Results are cited indicating that a new stoneware body has been produced which possesses very low expansion values, the expansion being fairly regular. By altering the composition of the body, it is possible to produce various expansion values between those of silica glass and ordinary ceramic bodies.

B. Lange discusses the coloration and origin of gold ruby glass: with W. Heller the same author describes tellurium-platinum thermo-elements which permit very accurate determinations of low temperatures over small ranges (20° to 40°, 0° to 40°, and with certain conditions from −75° to +90°); a tellurium-bismuth thermo-element is also referred to. Lange and W. Cousins discuss the molecular condition of fused sulphur. Lange and H. Möhl discuss the application of sedimentation analysis (of Wiegner-Lorenz) and of depolarisation methods to ceramic analysis, citing experimental results obtained with various clays and kaolins.

E. Kordes contributes a somewhat lengthy paper on the lowering of vapour pressure in concentrated solutions of two volatile components; in collaboration with E. Klever, the results of calorimetric investigations on dehydrated kaolin are reported. Kordes and F. Raaz present a paper on boiling diagrams of binary high-boiling liquid mixtures (of mercury and cadmium, and of the chlorides of sodium and potassium, respectively), the measurements of vapour pressures or boiling points being carried out by the spiral method devised by O. Ruff.

C. Gottfried gives a short (second) paper on minerals of the Adamello group, dealing with hornblende from a special material found in the Val di Dois; jointly with E. Lubberger he contributes a short article on antimonite.

G. Trömel is the author of the remaining paper, in which silicates (or rather alumino-silicates) of the type of nepheline and anorthite are discussed at considerable length, including an account of results obtained from X-ray examinations and by the substitution of soda for lime (and vice versa) in such alumino-silicates, and also the results of substituting certain rare earth oxides for alumina in similar compositions. Some interesting deductions are drawn from the results obtained.

Fixed to the inside of the back cover as an appendix is a copy of the sixth part of the fifth year of *Schriften der Königsberger Gelehrten Gesellschaft*, consisting of a paper by W. Skaliks on some double combinations of alkaline carbonates with carbonates of alkaline earths.

While it may be admitted that several articles in the volume under consideration would scarcely

appeal to most readers of even scientific literature, others present features capable of useful application, and the whole volume constitutes an important record of high-class research. Such a miscellaneous assortment of papers does not provide an easy task for a reviewer, but it is hoped that sufficient indications have been given to enable readers interested to appreciate the real value of the work.

Impedance Networks.

Transmission Networks and Wave Filters. By T. E. Shea. Pp. xvii + 470. (London: Chapman and Hall, Ltd., 1930.) 32s. net.

THE study of impedance networks has acquired much importance during the past decade, as a result very largely of the pioneer work of G. A. Campbell on wave-filters. The literature of the subject has hitherto been scattered through the pages of patent specifications and technical journals, particularly the Bell System technical journal: the present very thorough account, which is particularly complete in its treatment of wave filters, will therefore be of the highest value to electricians. Although wave-filters have hitherto been used mainly in their practical applications to telephony, telegraphy, and wireless transmission, the precision with which they can be made to suppress some frequency bands while admitting others may render them of service in some branches of pure research.

Part I. deals with general principles, such as impedance-matching and the determination of iterative and image impedances—properties of asymmetric networks which correspond to the characteristic impedance of a uniform cable; propagation constants, the real part of which determines the attenuation of oscillations transmitted through the filter chain, while the imaginary part determines their phase change or velocity of propagation; and equivalences between various types of impedance combinations. Part II. deals with wave filters, as distinct from artificial lines for imitating cables, from retardation lines for producing progressive phase-change, and from attenuation equalisers for correcting distortion in telephony. It discusses the criteria for determining the 'cut-off frequencies' at the edges of the suppressed and transmitted frequency bands; the principal types of filter, particularly the 'constant-K' in which the product of the series and shunt impedances in each filter section is constant for all frequencies; the design of band-pass, low-pass, and high-pass filters; and the evaluation of the reflection losses which arise when a filter is not terminated by matched impedances.

Part III. is devoted to the transmission through impedance networks of transient impulses, such as telegraphic impulses, and gives *inter alia* an interesting analysis of the blurring caused in television by the fact that the width of the scanning aperture is not zero—a defect which can be remedied by the insertion of a suitably designed network. There are an excellent bibliography, numerical tables and graphs, a list of U.S. patents, and an index.

Although the wording of the book does not always strike an English reader as perfectly lucid, the author contrives to make his complicated subject clearly intelligible, and the mathematical treatment is simple and direct. The style in which the mathematical formulæ are set out suggests that they were originally typewritten with an ordinary typewriter, and leaves something to be desired. The choice of symbols is irritating: dashes, suffixes, and sub-suffixes appear and disappear like 'bats in a belfry', and the list of symbols on page xv omits the most puzzling of them. Nevertheless, as an intelligible exposition of subject matter which has not previously been summarised with anything approaching the present thoroughness, the book will be indispensable to all whom it concerns.

C. W. HUME.

Our Bookshelf.

Christ's Hospital: from a Boy's Point of View, 1864–1870. By the late Rev. W. M. Digues La Touche. Edited by his Brother. Pp. xii + 82 + 2 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1928.) 3s. 6d. net.

THE appointment of Mr. Hamilton Fyfe as the head of a university in Canada and of Mr. Flecker as his successor recalls one's mind to the famous school which the one is leaving and the other taking over. The Blue Coat School has always held a special place in the affections of English people, partly from the picturesque dress to which the boys remain loyally and proudly attached, partly from its old situation in the heart of London, partly from the lustre which a long array of distinguished ex-scholars have shed upon it. What school would not shine brighter in the light of Charles Lamb and Samuel Taylor Coleridge? It has since 1902 been housed in the most magnificent group of buildings provided for any school in England, and its efficiency in education reached its highest point under the able direction of its late chief.

The little book before us gives a lively and interesting account of the school in its old home from the pen of an 'old boy' now dead, the Rev. W. M. Digues La Touche, a member of one of the many gifted Huguenot families who came over from France

after the revocation of the Edict of Nantes. His father was a Shropshire clergyman and he himself returned there in mid-life in the same capacity. But he had added many things to the equipment of the average parson, for he was an enthusiastic and accomplished draughtsman, an ardent geologist, and a musician capable of training and conducting the village band and choral society. Evidently Christ's Hospital had done well by him, even in the rough and barbarous days which he describes. It is so evident in all he says that a spice of roughness is no drawback to a sound and even enjoyable education. The book is a welcome addition to the large literature which has arisen from Blue Coat surroundings. Every 'old boy' would wish to have it, and to the general student of education it has more than local interest. One striking feature which must have reached its highest point here is the list of special and esoteric names applied to the various boys, objects, and actions familiar in the school. In this vocabulary we go from the 'Grecians' at the top, down to the 'Trades' of each ward who brought up the food from the kitchens and even the 'Cakes' left on the boy's person by the cheerfully accepted canings. Can one have a really intimate and effective home or school without some such affectionate jargon?

F. S. M.

Penrose's Annual: the Year's Progress in the Graphic Arts. Vol. 33, 1931. Edited by William Gamble. Pp. xix+172+72+98 plates. (London: Percy Lund, Humphries and Co., Ltd., 1930.) 8s. net.

THIS ponderous volume is considerably thicker than any of its predecessors, presumably because of the larger number of examples of work that it contains. Of these examples, some, so far as one can judge, are very fine; but of course when the merit of a piece of work consists in copying an original as nearly as possible, one cannot really judge of it in the absence of the original.

We are very glad to see that Mr. A. J. Newton sets the good example of illustrating the results of the Peridak process by a graduated device, not a picture. Here we get a full range of tones with a patch of sensible size for each. This is a process of definitely controlling the reduction by means of Farmer's solution, in such a manner that dots that are completely joined may be reduced to mere pin points without losing their opacity. The screen negative is etched in nine stages. This tendency to complexity of method is also manifest in colour work. Theoretically, three colours are sufficient. Then for some time we got accustomed to four. In this volume there are specimens of pictures in up to eight colours, and from the nature of the examples we cannot see the advantage of running from the simplicity of three, or at most four, up to the complexity so nearly rivalling the colour work done before the three-colour era.

Mr. C. T. Jacobi has this year selected the Cambridge University Press for his historical article. He traces its development from A.D. 1521, when John Siberch printed the first Cambridge book. Dr. A. Ruppel, the Director of the Gutenberg Museum in Mayence on the Rhine, contributes an illustrated article on the Museum, past, present, and future. The editor gives his usual review and notes, summarising the progress of the graphic arts during the third of a century.

Grundlagen der praktischen Optik: Analyse und Synthese optischer Systeme. Von Dr. M. Berek. Pp. vii+152. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 13 gold marks.

A NUMBER of circumstances have combined to bring the importance of applied optics to the fore in recent years. Unfortunately, research into the range of validity of some of the more important theorems has tended to lag behind the immediate needs of manufacturers, while, conversely, the practical optician has failed to appreciate the help which the applied mathematician—with workshop experience—can provide.

Prof. Berek is in a position to render great service in this connexion, in that he combines a first-hand knowledge of industrial conditions (and limitations) with an academic outlook upon physical optics. His book contains a number of very elegant theorems relating to image formation and synthetic optical systems, which should prove of considerable value in the design of microscopes and ophthalmic instruments. The latter have already benefited greatly from the classical work of Prof. von Rohr: it is gratifying to find the subject so much alive.

This is not a book that can be honestly recommended to junior students; its place is more in the post-graduate laboratory of technical colleges and in the research department of firms concerned with optical apparatus of high precision.

F. I. G. R.

Physik: ein Lehrbuch für Studierende an den Universitäten und technischen Hochschulen. Von Prof. Wilhelm H. Westphal. Zweite Auflage. Pp. xvi+571. (Berlin: Julius Springer, 1930.) 19·80 gold marks.

IN the second edition of his book, Prof. Westphal has retained the desirable features which were referred to in noticing the first edition (NATURE, July 6, 1929, p. 18). In particular, the first chapter is excellent, with its introduction to causality and the essence of hypothesis. This is clearly the way in which a text-book of physics should begin, and yet such an opening is all too rare.

As regards the rest, compared with the general high level, the portion dealing with thermodynamics seems a little uninspired. Would it not be possible to cut adrift from convention and attack entropy boldly from the axiomatic point of view of Carathéodory? Fear of the examiner is probably less acute in the German university than elsewhere. Again (p. 519), Debye's T^3 law is given without comment: Schaefer's reasons for doubting its validity at the lowest temperatures—where it is usually taken for granted—should surely have been mentioned.

The author writes with unusual clarity: many English-speaking students would do well to improve their physics and their German by using this book.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Ether and Relativity.

I OBVIOUSLY must not ask for space to discuss all the points raised in Sir Oliver Lodge's interesting letter in NATURE of Nov. 22, and so will attempt no reply to those parts of it which run counter to the ordinarily accepted theory of relativity. For I am sure nothing I could say would change his views here. But I am naturally distressed at his thinking I have quoted him with a "kind of unfairness", and should be much more so, had I not an absolutely clear conscience and, as I think, the facts on my side.

In the part of my book to which Sir Oliver objects most, I explained how the hard facts of experiment left no room for the old material ether of the nineteenth century. (Sir Oliver explains in NATURE that he, too, has abandoned this old material ether.) I then quoted Sir Oliver's own words to the effect that many people prefer to call the ether 'space', and his sentence, "The term used does not matter much".

I took these last words to mean, not merely that the ether by any other name would smell as sweet to Sir Oliver, but also that he thought that 'space' was really a very suitable name for the new ether. He now explains he was willing to call the ether 'space', "for the sake of peace and agreement". If I had thought it was only *qua* pacifist and not *qua* scientist that he was willing to call the ether 'space', I naturally would not have quoted him as I did, and will, of course, if he wishes, delete the quotation from future editions of my book. But I did not know his reasons at the time, and so cannot feel that I acted unfairly in quoting his own words verbatim from an Encyclopædia article.

Against this, I seem to find Sir Oliver attributing things to me that, to the best of my belief, I did not say at all, as, for example, that a mathematician alone can hope to understand the universe. My own words were (p. 128):

"No one except a mathematician need ever hope fully to understand those branches of science which try to unravel the fundamental nature of the universe — the theory of relativity, the theory of quanta and the wave mechanics."

This I stick to, having had much experience of trying to explain these branches of science to non-mathematicians. In the same way, if the material universe had been created or designed on æsthetic lines — a possibility which others have contemplated besides Sir Oliver Lodge — then artists ought to be specially apt at these fundamental branches of science. I have noticed no such special aptitude on the part of my artist friends. Incidentally, I think this answers the question propounded in the News and Views columns of NATURE of Nov. 8, which was, in brief: If the universe were fundamentally æsthetic, how could an æsthetic description of it possibly be given by the methods of physics? Surely the answer is that if the objective universe were fundamentally æsthetic in its design, physics (defined as the science which explores the fundamental nature of the objective universe) would be very different from what it actually is; it would be a *milieu* for artistic emotion and not for mathematical symbols. Of course, we may come to this yet, but if so, modern physics would seem rather to have lost the scent.

However, I am glad to be able to agree with much that Sir Oliver writes, including the quotations from Einstein which he seems to bring up as heavy artillery to give me the final *coup de grâce*: "In this sense, therefore, there exists an ether", and so on. On this I would comment that nothing in science seems to exist any more in the good old-fashioned sense — that is, without qualifications; and modern physics always answers the question, "To be or not to be?" by some hesitating compromise, ambiguity, or evasion. All this, to my mind, gives strong support to my main thesis.

J. H. JEANS.

Cleveland Lodge,
Dorking, Nov. 23.

Boric Acid in the Glaze of the Sealed Vases of Arezzo.

IT may be of interest to record a discovery I have made, with Dr Grassini, which should prove of importance in the study of old ceramics, and also of the commerce and industries of the Romans of the first century after Christ. My researches upon the antiquity of the boric acid bearing 'lagoni' and 'soffioni' of Tuscany led me to examine the glaze of the famous Arezzo pottery (*vasi sigillati aretini*). These vases are among the most beautiful and important of the artistic works of the Romans of the first century before and after Christ.

The constitution of that marvellous coral-like glaze, so bright and thin, many attempts at the reproduction of which have been made and about which so many hypotheses have been advanced, has always been something of a mystery. Dr. F. Keller,[1] a German worker, was the first to suggest that boric acid might be a constituent of the glaze, upon the assumption, based on experimental evidence, that good glazes could be obtained (excellent, to quote the author) only by using borax. His conclusions were not generally accepted, even by those who saw the results of his attempts to reproduce the old glazes. The question was still open. Nevertheless, the opinion was widely held that, in the glaze of the Arezzo vases, boric acid could enter as a constituent, and in the 'Storia della ceramica Greca', by Pericle Ducati, it is stated: "In Arezzo's manufactories, the application of a brilliant glaze, colourless, composed of silicates, iron oxide, and perhaps of borax, is also to be noticed". But no proof could be established; the historians of chemistry affirming, on the other hand, that borax was unknown to the Greeks and to the Romans.

I therefore made up my mind to try an *experimentum crucis* by analysing chemically the glaze of the Arezzo vases. This was not easy, since it was necessary to get a quantity of fragments of no artistic value; in addition, the glaze is only a thin layer, and it is difficult to detach it. Dr. A. Del Vita, the archæologist who, with his brother, so successfully attempted the revival in Arezzo of the famous Roman ceramic industry, came to my help by providing a good quantity of fragments from the potteries of "L(ucius?) Titi", and "Thursus", which were found during some trials made for research purpose, by Dr. De Vita, in an area situated under the walls of the northern side of Arezzo. Collaborating with Dr. R. Grassini, and in his private laboratory in Florence, the necessary analyses were carried out.

Accurate analyses of the glaze have led us to affirm with certainty that boric acid is found as a constituent part of the glaze, and not merely in occasional traces. It is, we think, the first time that boric acid has been certainly detected in products of that epoch;

it must be noted, on the other hand, that we have not found any boric acid in the glaze of Etruscan-Campanian fragments.

Prof. Xaver Landerer (born in Munich in 1809, died in Athens in 1883), of the University and Polytechnic of Athens, states that the Romans and Greeks were acquainted with boric acid, but I do not believe that his statements were based upon accurate analyses by himself or others. Whether the Romans extracted borax, mistaking it for other products, from Asia Minor or other places in the East, or whether they utilised, without knowing their nature, products of the actual 'lagoni', it is difficult to say. A detailed account of the present work, together with a full discussion of these questions, will appear elsewhere: we limit ourselves, for the time being, to recording the results of the present investigation, and expressing our thanks to those who are helping us in this difficult field. We would also urge the importance of extensive chemical and physico-chemical studies on the various ceramic, metallurgical, and similar products of antiquity, studies which, until now, have been very incomplete and fragmentary, and may throw new light upon so many vital questions.

R. NASINI.

Viale Regina Margherita, 269,
Roma.

[1] "Die rote römische Topferwaare mit besonderer Rucksicht auf ihre Glasur. Eine kunstgewerbliche Skizze." Von Dr Franz Keller, Rektor der Gewerbschule in Speyer. (Heidelberg: Buchhandlung von Carl Gross; 1876.)

Embryology and Evolution.

PROF. MACBRIDE, in his brilliant review (NATURE, Oct. 25, p. 639) of the recent embryological works by Dürken, Schleip, and Przibram, raises questions which are so fundamental in modern biology that I venture in all humility to interpose a word. Although I have not yet had the opportunity of reading these books, much of their work is already familiar ground, and Prof. MacBride's clear exposition renders reference to the originals unnecessary so far as these general questions are concerned.

My friend Prof. MacBride appears to have surrendered to the charm of Driesch's 'entelechy' as a directive agency in embryological development. But surely Driesch's method is the dangerous one of argument by exclusion. He says in effect, no mechanistic hypothesis yet brought forward will explain all the phenomena of development, therefore there must be some non-material agency at work. This, however, is an 'explanation' which explains nothing in any scientific sense. If it were to be accepted as an explanation, there would be no further incentive to experimental embryology. This is, indeed, the view which Prof. MacBride himself formerly took of Driesch's philosophy (see NATURE, vol. 92, pp. 291, 400; 1913).

But are the possibilities of a mechanistic explanation of development exhausted? I venture to think otherwise. The issue is the more important, because various writers, such as Rádl and Uexküll, endeavour to use Driesch as a means of decrying 'Darwinism', that is, evolution. Prof. MacBride's question, "If there be such a thing as evolution", leads one to wonder whether in his mind also an adherence to vitalism may lead to a questioning of evolution itself. Rádl, in his anti-evolutionary bias, goes so far as to say ("The History of Biological Theories", p. 187), "It is almost universally, though tacitly, assumed in biological text-books that organisms must have had a polyphyletic origin". I can only plead ignorance of any such 'text-book'. Again, he tells us (p. 388) that Darwinism was "completely rejected" by Driesch.

Turning to Uexküll ("Theoretical Biology", 1926), we find such statements as these. On p. 112 it is stated that whenever a vestigial organ has been tested, some function peculiar to it has always been revealed, and "it is to be hoped that 'vestigial organs' will soon disappear into oblivion". Again (p. 114), the framework of the cell "is an absolutely perfect machine", and "in this respect, there is no such thing as evolution". The first contradictory fact that occurs to one is the extremely primitive nuclei and mitotic mechanism of such organisms as the blue-green Algæ. But again (p. 164), "Every living creature is, in principle, absolutely perfect". Such statements savour more of medieval theology than of modern science. In this book we find (p. 238) that it was Mendelism which "swept the whole theory (of Darwinism) away"!

As is well known, Driesch's argument rests on those types of embryos in which the cells, when separated in the early stages of cleavage, are each capable of producing a complete embryo of smaller size. He argues that no machine can perform such feats, and that therefore, in short, the behaviour of such embryos cannot have a mechanical explanation. But what man-made machine is divided up into similar compartments, each having within it its own controlling centre? When those centres (the nuclei) are equipotential and are all moreover totipotent, why should there be surprise when each cleavage segment begins to develop as the original egg with its single nucleus began to develop?

Prof. MacBride agrees that emissions from the nucleus control development. Then why invent an entelechy to control these emissions? Is not the relation of the nuclei to the cytoplasm, and of the cells to each other and to the environment, sufficient to account for such differentiation of cytoplasm as takes place in development? Surely the facts of regeneration, remarkable as they are, would seem to lose some of their terrors when it is recognised that all the nuclei of an organism are in general totipotent.

Both Rádl and Uexküll adhere to the old conceptions of Weismann regarding the differentiation of nuclei during ontogeny, but such a view has long been obsolete and, as Prof. MacBride points out, the nuclei are to be regarded as undifferentiated during development. I reached a similar conclusion many years ago ("The Mutation Factor in Evolution", p. 297; 1915) on the basis of such mutations as *Œnothera lata*, which have an extra chromosome in every cell. Many similar cases have been discovered since. Driesch ("Science and Philosophy of the Organism", 1908, p. 154) regards the cambium of higher plants as a similar "equipotential system with complex potencies". This indeed appears to be true, but, so far as I am aware, botanists have never yet felt the need for an entelechy in their explanation of its characteristic activity. In the process of secondary thickening in an ordinary woody stem, secondary medullary rays soon begin to appear. This is because the cambium cells on certain radii change their activity and produce parenchyma cells instead of xylem and phloem. Has the entelechy changed its mind, or will it suffice to assume that with increasing diameter and circumference the altered spatial relationships between the tissues lead to a change in the activity of the cambial cells occupying certain positions?

The length to which such vitalistic conceptions can be carried is well exemplified by Uexküll, who, in his discussion of Mendelism, after adopting the current view that the chromosomes contain enzymes which in their turn initiate the development of

characters, makes the gratuitous assumption (l.c. p. 214) that these enzymes are themselves controlled by non-material impulses. We read (p. 216), "We may say that the genes are 'impulsive', but by that term we must not presume a physical energy, following the rule of causality; rather, we must understand the power to convert an extra-spatial and extra-temporal plan into a physical phenomenon". This seems pure mysticism, yet (p. 201) he accepts the usual conception that in Mendelian inheritance "a separation of the competing rudiments" takes place in germ cell maturation. What are these "competing rudiments" but material particles? After stating that Driesch "has proved that there is a framework present in the germ", Uexkull goes on to say (p. 209) that a framework is like a machine and cannot repair itself. It is important to point out that this also applies to the chromosomes. There is now clear evidence from various lines of observation and experiment that when a chromosome or a portion of one is lost it is never regenerated.

Prof. MacBride, in touching on the question of genes, states that Johannsen deplored "the damage and confusion of thought caused by the invention of the word 'gene'". There must be some further confusion of thought here, for it was Johannsen himself who invented the word gene ("Elemente der exakten Erblichkeitslehre", third edition, p. 165), as well as genotype and phaenotype. We find it more rational to accept the conception of genes spatially arranged in the chromosomes and distributed by mitosis to every nucleus during ontogeny, thus leading to an orderly development, than to postulate an entelechy the ways of which are past finding out, or a bundle of memories which seems an even more uncertain basis on which to explain the phenomena of ontogeny and regeneration.

Since Prof. MacBride accepts the conception of emissions from the nuclei as controlling development, and since we know that the nuclei of each species of animal or plant have a definite and characteristic morphological collocation of materials making up the chromosomes, might we not ask him to consider the definiteness in every detail of the structure of these bodies, as a possible basis for the orderliness which we behold in the successive stages of embryological development. That the essential substances in the chromosomes are autocatalytic in nature, is a view frequently held, and it appears to furnish an adequate mechanistic basis for the phenomena of development.

We fully agree with Prof. MacBride that Schleip's conception of an ultra-microscopic crystalloidal structure in the cytoplasm will not suffice to explain the phenomena of development and regeneration, but we have already seen that the known organisation of the nucleus appears to be sufficient, working in a cytoplasmic matrix which is relatively undifferentiated from species to species. The recent work on species-hybrids shows that in those cases, such as *Antirrhinum*, where Mendelian behaviour results, there is no cytoplasmic difference involved; whereas in many other experimental cases, both in plants and animals, the less nearly related species have their characteristic cytoplasm, as well as differences in the germ nuclei. It appears clear that in species differentiation nuclear differences arise first and cytoplasmic differences afterwards, as the nuclear differences become more pronounced.

We are fully impressed by Spemann's conception of 'organisers' in embryonic development, based chiefly on the more recent embryonic grafting experiments. But we take it that this need not lead to the conception that the organisers have an entelechy which dominates over the entelechy of the part on which they are grafted.

It is interesting to note that both Driesch and Przibram regard the stiffening or solidifying of the cytoplasm of the animal egg as an important element affecting development. For Driesch it limits the activities of the entelechy, and for Przibram it leads to the formation of 'apoplasm' which is not fully [illegible] ds plant embryoge[illegible] r, the conditions of stiffening in the cytoplasm appear to be quite the reverse. The meristem of a growing root or stem is composed of undifferentiated cells which are filled with dense and apparently stiff cytoplasm. Differentiation of the stelar tissues only begins in the older region of the stem or root, where the cells have taken in quantities of water and developed vacuoles which ultimately coalesce to form a large watery chamber with a thin peripheral layer of cytoplasm. It appears true that such secondary meristems as the cambium retain dense cytoplasm or develop it before they begin to divide, but their derivatives show a progressive increase in water content, and therefore in one sense at least in liquidity. These products of the meristems are, of course, the cells which become differentiated tissue elements.

R. RUGGLES GATES.

King's College,
Strand, W.C.2.

To answer Prof. Gates fully would require a philosophical treatise, for which I am sure no room could be found in NATURE. I shall endeavour to deal with his principal points as briefly as I can.

Prof. Gates asserts that Driesch assumed an entelechy because the facts of development could be explained by no mechanical hypothesis so far put forward; but that the entelechy "explained nothing" and was 'unscientific'. These are serious accusations to bring against a biologist of the eminence of Prof. Driesch. Prof. Gates's statement of Driesch's argument is incorrect. What Driesch said was that no *possible* mechanical hypothesis would explain development: for all such hypotheses in the last resort resolve themselves into the assumption of a "fixed constellation of parts" or, as I would put it, the juxtaposition in a fixed order of unlike molecules.

'Science' is only organised common sense, and if Driesch was driven to this conclusion by convincing logic, it is eminently 'scientific' on his part to say so. As to the entelechy explaining nothing, Prof. Gates should remember that *all explanation is comparison*—the ranging of less known with the better known. Prof. Gates does not believe that he himself is a mere mechanism; if he were, he could not carry out scientific reasoning. He knows that he possesses a personality which 'regulates' his bodily mechanism—and what Driesch's conclusion amounts to is that a rudimentary element of the same general nature exists in every organism. An eminently common-sense conclusion! For, as has been well said, the man who maintains that his brother or his cat is a mere mechanism, is either a fool or a 'physiologist'.

Prof. Gates agrees with me that nuclei are equipotential and that the nuclei control or 'organise' the cytoplasm, and these considerations, he thinks, afford a 'mechanical' explanation of development. On this point I shall only remark that it was precisely these considerations which led Driesch to his vitalistic hypothesis. I recommend Prof. Gates to re-read carefully "The Science and Philosophy of the Organism". The fact is that all so-called mechanical hypotheses of development surreptitiously introduce

vitalistic links into the chain of argument, but endeavour to cover them up by inventing technical names for them.

Prof. Gates admits that the cambium of the higher plants is an equipotential system, but says that no botanist as yet has postulated the existence of an entelechy. If Prof. Gates will read Prof. Bower's Bristol address to the British Association, he will encounter something suspiciously like the Drieschian entelechy.

I shall not follow Prof. Gates in his attack on Von Uexküll's "Theoretische Biologie", but will refer him to my review of that book which appeared in NATURE in July 1929.[1] Von Uexküll is one of our foremost comparative physiologists. His destructive criticism of the mechanistic position is, to my mind, unanswerable.

It is true, as Prof. Gates says, that Johannsen invented the word 'gene', but he lived to regret it, and his repudiation of it is contained in *Hereditas*, vol. 4 (1923), p. 133, to which I refer Prof. Gates.

Prof. Gates invites me to consider whether the conception of the chromosomes as composed of 'genes' which are 'autocatalysts' does not afford the explanation of development of which I am in search. The "orderly arrangement of genes" is a figment of the imagination; as Dürken has remarked, no one has ever seen 'genes' in a chromosome, which always appears when examined fresh to be a homogeneous rod of glutinous material. But if Prof. Gates were a zoologist instead of being a botanist, he would know that the assumption that 'genes' have anything to do with evolution leads to results, as in the case of *Drosophila*, that can only be described as farcical, and this assumption is repudiated by all those really conversant with the evidence for evolution.

The term 'autocatalysis' is a piece of bluff invented by the late Prof. Loeb to cover up a hole in the argument in his book, "The Mechanics of Living Matter". If we turn to the late Prof. Bayliss's book on enzyme action — and he is our foremost authority — we find a catalyst defined as something which causes a chemical action normally proceeding slowly to proceed quickly. All known chemical actions are inhibited by the accumulation of the products of the reaction. An 'autocatalytic' reaction, in which the products of the reaction accelerated it, must surely be a vitalistic one!

Prof. Gates has kindly and sympathetic concern about my 'salvation' as an evolutionist. Let me reassure him on this point: I am a thorough believer in evolution. I admit that statements of both Driesch and Uexküll give colour to his complaint that they repudiate evolution altogether. It was part of the object of my review to show that the concept of entelechy could be further analysed, and that entelechies could be brought into orderly relation to one another and fitted into a scheme of evolution.

E. W. MACBRIDE.

[1] "A Philosophy of Biology", NATURE, July 20, 1929.

Absorption of Sound at Oblique Incidence.

IN the issue of NATURE for Sept. 6, Dr. P. R. Heyl directs attention to a disagreement between theoretical conclusions concerning the absorption of sound by porous bodies at oblique angles of incidence.

The theories to which he refers are those given by Sir Joseph Larmor[1] and myself.[2] Dr. Heyl states that "For grazing incidence, Larmor finds that the absorption should be infinite, while Paris comes to the conclusion that it should be zero".

The disagreement is due to an unfortunate 'approximation' which occurs in Sir Joseph Larmor's calculation.[3] It is there shown that

$$\frac{u_1 - u_2}{u_1 + u_2} = \frac{k'}{k}\,\frac{a}{\cos\iota}, \qquad (1)$$

where u_1 and u_2 are the particle velocities in the incident and reflected waves respectively, k'/k is the ratio of the wave-length in the incident sound to the wave-length in the pores, a is the proportion of the reflecting surface occupied by the pore openings, and ι is the angle of incidence. The 'degree of stifling of the sound' (that is, the coefficient of absorption) is stated to be "$(u_1^2 - u_2^2)/u_1^2$ or approximately $(u_1^2 - u_2^2)/\frac{1}{4}(u_1 + u_2)^2$" (an obvious misprint which occurs in the original paper is corrected). This leads to an absorption coefficient $(k'/k)4a/\cos\iota$ which increases with obliquity and tends to become infinite at grazing incidence — a result which is manifestly wrong, since for physical reasons the coefficient cannot in any circumstances be greater than unity. The source of trouble is in the approximation. From the equation (1) quoted above we have

$$\frac{u_2}{u_1} = \frac{\cos\iota - (k'/k)a}{\cos\iota + (k'/k)a}, \qquad (2)$$

whence, without approximation, the absorption coefficient is

$$\frac{4(k'/k)a \cdot \cos\iota}{\{\cos\iota + (k'/k)a\}^2}, \qquad (3)$$

which tends to zero as grazing incidence is approached. It is clear from (3) that the so-called approximation consists in neglecting $(k'/k)a$ in comparison with $\cos\iota$ for all values of ι between 0 and $\pi/2$.

It appears therefore that when no approximation is made, Sir Joseph Larmor's results are in agreement with those given in my paper of 1927. In fact, the equation (1) which expresses the relation between the amplitudes of the incident and reflected waves has precisely the form of my equation[4] (3.4) deduced by the aid of 'acoustical admittance'.

It may be observed that $(k'/k)a = u/(p/a\rho)$ where u is the component of particle velocity normal to the reflecting surface, p is the pressure at this surface, a is the velocity of sound in air, and ρ is the density of air. This follows at once from equations on p. 234 of Sir Joseph Larmor's paper.[5] Hence $(k'/k)a = u/V$ where V is the particle velocity in a plane progressive wave in which the pressure is p. The possible values of $(k'/k)a$ therefore lie in the range zero to unity, that is, in the same range as the values of $\cos\iota$. Thus, from (2) we see that there are always values of ι for which u_2 is negligible compared with u_1, and for every value of $(k'/k)a$ there is a value of ι for which u_2 vanishes and the incident sound is totally absorbed.[6] The argument applies only to the ideal case when k' is real. For actual materials k' is expected to be complex, and then, as shown elsewhere, the absorption should be a maximum for some particular angle of incidence.

E. T. PARIS.

Shortlands, Kent, Nov. 10.

[1] *Proc. Camb. Phil. Soc.*, **26**, pp. 231-235; 1930.
[2] *Proc. Roy. Soc.*, A, **115**, pp. 407-419; 1927.
[3] P. 234, loc. cit.
[4] *Proc. Roy. Soc.*, A, **115**, p. 412.
[5] Cf. also Rayleigh, "Sci. Papers", vol. 6, p. 663.
[6] Cf. *Proc. Roy. Soc.*, A, **115**, p. 413.

Glucose and the Structure of the Cycloses.

THE cyclohexanols $C_6H_{12-n}(OH)_n$ and their methyl derivatives are of considerable interest from the point of view of biochemistry. It has been known for some time that these substances can, according to theory, exist in a great number of isomeric forms.[1] The following table shows the number of possible isomers

for various values of n, on the assumption of a plane ring structure for the cyclohexane nucleus:

TABLE I.

CYCLOHEXANOL ISOMERS (PLANE RING).

n	Substitution.	Active (in pairs)	Inactive.	Totals	
1	1.	0	1		1
2	1.2.	2	1	3	
.	1.3.	2	1	3	
.	1.4.	0	2	2	8
3	1.2.3.	2	2	4	
.	1.2.4.(1.2.5.)	8	0	8	
.	1.3.5.	0	2	2	11
4	1.2.3.4.	8	2	10	
.	1.3.5 6.	4	4	8	
.	1.3.4.6.	4	3	7	25
5	1.2.3.4.5.	12	4	16	16
6	1.2.3 4.5.6.	2	7	9	9

The natural occurrence of the cycloses is summarised as follows: There are two inactive cyclohexanhexols, *i*-inositol and scyllitol, which are definitely known to occur. The monomethyl *i* inositols, bornesitol, mytilitol,[2] and sequoyitol,[3] and two dimethyl derivatives are also recorded. The two active inositols as such have been reported only in the racemic form in the berries of the mistletoe, but their methyl derivatives, quebrachitol and pinitol, are of more general occurrence.

The dextrorotatory pentol known as *d*-quercitol has been obtained from several sources and its lævorotatory diastereomer has been found in the leaves of *Gymnema sylvestre*. One active tetrol, betitol, the constitution of which has not yet been discussed, is reported to occur in the sugar beet.

While it cannot be said that the search for cycloses has been exhaustive, very considerable work has been done which would lead to their discovery.[4] It is therefore not unreasonable to suppose that at least a majority of the naturally occurring cycloses have been discovered. It remains then to explain the discrepancy between the seven known cycloses with four or more hydroxyl groups and the fifty which are theoretically possible.

In view of the widespread occurrence of these substances in Nature, one is tempted to look for some common function or property which will limit the number of cycloses which can occur. Without considering its plausibility, let us assume that in Nature the cycloses and their methyl derivatives have their origin in glucose, or at least are chemically closely connected with some substance which contains in its structure the configuration: *

$$\begin{array}{ccccccc} & & \mathrm{OH} & \mathrm{H} & \mathrm{OH} & \mathrm{OH} & \\ & & | & | & | & | & \\ \mathrm{XYZC} & - & \mathrm{C} & \mathrm{C} & \mathrm{C} & \mathrm{C} & -\mathrm{CUVW} \\ & & | & | & | & | & \\ & & \mathrm{H} & \mathrm{OH} & \mathrm{H} & \mathrm{H} & \end{array}$$

Let us now determine which of the theoretical isomers of Table I. can give rise to the glucose configuration. In Table II. the number of isomers which satisfy this condition is compared with the number actually found in Nature. Of course, the monol, diols, triols, the 1.3.5.6 tetrols, and the 1.3.4.6 tetrols cannot contain the required arrangement of hydroxyls.

* We do not concern ourselves with the substitution of the end carbon atoms or with the sign of the activity. Thus the above formula might apply to *d*- or *l*-glucose, or to *d*- or *l*-gulose. This ambiguity does not have any bearing on the present argument.

TABLE II.

n	Activity	Theory.	Found.
4	inactive	0	..
..	dextro	1	1
..	lævo	1	.
5	inactive	1	..
.	dextro	3	1 †
..	lævo	3	1 †
6	inactive	3	2
..	dextro	1	1
.	lævo	1	1

† These are not antipodes, so that two models are represented.

We see from this table that of the fourteen cycloses required by the present theory, seven have been found. This agreement is surprisingly good when we remember that no account has been taken of the possible effect of the end groups in the formation of the ring. Any further condition can only reduce the number of isomers, so that the data in Table II. correspond to the maximum number of isomers consistent with the present assumption.

I am aware that the assumption of a puckered ring or a ring of any lower symmetry leads to a considerable increase in the number of possible isomers. Any criticism on this account is, however, equally well a criticism of most of the results of stereochemistry, and therefore need not be taken into account until circumstances warrant a more general view of the whole subject.

Of course, the theory that *i*-inositol is closely related physiologically to glucose is by no means new.[4] It provides an explanation of the association of glycosuria and inosituria in both pathological and experimental polyurias. Needham[5] has shown that inositol is synthesised in the embryonic development of the chick; and that in this case the maximum of the inositol time curve can be nearly doubled by the injection of glucose at the beginning of the development. Needham[6] has also shown that the dogfish embryo synthesises scyllitol in a similar manner, although the effect of glucose still remains to be investigated.

It is important to note here that the present assumption is in agreement with the structure arrived at for *i* inositol by S. and T. Posternak.[7]

A. L. PATTERSON.

Rockefeller Institute for Medical Research,
New York City, Oct. 10.

[1] L. Bouveault, *Bull Soc Chim France* (3), **11**, 144; 1894.
[2] R. J. Daniel and W. Doran, *Biochem J.*, **20**, 676; 1926. Specific references are only given for those substances not recorded in Beilstein (4th edition), vol 6.
[3] E. C. Sherrard and E. F. Kurth, *J. Am. Chem Soc.*, **51**, 3139; 1929.
[4] Cf. J. Needham, *Ergebn d Physiol* **25**, 1, 1926.
[5] J. Needham, *Biochem J*, **18** 891 and 1371, 1924, also loc. cit.
[6] J. Needham, *ibid*, **23**, 319, 1929.
[7] S. and T. Posternak, *Helv Chem. Acta*, **12** 1165; 1929.

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter.

IN a letter in NATURE of Nov. 8, p. 722, Prof. A. Haas proposes to relate the rate of expansion of the universe to the rate of 'disintegration' of matter by using Einstein's formula,

$$M = \frac{2}{\pi} R \text{ (gravitational units)} \quad . \quad . \quad (1)$$

and taking derivatives with respect to the time t.

Apart from the fact that this would give a negative velocity, that is, a contraction, the method itself seems to be illegitimate. Equation (1) is derived on the explicit assumption that R is not a function of t. When R is a function of t, (1) must be replaced by

$$\left(\frac{dR}{dt}\right)^2 + 1 = \tfrac{1}{3}R^2\lambda + \frac{4M}{3\pi R} \quad . \qquad (2)$$

where λ is Einstein's cosmical constant.[1] From (2) and related equations Eddington[2] has shown that Einstein's universe is unstable, so that when once disturbed it will expand or contract even if the total mass remains constant. He has further shown that if the initial disturbance were a conversion of matter into radiation it would actually start a *contraction*.

Prof. Haas does not state whether he is considering the *proper* mass or the *relative* mass. The latter does not change when matter is converted into radiation. If the proper mass is to be understood, a relation of his proposed type might hold good, apparently, only if λ were to vary in a suitable manner with the total amount of matter present. I am not aware that such a possibility has ever been suggested.

W. H. McCREA.

Mathematical Department,
University of Edinburgh,
Nov. 10.

[1] Lemaitre, *Annales de la Société Scientifique de Bruxelles*, **47** A, p. 49; 1927.
[2] *Mon. Not. Roy. Ast. Soc.*, **90**, p. 668; 1930.

A. HAAS deduces the equation:

$$v = 1{\cdot}1 \times 10^{-49} M,$$

where v represents 'cosmical velocity' and M the mass of the universe.[1] Taking $M = 1{\cdot}8 \times 10^{57}$ gm. he obtains $v = 2000$ km. per second and then says: "This value agrees well with the magnitude of the velocity with which the farthest spiral nebulæ appear to recede from us".

As against this, I find that according to more recent investigations the mass of the universe is considerably less than $1{\cdot}8 \times 10^{57}$ gm. According to A. S. Eddington[2] we may assume that $M = 2{\cdot}3 \times 10^{55}$ gm. If we insert this value we obtain only $v = 25$ km. per second.

In the near future the *Zeitschrift für Physik* will publish my paper: "Einige Folgerungen aus den neuesten Ansichten von E. C. Stoner und von E. A. Milne über das Innere der Sterne". In that article, among other subjects, I deal with the problem of the dissolution of matter, but from a totally different point of view from that of A. Haas.

WILHELM ANDERSON.

Tartu-Dorpat (Estonia),
Nov. 13.

[1] Arthur Haas, NATURE, **126**, p. 722; 1930.
[2] A. S. Eddington, *Mon. Not Roy. Ast. Soc.*, **90**, p. 678; 1930.

Evidence for Quadripole Radiation.

THE $S \rightarrow D$ transitions which occur in the alkali spectra are forbidden by the ordinary selection rules for the azimuthal quantum number. As they are still observable in absorption, the question arises whether they are due to the action of external electric fields and are still a dipole radiation from a perturbed atom, or whether they are due to quadripole radiation. Rubinowicz has calculated the Zeeman selection rules for quadripole radiation; they differ from the ordinary rules in that the change in the magnetic quantum number may have the values ± 2 in addition to the ordinary ones $0, \pm 1$. The polarisation also is quite different.

I have observed the transverse Zeeman effect of the 4642·17-4641·58 potassium doublet, which is an $S \rightarrow D$ combination, and I have been able to show that its Zeeman pattern agrees with the predictions of Rubinowicz for quadripole radiation and not with those for dipole radiation. This transition is thus shown to arise from quadripole radiation.

Details will be published elsewhere.

EMILIO SEGRÈ.

Istituto Fisico della R. Università,
Roma, Nov. 7.

The Carbohydrate Complex of Serum Proteins and the Clinical Determination of 'Bound Sugar' in the Blood.

IN connexion with the reference to my work (Rimington: *Bioch. J.*, **23**, 430) upon the isolation of a carbohydrate complex from blood-serum proteins, made in an article in NATURE of Nov. 1, p. 704, it may be of interest to state that I have now extended these observations, with the consequence that I have somewhat modified my earlier conclusions.

The complex obtained from the proteins of horses' serum appears to be a *tri*saccharide structure (possibly polymerised) and not a *di*saccharide as originally suspected. This conclusion was announced to the Biochemical Society on May 17 of this year, and is to be found in the *Proceedings* of that Society published in *Chemistry and Industry*, May 23, 1930, p. 440.

Each molecule of glucosamine is associated with two molecules of mannose, thus giving a substance with the empirical formula $C_{18}H_{33}NO_{15}$ and containing 2·78 per cent nitrogen. A similar trisaccharide complex, which appears to be identical with that already described, has also been isolated from the mixed serum proteins of ox blood. All my preparations are optically inactive.

It is of interest that the nitrogenous impurity which was found to be present in the substance originally isolated proved to be histidine. For its complete removal prolonged and vigorous hydrolysis is required. Since the carbon and hydrogen content of histidine differs little from that of the sugar which was being isolated, the fact that its presence was unsuspected is capable of explanation.

More recently I have attempted to prepare sufficient of the so-called mucoid of blood serum to examine it for associated carbohydrate material. In view of Levene and Mori's recent findings in the case of ovomucoid (*J. Biol. Chem.*, **84**, 49), it seems possible that this protein of the serum, also, may prove to be carbohydrate containing.

Finally, I should like to add that the discovery of these complexes in serum albumin and globulin affords a satisfactory explanation of some of the contradictory observations of various authors upon the 'bound sugar' of the blood. Alkaline hydrolysis of the proteins leads to a non-reducing complex which is also unattacked by enzymes; acid hydrolysis, on the other hand, yields reducing substances. Both glucosamine and mannose form an osazone identical with glucosazone, and such has frequently been isolated from the hydrolysed protein fractions of serum, but it is incorrect to assume, as has frequently been done, that the protein sugar is thus proved to be glucose.

Certain quantitative discrepancies between the results of various authors can be similarly explained. Bierry and Rathery (*C. R. de la Soc. Biol.*, **83**, 1890) give the figures for the protein sugar of horse plasma as about 0·13 per cent; Dische (*Bioch. Z.*, **202**, 74) finds it to be about 0·22 per cent. The former authors deproteinised their solutions with a mercuric nitrate reagent, which also precipitates glucosamine, whilst

Dische's figure was arrived at when using phosphotungstic acid as the protein precipitant.

The 'bound sugar' of the blood may have a physiological significance (Glassmann; *Zeit. physiol. Chem.*, **150**, 16, and **158**, 113).

A further communication on this subject will be published shortly.

CLAUDE RIMINGTON.

Biochemical Department,
Wool Industries Research Association,
Headingley, Leeds, Nov. 4.

Natural Selection Intensity as a Function of Mortality Rate.

IN NATURE of May 31, Prof. Salisbury points out that most of the mortality among higher plants occurs at the seedling stage, and concludes that natural selection is mainly confined to this stage. I believe, however, that this apparently obvious conclusion is fallacious, for the following reason:

Consider two pure lines A and B originally present in equal numbers, and with a common measurable character, normally distributed according to Gauss's law in each group. Let the standard deviations of the character be equal in each group, but its mean value in group A slightly larger than that in group B. Johansson's beans furnish examples of this type of distribution. Now let selection act so as to kill off all individuals in which the character falls below a certain value. I think that this type of artificial selection furnishes a fair parallel to natural selection, in which chance commonly plays a larger part than heritable differences. Let x be the proportion of individuals eliminated to survivors, and $1+y$ the proportion of A to B among the survivors, so that x measures the intensity of competition, y that of selection.

Then when x is small y is roughly proportional to it. Thus when x increases from 10^{-4} to 10^{-1}, y increases 200 times. But when x is large y becomes proportional to $\sqrt{\log x}$. In consequence y only increases 9 times when x increases from 1 to 10^{12}, and is only doubled when x increases from 1 to 1800. In other words, when more than 50 per cent of the population is eliminated by natural selection, the additional number eliminated makes little difference to the intensity of selection. The theory, which I hope to publish shortly, has been extended to cover cases where the standard deviations differ, and also where populations consist of many genotypes. In general y changes its sign with x, but when x is large y never increases more rapidly than $\log x$.

Careful mathematical analysis seems to disclose the extraordinary subtlety of the natural selection principle, and merely verbal arguments concerning it are likely to conceal serious fallacies.

J. B. S. HALDANE.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
Nov. 1.

The Exit of *Leishmania infantum* from the Proboscis of *Phlebotomus perniciosus*.

SANDFLIES, *P. perniciosus*, infected with *Leishmania infantum* on a hamster, were allowed to feed on a solution of citrate by Hertig's method. This method consists of inserting the biting apparatus of living sandflies into a capillary in such a way that the mouth parts go through all the movements of piercing. In some species these movements in the Hertig apparatus are followed by activity of the pumping apparatus of the buccal cavity and pharynx which results in the ingestion of fluid. In the case of *P. perniciosus*, the mouth parts go through all the actions of piercing, but the insects seldom ingest fluid in the Hertig apparatus.

Fifteen sandflies from five to thirteen days after the infecting feed were placed in the Hertig apparatus. After an interval of one to three minutes, the sandflies were removed and the fluid in the capillary was examined. In six cases (9-10 days after the infecting feed) the fluid was found to contain flagellates. The number of flagellates found varied from one to hundreds, but in all cases the number recovered from the biting parts was very small as compared to the enormous numbers afterwards found in the dissected sandflies. In contrast to the flagellates from the midgut and œsophagus, which are very active, those recovered from the biting parts are sluggish and many of them quite motionless.

The above observations prove that *L. infantum* can leave the biting parts of *P. perniciosus* during the act of biting and enter a new host in the absence of any active interference on the part of the latter. We suggest that this accounts for the main peculiarity of Mediterranean kala-azar, that is, its relative frequency in infants less than twelve months of age.

S. ADLER.
O. THEODOR.

Kala-azar Commission of the Royal Society
and Hebrew University of Jerusalem.

Elements present in Animal Tissues.

IN a letter published in NATURE of Nov. 15, Mr. A. Chaston Chapman announces the interesting discovery of antimony in an animal. He refers also to the known presence of vanadium and arsenic in certain animal tissues. We purposely omitted from our letter to NATURE of Nov. 1 reference to a number of other elements which have previously been recorded as occurring in animal tissues but which have not up to the present been detected in our work, for reasons already given by one of us[1]. They are the following: Aluminium, zinc, boron, and silicon, from numerous animals; gold in mammals[2]; titanium in an ascidian[3]; bismuth[4] and tin[5] in human organs; vanadium, not only in ascidians, but also in a holothurian[6]. In addition, Dr. J. Needham has directed our attention to records of molybdenum[7] and uranium[8] in hens' eggs.

H. MUNRO FOX.
HUGH RAMAGE.

Nov. 25.

[1] H. Ramage, NATURE, **123**, 601, 1929
[2] R Berg, *Bioch Zeit*, **198**, 28, 1928
[3] M. Azeme and H. Pied, *C.R Ac Sci*, **190**, 1, 1930.
[4] T. Fairley and F A. Burrell, *J. Soc. Chem. Ind.*, **37**, 105, 1918.
[5] E. Misk, *C.R Ac Sci*, **176**, 138, 1923
[6] A. H Phillips, *Am J Sci*, **46**, 473, 1918
[7] W. R. Mankin, *Med Jour. Aust*, **2**, 87; 1928.
[8] W. B. S. Bishop *ibid.*, **1**, 480; 1928.

English Equivalents of *Eigenfunktion* and *Eigenwert*.

MR. C. N. HINSHELWOOD suggests in NATURE of Oct. 18, p. 604, that the English equivalents of *eigenfunktion* and *eigenwert* should be *proper function* and *proper value*. Having shown how to develop the functions used by Schrodinger (see, for example, my paper in the *Phil. Mag.*, vol. 6, July 1928), may I again suggest from the nature of the Heaviside operator method disclosed that the terms to employ are *parametrals* and *parametral functions*.

A. PRESS.

New York, Nov. 3.

Intense Magnetic Fields and Low Temperature Research.*

By Sir ERNEST RUTHERFORD, O.M., P.R.S.

EXPERIENCE has shown that the encouragement of research by minor grants for special apparatus and material is in reasonable measure provided for by the Government grant to the Royal Society, supplemented from the Society's own research funds. The grants to individual investigators from such sources are usually small but suffice to assist materially important researches of a limited scope. The situation, however, is very different when we consider large scale investigations of a pioneering character, which may require considerable financial support extending over a period of years in order to provide the necessary apparatus and technical assistance to bring the investigation to a definite conclusion. Few of our universities or other scientific institutions are sufficiently well endowed to support large scale researches of this kind, even when the research appears of marked promise and when the idea and the man are forthcoming. In considering the best method of utilising the balance of the Society's present resources, the Council of the Royal Society has decided that it can best help the advance of science by assisting major researches of this character, and, after careful consideration, was impressed with the fundamental importance of the researches at present being carried on by Dr. P. Kapitza, at Cambridge, and the need for continuing this work on a more permanent basis.

It may be helpful at this stage to give a brief history of the origin and development of the work on which Dr. Kapitza has been engaged for the past eight years. Trained as an electrical engineer, Dr. Kapitza was lecturer in physics in the Petrograd Polytechnical Institute from 1918 until 1921. In 1921 he came to England and commenced research work in the Cavendish Laboratory, Cambridge. In 1922 he began experiments to test the possibility of obtaining intense magnetic fields by sending very strong currents through a coil for such a short interval that the heating effect in the coil is restricted to a permissible value. With the assistance of a grant from the Department of Scientific and Industrial Research, special accumulators were constructed to give the necessary intense currents for a short interval of about $\frac{1}{50}$ sec. In this way, fields up to 200,000 gauss were obtained, and it was found practicable to carry out experiments by this method, for example, on the Zeeman effect and on the deflection of α-particles.

In order to carry these experiments still further, it was necessary to have a method of obtaining currents still larger and more under control. For this purpose, a generator of special design was constructed which gives, on short circuit, a current of about 70,000 amperes. The heavy current from the generator is passed for about one-hundredth of a second through a coil and is then broken by means of a specially designed automatic break. The Department of Scientific and Industrial Research gave a very substantial grant for the construction of this apparatus, while Sir William Pope kindly provided a temporary laboratory to install the plant and to carry out the experiments. In 1926 the laboratory was opened formally by the late Lord Balfour, then Lord President of the Council, who had throughout taken an active interest in promoting these large scale experiments. This pioneering investigation, which was carried out in connexion with the Cavendish Laboratory, was only made possible by the generous and bold support of the Department of Scientific and Industrial Research, which, up to the present, has defrayed the complete cost of the apparatus and of the subsequent investigations.

One of the chief difficulties in these experiments has been to construct a coil strong enough to withstand the enormous disrupting forces which arise when a large current is passed through it. A number of coils have been constructed which give magnetic fields of between 300,000 and 400,000 gauss over a volume of about 3 c.c. There appears to be no inherent difficulty why fields of the order of 1 million gauss should not be obtained, when called for, by this method. As the current through the coil only lasts for about $\frac{1}{100}$ sec., oscillograph methods are used to determine the strength of the current and magnetic field and to follow the changes in the properties of the material under investigation. There is no special difficulty in conducting experiments with these momentary fields. In fact, a single photograph, obtained in $\frac{1}{100}$ sec., may give a complete quantitative record of the magnetic effects produced in a material over a wide range of magnetic field.

The application of these new methods of producing intense magnetic fields opens up a wide field of research where all magnetic properties can be examined in fields ten to thirty times greater than those hitherto available by the use of electromagnets.

As soon as the apparatus was in working order, experiments were begun to investigate the change of resistance of crystals of bismuth in these intense magnetic fields from atmospheric temperature to that of liquid air. This was followed by an extensive investigation of the behaviour of a large number of metals under corresponding conditions. In general, it was found that the change of resistance was at first approximately proportional to the square of the magnetic field, but above a certain critical field, which varied from metal to metal, the change of resistance tended to become linear. On the basis of these new results, Dr. Kapitza has suggested a new way of looking at the phenomena which underlie the electrical conductivity of metals and its variation with temperature. Preliminary experiments have also been made on the action of these strong fields on the paramagnetism and diamagnetism of certain substances, while a new and sensitive apparatus has been constructed to study magnetostriction effects. An

* Excerpts from the presidential address to the Royal Society delivered at the anniversary meeting on Dec. 1.

account of the apparatus and the experimental methods, together with the results of some of these investigations, has been published by Dr. Kapitza in the *Proceedings* of the Royal Society.

Magnetic phenomena are shown in their simplest form at very low temperatures when the complications due to the motion of the atoms and molecules are largely avoided. In order to obtain temperatures still lower than that of liquid air, a liquid hydrogen plant has been installed during the present year, and is now in working order. Preliminary arrangements have been made to install a liquid helium plant when this is required for the investigations.

The grant given by the Department of Scientific and Industrial Research for carrying out these researches expires in a few years, while the laboratory temporarily lent for the purpose of these experiments is now required by the Chemical Department of the University. The Department of Scientific and Industrial Research, by its broad-minded and far-seeing action, has done a great service to science in thus supporting, through their initial stages, investigations having no obvious or immediate application in practice or industry. Their support for an indefinite period, however, could scarcely be part of the Department's policy. On the other hand, it appeared to the Council of the Royal Society that investigations of this kind, in which new fields of knowledge are being opened up by new methods, had a peculiarly strong claim for support from those funds which the Society was holding ready for the furtherance of fundamental researches in pure science.

The Council of the Royal Society, in addition to appointing Dr. Kapitza to a Messel professorship, has therefore agreed to offer the University of Cambridge the sum of £15,000 for the building of a suitable laboratory within the next three years, provided the University was prepared to offer an appropriate site and to defray the running expenses of the new laboratory. If the University of Cambridge concurs with these proposals, the Royal Society will thus have been instrumental in founding a new and up-to-date laboratory, primarily designed for carrying out researches in intense magnetic fields, but at the same time providing the essentials of a modern cryogenic laboratory for the study of magnetic and other effects at the lowest attainable temperatures.

The name of the new laboratory at Cambridge has not yet been settled, but it would be appropriate if it indicated the connexion with the Royal Society and with the late Dr. Ludwig Mond, whose bequest furnished the income from which the cost of the laboratory will be defrayed. It should be noted that among the purposes indicated in the will of Dr. Mond for the use of his bequest was "erecting new laboratories".

It will be remembered that, thirty years ago, Great Britain was pre-eminent in the study of effects produced on matter by the low temperature produced with the aid of liquid hydrogen. It will be recalled that the late Sir James Dewar, with the technical assistance of Mr. Lennox, first produced liquid hydrogen in quantity in the laboratories of the Royal Institution in 1898, and in 1899 the first solid hydrogen was obtained. It was so early as 1893 that Dewar devised the vacuum flask which has proved to be of such fundamental importance in the technique of low temperatures and has so greatly simplified the handling of liquid gases. It is of interest to note that it was decided in 1902 to construct a liquid hydrogen plant, of capacity of about five litres of liquid hydrogen per hour, as a British Government exhibit to the St. Louis Exposition in 1904. This plant was placed in the competent hands of Mr. (now Sir) Joseph Petavel, and I well remember the interest of his demonstrations of the properties of liquid hydrogen at that Exhibition. Some time later, a small liquid hydrogen plant was installed by Dr. M. W. Travers, in the laboratory of the late Sir William Ramsay at University College, London.

In the meantime, an efficient cryogenic laboratory had been established at Leyden, under the direction of the late Prof. Kamerlingh Onnes. His success in liquefying helium and also the wide range and importance of the investigations carried out on the effects of low temperatures on the properties of matter are well known. It was only a few years ago that Prof. W. H. Keesom, who followed Onnes in the charge of this laboratory, was successful in producing solid helium.

A few years ago, owing to the energy and enthusiasm of Prof. J. C. McLennan, liquid hydrogen and helium plants were installed in the University of Toronto, and have proved their utility in a number of important researches. In recent years modern equipment for the liquefaction of hydrogen and helium has been installed in the Reichsanstalt, Berlin, by Dr. W. Meissner, and very valuable results have been already obtained. Dr. Franz Simon, of the University of Berlin, obtains the temperature of liquid helium by an ingenious method involving the use of liquid hydrogen and the absorption of helium gas by charcoal.

I am sure it will be gratifying to the Society to know that we may soon expect to have an up-to-date cryogenic laboratory on a small scale in Great Britain. I believe that it is in helping such important schemes of research that the Society can best utilise any research funds which it already possesses or which may become available in the near future. It not infrequently happens that a promising line of research or the development of a new method may be held up or abandoned because of the difficulty of obtaining adequate financial support. In some important directions, advance can only be made with the help of technical assistance in the construction and use of special apparatus, in some cases on an almost engineering scale.

It is by the encouragement and support of such major researches, especially in their initial stages, that the Society can be of great service in helping the advance of fundamental science in Great Britain. Along such general lines, it is not difficult to foresee that the Society will exert an ever-increasing influence on the progress of science and thus promote still further the original intentions of its founders.

News and Views.

ADMIRABLE sentiments were expressed by the Prime Minister when proposing the toast of 'The Royal Society' at the anniversary dinner on Monday last. Readers of NATURE must be familiar with, and possibly weary of, our continual insistence upon the use of scientific knowledge in the service of the State and of scientific method in administration. It is encouraging, therefore, to find Mr. Ramsay MacDonald expressing himself in entire sympathy with the view that public administration without science may be little more than a collection of words and phrases which can never lead a nation to security and prosperity. We are glad to record the words in which he stated this conviction: "The Royal Society", Mr. MacDonald said, "has stood pre-eminently for experimental knowledge, for the testing of every dogma whenever a competent witness arose to bring that dogma to the bar of reason and experiment. Until in our public life we can catch up the same spirit, the same rationality, the same conception of how truth is to be discovered and reality reached, and those who are engaged in public work and in government acquire the same frame of mind and adopt the same methods that the scientists adopt in their laboratories, government will be feeble, uncertain, and misleading. I make bold to offer the claim that science does not merely deal with the conception of the universe, with biochemistry, or with the conception of human nature, but that when science has claimed its full field, in all its width and length, it will claim to deal with governments and with administrations, and will assault and attack successfully those tremendously interesting and intricate problems of how to handle great masses of men, not by rule of thumb, not by the passing emotions of the day, but by a careful study of the permanent psychologies, emotions, leanings, and allurements of the human mind."

Now that Mr. MacDonald is himself a fellow of the Royal Society and has publicly declared his belief in the application of the methods of scientific inquiry to government, we may perhaps expect to see the principle put into practice more clearly than it is usually. The position of the dyestuffs industry, for example, might be considered on the Baconian plan of collecting facts and arriving at conclusions from them, instead of being decided upon political grounds. Attention might also be given, as was pointed out in a leading article in NATURE of Nov. 22, to the ethnology, social anthropology, and customs of the Indian peoples in connexion with the Round Table Conference now sitting in London. These are two opportunities which present themselves for consideration in the light of ascertained knowledge; and we may perhaps now hope that the Prime Minister will take advantage of them. In science, the test of a principle is the fulfilment of a prediction based upon it, and when we see that standard applied to political promises there will be more faith in democratic government than exists in most scientific circles to-day.

IN a letter addressed to the Prime Minister jointly by fifteen professors of chemistry in British universities, a strong case for reconsideration of the Government's decision to allow the Dyestuffs (Import Regulation) Act to lapse is cogently presented. The point of view is industrial as well as educational, for so closely is organic chemical research linked to the prosperity of organic chemical industry that it is impossible to consider one except in relation to the other. Moreover, the dyestuffs industry, which was the first industrial result of the development of organic chemistry into a systematic science, provided the experience and remains the pivot for the development of other branches of synthetic chemical industry: in no other branch of industry has there been such a clear repercussion between the art of the manufacturer and the science of the schools. The signatories are just those persons who are best qualified to express an opinion on the support which organic chemical industry affords to the advance of chemical knowledge, and they have declared that the existence of flourishing schools of organic research in the universities is indeed dependent on the demands made by the industry for the services of their students. Further, they insist that the salvation of many great industries of national importance depends on the application of scientific methods. They claim that the best training school for the future technologists and administrators of many of these industries is the organic chemical laboratory. Hence anything which tends to check the growth of the schools of organic chemistry is a blow at the future of a great many industries besides those most obviously or immediately concerned.

PRESENTING the report of the Council at the annual general meeting of the British Association of Chemists at Liverpool on Nov. 22, the general secretary, Mr. C. B. Woodley, showed that there has been a steady advance in every department of the Association's established activities. Mr. H. T. F. Rhodes referred to the position of the dyestuffs industry, remarking that the Council of the Association has not yet definitely decided what action should be taken, but that it desired to assist the Government so as to ensure that the dyestuffs industry should not suffer as a result of the lapsing of the Dyestuffs (Import Regulations) Act of 1920. He said that the future of the organic chemical industry, and consequently the supply of adequately trained organic chemists, depends upon an efficient dyestuffs industry; if it suffers, the efficiency of all industries depending upon organic chemistry will suffer. Allusion was again made to this important matter in Mr. F. Scholefield's presidential address. It is obviously impossible, said the president, for any individual or group of individuals not in full possession of all the facts to arrive at any decision as to the extent to which it may be desirable to protect the industry against foreign competition, or if it is necessary to protect the industry at all. There is no doubt, however, that a successful dyestuffs industry is the very backbone of the whole organic chemical industry, and that the research carried on in organic chemistry is very largely applied to dyestuffs. This has naturally

stimulated interest in applied organic chemistry, and has resulted in improved facilities for training organic chemists and in the attraction of suitable recruits to the ranks of the profession of chemistry

MR. SCHOLEFIELD, continuing his presidential address to the British Association of Chemists, criticised chemical training in Great Britain, alleging that "the newer universities are showing a tendency to model themselves on Oxford and Cambridge, and to be too keen on purely academic studies", whilst an investigation into technical education on the Continent, and particularly in Russia, shows that excellent work is being done. The Association should advocate an extension of the course to at least four years, the universal adoption of the metric system, and a bridging of the gulf between industry and academic institutions At the annual dinner, when the Lord Mayor of Liverpool spoke of the city's long association with chemical industry, anxious reference was once again made to the lapse of the Dyestuffs Act: the speaker on this occasion was Mr. C. S. Garland, who feared injury not only to the industry but also to the profession of chemistry. Dr E. F. Armstrong declared that Europe is going through a crisis equalled only by that which resulted from the Napoleonic wars. Great Britain has not yet adjusted herself to the new conditions. As a result of the War we shall have to adopt the policy, adopted by other countries, of being self-contained and self-sufficient. The future of Great Britain, and indeed of the world, he said, is in the hands of the chemist: the chemist cannot and must not fail, for the price of failure in the modern world is death.

THE twenty-eighth annual report of the Imperial Cancer Research Fund contains an interesting summary of the year's work; full accounts will appear in the Ninth Scientific Report, which is to be issued immediately. A good deal of energy has, naturally, gone to the study of the tumours of fowls which can be transmitted from one bird to another without the intervention of living cells, and three distinct histological types of tumour of this sort are under investigation. The possibility of transmitting mammalian tumours by cell-free preparations has been re-examined in the light of the experience with bird tumours, without finding any certain evidence that living cells can ever be dispensed with. The question whether one tumour renders an animal resistant to the development of a second tumour still remains unsettled. A careful examination by modern methods of the innervation of the skin and of tumours developing therefrom in the mouse has failed to confirm the suggestion that tumours have nerves of their own, though it is of course possible that this may sometimes occur. Chromosome studies of tumour cells have also been resumed, partly from the point of view that irregular distribution during mitosis may underlie some of the abnormalities of cancer cells, and partly with the ideas of heritable changes in genes which a contemplation of the fixity of type of any one tumour throughout its history must suggest. The whole report gives an encouraging account of the solid, steady progress made by Dr. J. A. Murray and his colleagues.

AMONG the foreign men of science who either visited or settled in England during the eighteenth century, few were better known than Jan Ingenhousz, whose trough for comparing the thermal conductivities of metal rods has figured in innumerable textbooks. Ingenhousz, who was born on Dec. 8, 1730, two hundred years ago, was Dutch by birth and a doctor by profession, and it was his desire to acquaint himself with the method of inoculation for smallpox which first brought him to England. From England he went to Vienna to inoculate the Austrian Royal family, and then travelled in Italy, France, and Germany. Returning to England in 1779, he spent the remainder of his life in the congenial society of his scientific friends, enjoying, as he said, "that felicity which a free and independent man finds in the pursuit of knowledge and wisdom, in the society and friendly intercourse of those who have distinguished themselves by learning". A friend and correspondent of many, he was elected a fellow of the Royal Society, twice delivered the Bakerian lecture, and wrote on electricity, chemistry, magnetism, and other subjects. Ingenhousz died at Bowood, the seat of the Marquis of Lansdowne, on Sept. 7, 1799.

ON Dec. 7 occurs the centenary of the birth of the eminent Italian mathematician, Luigi Cremona. Born and educated at Pavia, Cremona in his eighteenth year joined the Italian volunteers, during the rising against the Austrians, and was present at the defence of Venice. Resuming his studies, he graduated at Pavia, where Brioschi was among his teachers, and afterwards taught mathematics at Cremona and Milan. In 1860 he became professor of higher geometry in the University of Bologna, in 1866 was transferred to Milan, and in 1873 became professor in the University of Rome and director of the School for Engineers. During thirty years of arduous work he reorganised the whole mathematical instruction of Italy, and was as ardent a politician as man of science. His writings include his "Graphic Statics", translated into English by Sir Hudson Beare, his "Introduction to a Geometrical Theory of Plan Curves", and "Elements of Projective Geometry". He became a Senator of Italy in 1879, and in 1898 was made Minister of Public Education. A member of many scientific societies, including the Paris Academy of Sciences and the Royal Society, he was well known among British mathematicians. He attended the tercentenary celebrations of the University of Edinburgh, and was the guest of Chrystal, who, in a note appended to an obituary of Cremona and referred to in NATURE of Aug. 27, 1903, p. 392, recalled the dinner given by Lord McLaren, when seated around the table were Cremona, Hermite, Picard, Helmholtz, Cayley, Sylvester, Kelvin, Stokes, Salmon, and Rayleigh.

MR. J. BRADLEY, Wallasey Grammar School, Cheshire, referring to the review by Prof. H. Dingle in NATURE of Nov. 22 of Sir James Jeans's 'The

Mysterious Universe", sends us the following apposite quotation from an address by Ernst Mach, delivered at the anniversary meeting of the Imperial Academy of Sciences, at Vienna, on May 25, 1882, entitled, "The Economical Nature of Physical Enquiry" ("Popular Scientific Lectures", by Ernst Mach. Open Court Publishing Company): "What those ideas are with which we shall comprehend the world when the closed circuit of physical and psychological facts shall lie complete before us, (that circuit of which we now see only two disjoined parts), cannot be foreseen at the outset of the work. The men will be found who will see what is right and will have the courage, instead of wandering in the intricate paths of logical and historical accident, to enter on the straight ways to the heights from which the mighty stream of facts can be surveyed. Whether the notion which we now call matter will continue to have a scientific significance beyond the crude purposes of common life, we do not know. But we certainly shall wonder how colours and tones which were such innermost parts of us could suddenly get lost in our physical world of atoms; how we could be suddenly surprised that something which outside us simply clicked and beat, in our heads should make light and music; and how we could ask whether matter can feel, that is to say, whether a mental symbol for a group of sensations can feel?"

MR. HERBERT MORRISON, Minister of Transport, proposing the toast of the Institution of Professional Civil Servants at the annual dinner on Nov. 27, paid an encouraging tribute to the work of the technical and professional people engaged in various departments of the Civil Service. These include research workers and observers of many types; civil, electrical, mechanical, naval, and aeronautical engineers; surveyors, architects, valuers, medical men, and others with professional qualifications carrying on the work of the State. Mr. Morrison said he has "a special affection for the technical and professional officers in the public service", and he appreciates their readiness "to make their political chiefs understand the technical effects of the problems with which they have to deal". The difficulty in the past has often been for an officer in charge of a scientific or technical department to have direct access to a Minister, but we believe this condition of things is changing, and Mr. Morrison is evidently desirous himself of being provided with as full knowledge as possible of the technical aspects of problems which it is his duty to champion in the public arena.

SIR RICHARD REDMAYNE, in responding to the toast of the Institution of Professional Civil Servants, referred to the importance of the problem of transport in connexion with the distribution of everyday commodities and the aid which scientific men and technologists can give the administrator in solving it. He said: "In my view, what is required to be done is to mobilise more fully, in the interests of the community, the scientific knowledge and the technical experience possessed by such classes as those who form the membership of the Institution. The difficulties in which we as a nation now find ourselves are not, if Mr. Morrison will allow me to say so, entirely soluble by political methods. When all is said, the expert, and under this term I, of course, include the scientist, is largely the architect of modern civilisation and should be given a status in the community worthy of his attainments. If the Royal Commission, now sitting, do nothing more than recognise this fundamental truth and make the necessary recommendations in regard to the Civil Service, we, in the Institution, would be well content with our efforts in that direction".

FOR the third time since the great disaster of 1923, Japan has been visited by a destructive earthquake. The Tazima earthquake of May 23, 1925, and the Tango earthquake of Mar. 7, 1927, both on the Japan Sea side of the Main Island, were responsible for the losses of 428 and 3017 lives respectively. The centre of activity has now returned to the Pacific coast, and at 4.3 A.M. on Nov. 26 (7.3 P.M. on Nov. 25, G.M.T.) a severe earthquake caused much loss of life and property in the Izu peninsula and on the west side of Suruga Bay. According to the official estimate of the following day, 245 persons were killed, the towns that suffered most being Shizuoken and Mishima, while great damage is reported at Numazu, Hakone, and other places in the Izu peninsula. The shock was felt as far as Fukui, about 170 miles from the epicentre, which, according to Prof. Imamura, is believed to be slightly to the east of the centre of the peninsula. It was recorded at Kew at 7 h. 15 m. 40 s. P.M. on Nov. 25, but the movement there was less than that on Mar. 7, 1927, or even on Aug. 5, 1927, and May 27, 1928. The Izu peninsula, which lies between the two deep depressions of Sagami Bay and Suruga Bay, has felt at least ten destructive earthquakes since the beginning of the Japanese seismic record in 416. Its eastern coast near Ito was the seat of 3684 slight shocks in the spring of the present year (NATURE, Aug. 30, 1930, vol. 126, p. 326). It is perhaps worthy of notice that, while the epicentre of the Tango earthquake lies 11 miles to the east of that of the Tazima earthquake, the epicentre of the recent shock is only a few miles to the west of that of the great Kwanto earthquake of 1923.

IT seems now to be quite satisfactorily settled that Louis Aimé Augustin Le Prince was actually the first to make cinematograph pictures and to show them by methods and apparatus strictly comparable with those in common use to-day. Le Prince was born at Metz in 1842, but he lived for about nineteen years in Leeds and five years in the United States. He was last seen entering a train for Paris on Sept. 16, 1890. From then, he and his luggage and papers disappeared completely, and exhaustive inquiries have never led to any clue being discovered. In 1886 he applied for an American patent, and in January 1888 for a British patent, which included punched holes fitting on the pins of the guide rollers. In 1888 he took pictures at the rate of 12 and at 20 a second, in Leeds, and showed them successfully. A memorial tablet to Le Prince will be unveiled by the Lord

Mayor of Leeds on Dec. 9, on the site of his workshop. It is also proposed, if sufficient funds are available, to publish a pamphlet giving full details of Le Prince's work in cinematography, and also that of other pioneers. There is already a considerable list of subscribers, but more funds are needed. Cheques or postal orders made payable to "Le Prince Memorial", and crossed "Midland Bank, Leeds", may be sent to the hon. treasurer, Mr. John H. Horsman, 31 Wesley Road, Armley, Leeds, or to the hon. secretary, Mr. E. Kilburn Scott, Conway Hall, Red Lion Square, London, W.C.1.

THE annual general meeting of the Newcomen Society was held at Caxton Hall on Nov. 27, when Mr. C. E. Greener was elected president in succession to Mr. L. St. L. Pendred. There are 259 individual members and 58 institutions now on the roll of the Society, of which 67 members and 25 institutions are in the United States. Seven papers were read during the session 1929–30; during the summer meeting at Liverpool the Society took part in the centenary celebrations of the Liverpool and Manchester Railway, and it was also represented at the jubilee meeting of the American Society of Mechanical Engineers and at the unveiling of the monument erected to mark the site of the Allegheny Portage Railroad constructed in 1834 to link together the eastern and western division of the canal system from Harrisburg to Pittsburg. Through the Council, the Society has given its adhesion to the International Congress of the History of Science and Technology to be held in London in June–July 1931.

AT the same meeting on Nov. 27 of the Newcomen Society, Mr. Rhys Jenkins read a paper on "Fire-extinguishing Engines in England, 1625–1725", the former year being that in which a patent was granted to Roger Jones by James I., and the latter being the year of Newsham's second patent. At Roger Jones's request, the patent was issued in the name of his brother John, a London merchant, who in his travels abroad had found out the plan of making a portable pumping apparatus. With the aid of the invention, so the patent ran, ten men could quench a fire with more ease than five hundred men with buckets and ladders, and its value had been shown on the occasion "of a fire latelie happened in the dwelling house of James Demetrius, Brewer in St. Katherines neare the Tower of London". Illustrating his remarks by means of the writings of Besson, 1587; Lucar, 1590; Zeising, 1612–14; de Caus, 1615; Bate, 1634; Fuller, 1662; and others, Mr. Jenkins gave a sketch of the development of the hand fire-engine, which reached a certain degree of perfection by the efforts of Richard Newsham, of Cloth Fair, London, engineer, one of whose engines can be seen in the Science Museum. It was remarked of Newsham by a writer in the *London Magazine* for 1752 that in his engines he gave "a nobler present to his country than if he had added provinces to Great Britain". These early fire pumps could throw a jet of water a considerable height, but their usefulness always depended on the rapidity with which water could be conveyed to them, which was generally done with buckets.

ACCORDING to a dispatch from its Beirut correspondent which appears in the *Times* of Nov. 27, a chair in archæology has been founded in the American University of Beirut through the munificence of a Syrian woman who wishes to remain unknown. The first occupant of the chair will be Dr. Ingholdt, the Danish archæologist, the appointment in the first instance being for a period of five years. Under the terms of his appointment, Dr. Ingholdt will lecture during one semester in each year and will spend the second semester in excavation at Hama, on the Orontes, on behalf of the Carlsberg Foundation. Dr. Ingholdt, who is a gold medallist of the University of Copenhagen, is an authority on Aramaic inscriptions and papyri of pre-Christian times and on Aramaic dialects. His discoveries of a few years ago in Palmyrene tombs attracted no little attention at the time. Although archæological studies have been actively prosecuted in Beirut for some time past, especially by the French Fathers of the Université de St. Joseph, who publish a journal of much interest to students of early Syrian culture, the facilities for instruction and training which will now be available in Syria itself will prove without doubt of great assistance in the advancement of such studies in an area which, notwithstanding its interest, has scarcely received adequate attention.

AT a meeting of the Optical Society, on Nov. 13, Mr. D. M. Smith, of the British Non-ferrous Metals Research Association, demonstrated the use of the spectrograph in metallurgical analysis. Messrs. H. Buckley and F. J. C. Brookes, of the Photometry Department, National Physical Laboratory, showed a new type of spectrophotometer in which there are no moving optical media. Two light sources, consisting of gas-filled tungsten lamps each behind ground glass, are used. The ground glasses are used as secondary light sources of high uniform brightness (up to 400 candles per square inch). The photometric scale of the instrument is in terms of the voltage intensity relation of one of the light sources at a standard wave-length in conjunction with rotating sector discs of known transmission. The voltage intensity relation at other wave-lengths is deducible from that at the standard wave-length by simple computation. Special provision is made whereby the wave-length scale of the instrument is not affected by mechanical alteration in slit width. The Maxwellian method of view is utilised. The precision of the instrument is high, the average deviation from the mean of determinations of spectral transmission throughout most of the spectrum being about 0·5 per cent.

EXCELLENT and novel methods of lighting streets and buildings have recently made rapid progress in many towns in Germany. When electric light was first used, the main object was efficiency. The sole object of the lamps was to give light. Then came the time when old chandeliers, lanterns, and brackets were introduced, some of which were good and others very bad reproductions of 'period forms' with electric bulbs instead of candles. Now, especially in Germany, the designers of illuminating fittings have

recognised that the shapes of the lamps can be made interesting and decorative. In a series of papers on modern lighting, the first of which appeared in the *Electrical Review* for Oct. 24, A. B. Read gives many illustrations of the modern methods of lighting used by German electricians. He compares the lighting of the dining-rooms in our giant liners with the decorative lighting of the new North German Lloyd *Bremen*. British shipping companies still adhere to 'period' decoration similar to that used in many large hotels. In the *Bremen* the lighting forms a prominent decorative feature. The continuous alabaster lighting of the first class dining-hall and the huge ceiling fitting in the ballroom are admirably designed. Neat tubular wall brackets, corner lights, large decorative fixtures, and even the small bunk lights all show a breaking away from tradition. In London we see too often shops competing with their neighbours by means of projecting signs and flickering lights of every conceivable kind. There are also in some places huge signs with colossal letters straddling over windows and other architectural features and quite spoiling well proportioned buildings. In many towns on the Continent the names over the shops are made luminous at night and a high standard of lettering is used. The orderliness of the signs adds dignity to the streets and is very impressive.

THE Astor expedition to the Galapagos Islands, an account of which appears in the August number of the *Bulletin* of the New York Zoological Society, is the latest of several recent expeditions to this wonderful group. The explorers reached farther inland on Indefatigable Island than former travellers and attained a height of 2100 feet, but the main observations have to do with the fauna of the islands, which is distinctive. The islands boast two flightless sea-birds, the Galapagos penguin and a flightless cormorant (*Nannopterum harrisi*), a species which is gradually disappearing. The same fate hangs over many of the inhabitants the great tortoises, the land iguana, the peculiar fur seal (*Arctocephalus philippi*), and others. This is due partly to the use made of some for food and oil, and partly to the introduction on some of the islands of pigs, dogs, cats, and rats, all of which are now abundant in a wild state, and have seriously affected the native fauna. The recommendations are made that all surviving species of tortoises, as well as the penguin and flightless cormorant, should be protected; that sealing should be prohibited; that the land iguana should be introduced to such islands as are free from pigs and dogs; and that pests should be destroyed. It is wise advice (notwithstanding that it so often comes from an expedition which has freely satisfied its own needs), and it would be well for science if the Ecuadorian Government could be convinced of its necessity and supported in carrying it out.

AN excellent photograph of a school of the false killer whale (*Pseudorca crassidens*) stranded near Kayts, Ceylon, in 1929, appears in the Report of the Colombo Museum for that year. Extraordinary interest attaches to this occurrence, following upon the strandings of large numbers, first in the Dornoch Firth in Scotland and later near Cape Town, of a species regarded as on the verge of extinction. It is strange, therefore, that the only reference in the text of the Report to the stranding of the false killers is a bare record—not even mentioning the numbers of whales observed—of the preparation of 12 skulls and 2 complete skeletons. The Museum itself becomes more and more appreciated, judging by the increase in the number of visitors (now about 800,000 a year) and the greater use made of the collections by teachers and school classes. A new wing is now being built to relieve congestion amongst the exhibits.

AT a general meeting of the members of the Royal Institution held on Dec. 1, Lord Eustace Percy was elected president of the Institution in succession to the late Duke of Northumberland. Lord Eustace, who is a younger brother of the late Duke, was president of the Board of Education in 1924–29 and this year is president of Section L (Educational Science) of the British Association.

AN international celebration and exhibition to mark the three-hundredth anniversary of the first recognised use of cinchona by Europeans will be held at the Wellcome Historical Medical Museum, 54 Wigmore Street, Cavendish Square, London, W.1, on Dec. 8 and 10. Addresses will be given by the Marquis de Merry del Val, Ambassador for Spain; Archbishop Goodier, formerly Archbishop of Bombay; Sir David Prain, formerly Director of the Royal Botanic Gardens, Kew, and Sir Humphry Rolleston, Regius professor of physic in the University of Cambridge. An extensive collection of exhibits has been arranged to illustrate the history of cinchona, the addition of which to the world's materia medica has, for three hundred years, proved itself to be of incalculable value, especially in tropical regions. An article on the history of cinchona and its introduction to India and other countries appeared in NATURE of Nov. 29, p. 850.

THE annual Congress and Exhibition of the British Institute of Radiology was held at the Central Hall, Westminster, on Dec. 3–5. The Mackenzie Davidson Medal of the Institute was awarded to Prof. G. P. Thomson, of the Imperial College of Science and Technology, and the Silvanus Thompson Medal to Dr. A. E. Barclay, lecturer in medical radiology and electrology in the University of Cambridge, who delivered the respective memorial lectures during the Congress.

DR. BRONISLAW MALINOWSKI, professor of anthropology in the University of London (London School of Economics), has been awarded the Rivers Memorial Medal of the Royal Anthropological Institute, in recognition of his distinguished field work in anthropology. Prof. Malinowski, who graduated at Cracow, did research work at the British Museum and the London School of Economics from 1910 onwards, went with the Robert Mond Anthropological Expedition to New Guinea and North-west Melanesia in 1914, returning to Australia in 1918 and to Europe in 1920. Among his numerous publications may be

mentioned "The Family among the Australian Aborigines", "Argonauts of the Eastern Pacific", "Crime and Custom in Savage Society", "Sex and Repression in Savage Society", and "The Sexual Life of Savages in North-west Melanesia".

THE Royal Anthropological Institute has created a class of associates with the object of bringing its facilities for study and research within the reach of the younger workers in anthropological subjects. Associates must be less than twenty-six years of age, they will pay an annual subscription of one guinea only, will receive the Institute's monthly publication (*Man*), and will have access to the library and ordinary meetings.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A graduate in engineering at the Oxford City Technical School and Municipal Secondary School—The Principal, City Technical School, Oxford (Dec. 8). A chief assistant in the Physico-therapy Department of St. Thomas's Hospital—The Secretary, St. Thomas's Hospital, S.E.1 (Dec. 9). A principal of the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (Dec. 13). A full-time teacher in the Department of Chemistry of West Ham Municipal College—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15 (Dec. 13). An assistant bacteriologist and pathologist, an assistant and a junior assistant, each in the Bacteriological and Pathological Laboratory of the Staffs County Council—The Clerk of the County Council, County Buildings, Stafford (Dec. 13). A pathologist at the Royal Devon and Exeter Hospital, Exeter—The Secretary and Manager, Royal Devon and Exeter Hospital, Exeter (Dec. 31). An assistant in the Natural History Department of the Royal Scottish Museum—The Director, Royal Scottish Museum, Edinburgh (Jan. 17). An instructor for evening classes in engineering drawing at the Kingston-upon-Thames Technical College and School of Art—The Principal, Technical College and School of Art, Kingston-upon-Thames.

Our Astronomical Column.

Ancient Eclipses in Scotland. Mr. L. MacLellan Mann writes with reference to his claim of having identified a record on stone of the eclipse of B.C. 2983 Mar. 28 (see NATURE, Nov. 8, p. 743). As regards the time of day at which the eclipse occurred, he notes that the 0·6 day (about 2.30 P.M. Greenwich) found by the writer of the note in NATURE, is in good agreement with the value 0·63 found by C. Schoch, and with the value 0·66 which Mr. Mann obtains from the record on the stone; he notes that this may be the end of the eclipse. He states that he obtained the year by his interpretation of the system of wheel-like markings on the stone, which he takes to be cycles of years.

Referring to the cycle of 1805 years, Mr. Mann claims that this was probably known in ancient times; M. Oppert, the discoverer of the cycle, made a similar claim, but most astronomers hesitated to accept it. Mr. Mann makes an evident mistake when he speaks of the related cycle of 100 saroses: there is no such cycle—the greatest possible number of returns of an eclipse in the saros cycle is about 84; further, the eclipses at the beginning of a series would be visible in regions near one of the terrestrial poles, while those at the end would be visible near the opposite pole. Some thirty returns, or not many more, would suffice to carry the region of visibility away from a given latitude. Mr. Mann states that his investigations of these old stone records have occupied him for some twenty-five years, and he promises to make his results accessible to students at an early date.

Light-variation of Eros.—A note from Leningrad in *Astr. Nach.*, No. 5748, dated at the end of October, notes that M. Zessewitsch detected a light-variation in Eros with an amplitude of 1 magnitude and a period of 0·105 days, or $2^h\ 31^m$. In February 1901 a light-range of a magnitude was also noted, but the period was then given as $5^h\ 16^m$, slightly more than twice the period now announced. The $5^h\ 16^m$ period, however, included two unequal maxima, so that the period now found may be half the complete period. The variation was noticed in 1903, but appeared to be absent in 1907. The study of the light-variation is a suitable one for amateurs to undertake. The attention of the large observatories will be chiefly taken up in photographs for position, for the deduction of the solar parallax and the mass of the moon.

The Kepler Tercentenary. It is noted in *Astr. Nachr.*, No. 5744, that at the celebrations in memory of the death of Kepler that took place at Regensburg on Sept. 24 and 25, two minor planets were given names that would commemorate the event. Planet 927, discovered in 1920, was named *Ratisbona*; while planet 1134, discovered last year, was named *Kepler*. Both these planets were found at Konigstuhl by Prof. M. Wolf. The use of a masculine name for 1134 is justified by its small perihelion distance; the usual rule is that the names should be feminine, but exceptions are made in the case of the Trojans, and those (like Eros) that come fairly near the earth.

Astronomical Equipment.—The new catalogue of astronomical instruments and observatory equipment issued by Messrs. Cooke, Troughton and Simms, Ltd., is a beautifully illustrated volume which will be of interest to all concerned with observational work in astronomy, whether they are in need of additional facilities or not. The catalogue includes four main sections, dealing respectively with object glasses and general telescopic accessories, telescope mountings, transit instruments, and observatory domes, each of which is prefaced by a short note on the general subject of the section. These notes—particularly the first, on the adjustment, care, and use of telescope objectives—will be found very valuable by the working astronomer of limited experience. The telescopic accessories which are described are, in addition to eyepieces, mainly photographic, spectroscopic, and micrometrical. The spectroscopic instruments mentioned are not numerous, but a note of general application in the introduction states that although the catalogue includes only instruments of general interest and use, others required to meet special and unusual needs can also be supplied. The fine quality of the work produced by this firm and its predecessors is well known, and a historical note at the beginning of the catalogue reminds the reader of the original work of the separate firms of Troughton, Simms and Cooke, photographs of some of the more important instruments of which are given.

Research Items.

The Greenland Shaman.—Dr. William Thalbitzer records in the *Journal des Américanistes*, N.S., vol. 22, fasc. 1, observations on the character of the shaman and his beliefs relating to the world and the soul, made at Ammassalik, the most northerly settlement on the eastern coast of Greenland. Near the settlement were about 500 pagan Eskimo, living in villages. Each group had its shaman (*angakkok*). These had no temporal power but considerable moral and religious authority. The shaman gave spirit manifestations almost nightly in one of the houses by the light of a single lamp, all other lights being extinguished. He conversed with the spirits in a sacred and mystical language, consisting of archaic words not fully understood by the spectators. Only the elect became shamans—dreamers and visionaries of an hysterical temperament. They were selected by the shaman to become his pupils and receive instruction in the mountains. The course of instruction lasted for from five to ten years, and the pupil received instruction not from one alone but from several shamans. In the course of instruction the pupil was devoured by the spirit of a bear but came to life again; he entered into communion with the spirits of the dead, spirits of metamorphosed animals, and the spirits of the other world. When he had learned from these their names, they became his allies and he could summon them to do his bidding. When he had thus become the master of all knowledge, he took up the functions of a shaman, one of these being the power of inflicting evil on a man's enemies or protecting him from their attacks. Each shaman had from ten to fifteen allied spirits. The shamans were thoroughly sincere in their belief in their powers and the manifestations of the spirits.

The Monozoic Cestode *Archigetes*.—L. W. Wiśniewski, in *Mem. Acad. Polonaise Sci. et Lettres*, Series B, Sci. Nat., vol. 2, 1930, gives an account of the anatomy, biology, and systematics of the cestode genus *Archigetes*, three species of which were studied. The adult *Archigetes* is regarded as a neotenic procercoid and this is the final stage of the life-history. The host, an aquatic oligochaete—for example, some species of *Limnodrilus* or of *Tubifex*—becomes infected by swallowing the egg containing a fully developed oncosphere which is not ciliated or free-swimming. The oncosphere issues from the operculate egg in the intestine of the host, penetrates the gut-wall, and lies in the body cavity, where it grows to sexual maturity, causing a swelling of the body and eventually a rupture of the body wall so that the parasite escapes to the exterior. Its tissues decompose and the eggs fall into the mud. The oncosphere, which has three pairs of hooks—a larger median and two lateral pairs—develops in about 40 days and may live enclosed in the egg-shell for 70-80 days. The egg-shell is formed from the secretion of the yolk-cells. In the young stages the cells of the developing oncosphere lie loose, there is no epithelium; the cells are surrounded by a membrane. The author describes the anatomy and histology of the adult worm. An account of the early stages of *Archigetes* is given by I. Motomura in *Annot. Zool. Japon.*, vol. 12, 1929, who states that the development so far as the oncosphere is carried on in the uterus of the parent.

Demanian Vessels in Nematodes.—N. A. Cobb (*Jour. Washington Acad. Sci.*, June 1930) describes in nematodes of the genus *Oncholaimus* a remarkable system of vessels which he terms the demanian vessels—after de Man, who first discovered these tubular organs. The complicated double system of vessels is connected with the middle or posterior part of the intestine and with the uterus. The two ducts are confluent and discharge their contents through pores in the body wall near the base of the tail. The vessels are not present in young females; they come into existence at the last moult. In adult females the vessels elaborate a copious sticky secretion, insoluble in water; and the author, after examining the possible functions of this material, suggests that it is utilised during agglomeration and copulation, and also presumably to protect and preserve the batches of eggs after deposition. The demanian organs seem to occur in mud-inhabiting Oncholaims, that is those of stagnant habit, and to be absent in those which live in more thoroughly oxygenated water.

Habits and Development of the Synentognathi.—Mr. C. M. Breeder's notes on the fishes belonging to the families Belonidæ and Exocœtidæ from the Dry Tortugas are very interesting (Year Book 28, Carnegie Institution of Washington, pp. 279-282). The young of the four species of *Strongylura* are highly differentiated and specialised in various ways, the proportional development of the beak proceeding in decidedly different directions in each. The post-larvæ here are almost entirely confined to the drifting *Sargassum*. Older, but still young, fish occur in schools, usually of one species and of one size, and stay close to the shores, circulating about so that a given school may appear every two or three hours at a given place, in the meantime being replaced by other schools of different species or of different-sized individuals. Three species belonging to the Exocœtidæ were specially studied, *Parexocœtus mesogaster* being much the most abundant. Its young, of only a few millimetres in length, when the wings are too short for flight, so closely resemble their parents as to be recognisable at sight with their simple blue and silver colouring. These occupy the clear spaces between the drifts of *Sargassum*. On the other hand, the young of *Cypselurus fuscatus* are markedly different from their parents and show a series of patterns and colour changes which resemble the floating *Sargassum* and debris in which they are found. Associated with the habitat is a difference in the possession of barbels in the young *Cypselurus* and not in *Parexocœtus*. The barbels seem to be used in poking about in the weed. The Exocœtids, especially the young, are found to be very important as food for other fishes and for sea-birds.

Types of Gabb's Californian Fossil Pelecypods.—R. B. Stewart's revision and rectification of Gabb's work on the Cretaceous and Tertiary fossils of California (published in 1864 and 1869 by the California Geological Survey) has now been completed by the issue of the part relating to the Pelecypoda or Lamellibranchia (*Acad. Nat. Sci. Philad.*: Special Publication, No. 3). The first part, relating to the Gastropoda, appeared in 1926 and attention was directed to it in NATURE of Feb. 12, 1927, p. 255, and the lines on which the reviser proceeded were then indicated. The same methods have been adopted in the present part, with some amplification of the information concerning the strata containing the fossils, but as a whole it is of far greater importance to systematists generally. For the first time, we believe, in an American work of this importance, Pelseneer's classification of the group Pelecypoda, as set forth in Lankester's "Treatise on Zoology" (vol. 5), has been employed in lieu of Dall's; whilst in the matter of nomenclature, the International Rules of Zoological Nomenclature have been applied even when opposed to the revisor's own ideas, and the need for teaching students of palæontology the rudiments of those rules pointed out. To all this has gone

an immense amount of research work, which has been most thoroughly and carefully carried out, to the great benefit of all subsequent investigators, although doubtless some *emendanda* will reveal themselves as time goes on. Certain new names have had to be created: thus there are seven new genera and twenty-five new subgenera proposed, some of the latter being for the reception of old friends. The illustrations on the 17 plates are, as before, from photographs taken and retouched by Miss Helen Wichester: and excellent they are. Some additions and corrections to the part on the gastropods have been appended to the introductory chapters, while an "Index to Genera and West Coast Species and to Genera of the paper on the Gastropods" concludes this indispensable work.

Flora of Yucatan.—This work by P. C. Standley (*Field Museum of Nat. Hist.*, Chicago. Bot. Series, vol. 3, No. 3; 1930) treats of the Mexican portion of the Yucatan Peninsula. The whole area of 55,000 sq. miles is low-lying and composed of a sheet of porous and friable limestone rock with a striking absence of permanent surface streams. In the dry region of the northern plains there are few large trees, and where not under cultivation the land is covered with scrub, a few cacti being plentiful, with occasional palms. The central undulating part of the Peninsula, which has a heavier rainfall, has extensive low forests, whilst the forests of Campeche and Quintana Roo yield many valuable woods and other produce, including logwood, mahogany, cacao, sarsaparilla, and rubber. The sharply differentiated geological and physiographical features of Yucatan are reflected in the flora, which is radically different from that of other parts of Mexico and Central America. Its proximity to Cuba and similarity in geological conditions account for the many plants common to both countries. The number of native plants listed comprises 557 genera and 1068 species, the best represented families being the Leguminosæ (119 sp.), Compositæ (86 sp.), Euphorbiaceæ (69 sp.), and Gramineæ (68 sp.). The degree of endemism is notably high for a continental area, embracing 17 per cent of the native flora. Of the Euphorbias 39 per cent are endemic, whilst three genera of the Rubiaceæ and Compositæ are confined to the Peninsula. The species enumerated include naturalised and cultivated plants, whilst an account is given of botanical exploration of the Peninsula—far from complete—together with a list of vernacular names and a bibliography.

Pre-Cambrian Formations of Western Australia.—The Annual Progress Report of the Geological Survey of Western Australia for 1929 is notable in containing a valuable summary of the present state of knowledge of the Pre-Cambrian rocks of that terrain, accompanied by a clearly drawn geological map. The Yilgarn Series are predominantly of sedimentary parentage; they are invaded by greenstones which in turn are followed by granites. In the Kalgoorlie Series, greenstones with intermediate and acid lavas and pyroclasts are the characteristic members. A later series of metamorphosed basic and ultrabasic rocks, known as the "younger greenstones", invades the "older greenstones". The Mosquito Creek Series has been regarded as younger than the Kalgoorlie greenstones. It consists in the main of sediments that are less profoundly metamorphosed than those of the Yilgarn Series. The Government Geologist, Mr. Blatchford, however, thinks that some of the rocks mapped as Mosquito Creek may be Yilgarn or Kalgoorlie, while others may even be Nullagine. The Nullagine Series is not yet definitely known to be Pre-Cambrian, in the Kimberley district; it may be Lower Cambrian. A large part of the State is shown as consisting of granites and gneisses. It is probable that these are of several ages. The goldfields granites cut the Yilgarn, Kalgoorlie, and Mosquito Creek series, but the marginal gneisses are themselves cut by dykes which are indistinguishable from those of Kalgoorlie age.

Relations between Sunspot and Earthquake Frequency.—Messrs. T. Takayama and T. Suzuki have studied the relations between sunspot activity and the frequency of destructive earthquakes in Japan (*Earthq. Res. Inst. Bull.*, vol. 8, pp. 364-374; 1930). In the whole Japanese area they are unable to detect any relation, but considering Omori's three seismic zones separately, they find that, in the inner or Japan Sea zone, destructive earthquakes are more frequent near the sunspot maxima, in the outer or Pacific zone near the sunspot minima, while in the inland zone between them there is no definite relation.

Surface Drift Currents in the North Sea. Mr. J. B. Tait, in "Surface Water Drift in the Northern and Middle Areas of the North Sea and in the Faroe-Shetland Channel" (*Fisheries, Scotland, Sci. Invest.*, 1930, No. 2), reports upon the drift of 4825 bottles which were liberated in batches from numerous widespread points in order to determine the drift of surface waters in this area during each of the five years 1910-14. Of these bottles, weighted to float just awash, 1096 were recovered, mostly stranded on the east coast of Britain and on the shores of the Continent between Texel and the North Cape. The results suggest that more water from the Atlantic enters the North Sea between Shetland and Norway than through the channels between Shetland and the mainland of Scotland, and indicate that almost two-thirds of the distance between Shetland and Norway is occupied by water moving southward into the North Sea. A stream of surface water from the Atlantic in the direction of the channel between the Shetlands and Orkneys appears to have its progress barred on occasions by a north-flowing surface current from the Moray Firth to Shetland, causing the former stream to divide, part turning north to flow west of the Shetlands and part turning south between Fair Isle and Orkney. The results also suggest that the general current system in the northern part of the North Sea is subject to irregularities. The author mentions the lack of close correlation between the drift of these bottles and wind, such as is met with in the southern part of the North Sea and in the English Channel.

Map Revision by Air Photographs.—With the view of investigating the value of air photography compared with ground work in the revision of large scale maps, the Ordinance Survey chose an area near Brighton to be photographed on a scale of about 1 to 7500 with a 50 per cent overlap in consecutive negatives. The photographs were compared with corresponding field traces which were marked to show where alterations had occurred. Revisers then visited these places and put in the detail by the usual ground methods. Three types of country were included in the experimental area, open down, suburban districts with much new building, and closely built town. The results are summarised in a leaflet of the Ordinance Survey (Report on the Experimental Revision of the 1/2500 Ordinance Survey Plans with the aid of Photographs taken from the Air, No. 2, 1928-30). The method was found to be uneconomical in open down lands and in suburban areas of rapid growth. On the other hand, in closely built areas it effects substantial economies compared with ground work, although the completeness of the revision is liable to suffer since certain features are

missed, notably wire fences and internal divisions between houses. These would have to be put in by ground work if required.

Flashing Afterglow in Discharge Tube.—Mr. V. Dumert, 22 Fortis Green Road, East Finchley, sends us a letter describing flashing phenomena in a discharge tube similar to those described by Mr. Braddick in NATURE of Nov. 8, p. 725. The discharge tube was a burnt-out carbon filament lamp, made presumably of soda glass since it showed green luminescence. A continuous afterglow was followed by an intermittent flashing when the glass of the lamp was touched. A valve amplifier, connected between the metal cup and an external electrode of copper foil, gave no sound during the continuous afterglow; then a rushing sound which stopped abruptly at each flash. The phenomenon suggests that the conditions in a discharge tube may be considerably affected by charges on the inside and outside of the glass walls. An effect which is doubtless due to such charges is sometimes observed with heavy discharges run through capillary tubes with moderate voltages; for example, the hydrogen discharge tubes used as a source of light in ultra-violet spectrum work. The tube refuses to run steadily unless an earthed coating of metal foil is closely wound about the capillary.

Emission of Radiation from Excited Surfaces. It is known, from the experiments of Prof. O. W. Richardson and others, that the inelastic reflection of an electron from a metal surface involves characteristically the transfer of a definite amount of energy from the electron to the surface. The surface appears to have quantised energy levels, and so it might be expected that an excited surface would emit radiations corresponding to transitions between pairs of these. A search for radiation of this type is described by Dr. E. Rudberg in the *Proceedings of the Royal Society* for November, a number of substances being bombarded which would be expected to emit line radiation from this effect in the visible or quartz ultra-violet regions. The experiments were entirely negative, the only lines obtained being attributable to impurities in the vacuum apparatus; and from a discussion of other results on the energy levels of the surfaces, Dr. Rudberg concludes that this result, which applies in the first instance only to the lower possible energy losses of the surfaces, is probably general, that is, that the rearrangement of the disturbed surface takes place without emission of radiation.

Ozone in the Earth's Atmosphere.—Dr. G. M. B. Dobson has contributed a paper to the November number of the *Proceedings of the Royal Society*, in which, after giving an account of further detailed observations on the ozone of the air, which conclude the original programme of work proposed five years ago, he summarises the results which have been obtained, and discusses the remaining outstanding problems. Dr. Dobson considers that the two fundamental points which need to be decided are, first, the nature of the agents forming and destroying the ozone, and secondly, the nature of the connexion between the ozone high in the atmosphere and the meteorological conditions much lower down. He expresses the opinion that the chief ozone-forming agent is the corpuscular radiation from the sun—including the action of electric fields which may be set up by this in the air—at least, near the poles, and possibly over the whole world; the destruction of ozone is attributed to the action of solar radiation of wave-lengths between 3300 A. and 2200 A., and to thermal decomposition, the amount of the latter being rather sensitive to the temperature. Dr. Dobson expresses no definite opinion on the second question, but gives, as the most probable ways in which a connexion could be brought about, transport of large masses of the atmosphere over the surface of the earth, transport by vertical currents, and actual formation and decomposition of ozone over the areas in question, all of which are, however, somewhat unlikely for one reason or another. Dr. Dobson hopes to conduct future work with photoelectric spectrophotometers, instead of the photographic instruments which have been used up to the present. It should be mentioned that two recent papers by Prof. S. Chapman (in the *Philosophical Magazine* and the *Memoirs of the Royal Meteorological Society*) in which the kinetic aspects of the reactions occurring in the upper air are examined, emphasise the need for fairly accurate knowledge of the temperatures involved, and that these are now believed to be higher than was previously supposed.

A New Methylation Process.—The difficulties encountered in the exhaustive methylation of hydroxyl groups in complex compounds are well known. Since the methylated products have often proved extremely useful in the elucidation of structural problems in the investigation of carbohydrates and many other natural compounds, it is of interest to learn that Dr. M. Nierenstein, of Bristol, has described a new process of methylation which consists in replacing acetyl groups by methyl groups with the aid of diazomethane in the cold. This reagent needs careful handling as it is extremely poisonous. In the *Journal of the American Chemical Society*, vol. 52, p. 4012, some preliminary results are recorded. The reaction takes place in the presence of piperidine, one molecular proportion of which is used for every acetyl group replaced. An ethereal solution of diazomethane prepared from nitrosomethylurethane by a method described in a previous paper in the same journal (vol. 52, p. 1508) is distilled into an alcoholic solution of the acetylated hydroxy-compound to which the requisite amount of piperidine has previously been added. After standing for 24 hours the alcohol is removed and the residue refluxed with aqueous alkali. The piperidine is then extracted with ether and the methylated product is liberated with acid. The method has been successfully applied to the preparation of veratric acid, isovanillic acid, dimethyl β-resorcylic acid, monomethyl β-resorcylic acid, and trimethyl gallic acid. Experiments on the methylation of penta-acetyl catechins, which by other methods give impure products, are in progress.

Atomic Weight of Rhenium.—Since the element rhenium is now being produced in Germany in considerable quantities, its atomic weight has been redetermined by O. Honigschmid and R. Sachtleben in the Atomic Weight Laboratory at Munich (*Zeit. anorg. und allgem. Chemie*, **191**, 309; 1930). The authors have studied the reaction of rhenium which appeared suitable for an atomic weight determination, and found that the preparation of metallic rhenium from the disulphide by heating in a stream of hydrogen did not take place quantitatively, so that the value for the atomic weight determined by W. and I. Noddack appeared doubtful. By heating rhenium metal in a stream of chlorine there was formed a rhenium chloride which could be sublimed but was apparently not homogeneous. The analysis of silver perrhenate ($AgReO_4$), by precipitating with hydrobromic acid and weighing the silver bromide, proved to be a suitable method. The methods used in the preparation and analysis of the pure silver perrhenate are described. From seven determinations it was found that 51·82860 gm. $AgReO_4$ gave 27·17309 gm. AgBr, from which was derived the relation: $AgReO_4 : AgBr = 1 \cdot 90735$, and the atomic weight of $186 \cdot 31 \pm 0 \cdot 02$ for rhenium.

Anniversary Meeting of the Royal Society.

SIR ERNEST RUTHERFORD completed his term of office as president of the Royal Society by a noteworthy address on the Society's policy for the promotion of research, before he presented the medals for 1930 at the anniversary meeting on Dec. 1.

Looking back over the years since the end of the War, Sir Ernest pointed out how the responsibilities and work of the Society have increased during that period. Between 1919 and 1923, the Society received bequests under the wills of Miss Agnes Foulerton, Dr. Rudolph Messel, and Dr. Ludwig Mond, and a notable benefaction from Sir Alfred Yarrow. Foulerton and Yarrow research professorships were in due course instituted, and regulations for the Messel and Mond funds were adopted, subject to periodical review, which provided for further professorships as the need and opportunity might arise.

The Council of the Royal Society has watched the effect of thus endowing research professorships and is satisfied that the experiment, in Sir Ernest's words, "has proved an unqualified success". The appointments have added materially to the strength of the research side of the universities where the Royal Society professors are working, and "have led to a marked increase in the research power of the nations". While it would be unwise to increase their number unduly in the near future, the Council has decided that the Messel and Mond funds can now be employed to the benefit of the whole body of science by supporting the work carried out in recent years by Dr. P. Kapitza, fellow of Trinity College, Cambridge, who has accordingly been appointed to a Messel professorship.

The funds held in trust by the Royal Society now amount to more than £600,000. Plans for the utilisation of the income from these funds have been carefully matured during the past ten years, for it was difficult to foresee the financial commitments of the Society due to its existing activities. The increased volume of publication after the War and the disproportionate increase of costs involved heavy expenditure, which the Council felt was justified in the interests of scientific research, but it has now been decided that the price of the Society's publications to outside subscribers must be increased. This will release a substantial sum which can be devoted to other purposes. It is now felt, however, that the time and opportunity have come to expend some of the accumulated income of the Society's trust funds, with the result that the sum of £15,000 has been offered to the University of Cambridge for the purpose of building a cryogenic laboratory for the continuance of Dr. Kapitza's researches on the magnetic properties of materials at very low temperatures. The circumstances of the offer and an outline of Dr. Kapitza's work are given in an extract from Sir Ernest Rutherford's address which appears elsewhere in this issue.

The Council's policy, Sir Ernest said, has been and will be to keep watch over the whole field of scientific activity, giving help where there is promise of important advances and where the right man is to hand. It is by the support of major fundamental researches, especially in their initial stages, that the Society can employ most effectively the research funds which it has at its disposal.

Sir Ernest Rutherford also referred to the institution of a new research fellowship, financed from the bequest of the late Mr. E. W. Smithson. The first award has been made to Dr. P. D. F. Murray. After a distinguished undergraduate career in the University of Sydney, Dr. Murray spent two years in research work in the Department of Comparative Anatomy at Oxford, and since 1926 has been lecturer in zoology at the University of Sydney. Nearly all his work has been in the field of experimental embryology, and he has investigated with conspicuous success the factors which determine the differentiation and shaping of the limbs and other parts of the body. Dr. Murray proposes to examine the cellular differentiation of the developing chick, which underlies the coarser morphology, and he will work in the first instance at the Strangeways Research Laboratory in Cambridge.

Sir Ernest Rutherford announced at the anniversary meeting that it has been decided to increase the number of candidates recommended annually for election to the Society from fifteen to seventeen. The Council reports that during the past year the Society received £8000 for general purposes under the will of Sir Dawson Williams and £500 for research under the will of Col. G. H. Leathem. In addition to the Messel research professorship and the Smithson research fellowship referred to above, the following research appointments were made during the past year, the subject of research being given in brackets: Foulerton Research Fellow, Dr. A. S. Parkes (physiology of reproduction); Mackinnon Research Student, Miss M. E. J. Chandler (fossil fruits and seeds of tertiary and quaternary age); Moseley Research Students, Mr. G. S. Adair (proteins of blood) and Dr. J. K. Roberts (exchange of energy between gas atoms and solid surfaces); Lawrence Research Student, Lieut.-Col. E. C. G. Maddock (tuberculosis); Tyndall Mining Research Student, Mr. A. G. R. Whitehouse (loss of salts from the body in sweating and the passage of water through the skin with and without sweating). Through the bequest of the late Mrs. Sollas, the capital of the Moseley Fund has been increased to more than twice its former value, so an additional studentship has been created; the two studentships will be awarded for work in physics or chemistry and for biological work bearing on pathology respectively. The Tropical Diseases Committee, with the aid of the Anonymous Bequest Fund, has instituted a research into kala-azar in Mediterranean countries, which is being conducted by Dr. Saul Adler, of the Hebrew University of Jerusalem. Grants amounting to £6002 have been allotted from the general fund by the Government Grant Committee, and ten grants, amounting to £1600, have been made from the Government Publication Grant.

We print below extracts from the remarks made by the president on the recipients' scientific work at the presentation of medals.

Presentation of Medals.

COPLEY MEDAL, AWARDED TO SIR WILLIAM BRAGG.

To the rapid advance of experimental physics in the last thirty years, Sir William Bragg has made conspicuous contributions by his pioneering researches in radioactivity, X-rays, and crystallography. He was the first to realise, in 1904, the characteristic difference to be expected in the nature of the absorption of the massive α-particle and the light β-particles expelled from radioactive substances. His experimental researches brought out clearly

the rectilinear path of the α-particles and their limited range of travel. In collaboration with his students, he examined in detail the variation of the ionisation of the α-particle along its path and its absorption by different kinds of matter. In his researches in X-rays and γ-rays, he was impressed by the difficulty that these high frequency radiations behaved like projected corpuscles—a difficulty which has only been in part resolved to-day. Following the discovery by Laue of the diffraction of X-rays by crystals, he was the first to develop a method for showing that ordinary X-radiation gave bright lines superimposed on a continuous spectrum. This reflection method of studying the spectrum of X-rays has proved of great importance to the development of knowledge. In the hands of Moseley, it supplied a means of showing that the atoms have all a similar structure and that their properties are defined by a whole number. In the hands of Sir William Bragg and his son, Prof. W. L. Bragg, it has provided a powerful tool for unravelling the structure of crystals. In this important development, which has added widely to our knowledge, Sir William Bragg has taken an active part, not only by his own researches but also by the direction of an important school of research on this subject at the Royal Institution.

RUMFORD MEDAL, AWARDED TO PROF. P. DEBYE.

Prof. Debye introduced and developed a theory of the specific heats of solids which is of fundamental importance. By it, for the first time, the main phenomena relating to specific heats and their variation with temperature were quantitatively explained. He has made important contributions to the theory of the scattering and reflection of X-rays. Independently of Compton, he put forward the quantum theory of the change of frequency due to the scattering of X-rays—the Compton effect. He was one of the inventors of the powdered crystal method of X-ray crystal analysis. By his introduction of the idea of spatial quantisation and by his investigations relating to the electric and magnetic properties of molecules he did much to advance our understanding of radiation and molecular phenomena. In collaboration with Hückel, Debye has developed a theory to account for the properties of strong electrolytes which has many important applications.

ROYAL MEDAL, AWARDED TO PROF. O. W. RICHARDSON.

In his earlier work, Richardson laid the foundation of thermionics. He was the first to study in detail the escape of electrons from hot bodies in a vacuum and to give the correct interpretation of the phenomena. His work on photo-electric emission was also of fundamental importance, and in it many of the now generally accepted ideas relating to interaction between radiation and matter were suggested. Among many important contributions in other fields was the prediction and calculation of the gyromagnetic effect—the rotational torque accompanying the magnetisation of a rod. In addition, he has done important work on electron emission associated with chemical action. He and his students have contributed largely towards filling up the gap between the ultra-violet and X-ray spectra. His main work in recent years has related to the hydrogen molecule, and has afforded a detailed test of the new quantum mechanics when applied to one of the simplest structures for which the old quantum mechanics breaks down.

ROYAL MEDAL, AWARDED TO PROF. J. E. MARR.

At a time when few believed it possible, Prof Marr discerned a delicate time-scale in the Lower Palæozoic Rocks, chiefly in the Lake District and North Wales, and applied it to elucidating the development of life and earth-structure. After testing his results in Scandinavia and in Bohemia he was able to make further use of them in setting in order corresponding rocks in South Wales. He has worked out the structure, origin, and development of the mountains, lakes, and rivers in Lakeland and elsewhere in the north of England. His work in association with Dr. Harker on the metamorphism brought about by the great mass of granite of Shap Fell on the rocks into which it was injected has become classic, and has inspired the rapid advance now being made in kindred studies. Of recent years he has contributed largely to knowledge of the Cambridge district, and particularly of the Pleistocene deposits and their relation to early man there and in East Anglia generally.

DAVY MEDAL, AWARDED TO PROF. R. ROBINSON.

By his investigations of the chemistry of the alkaloids, Prof. Robinson has made notable additions to the knowledge of the structure of these complex substances, and by experiment extended by theoretical discussion he has strikingly indicated possible mechanisms of their formation in Nature. He has also carrie[d] out brilliant synthetical work in connexion with th[e] colouring matters of flowers. His theoretical studie[s] of the mechanism of organic reactions, in particula[r] substitution in aromatic compounds, have led t[o] results of great value in that they enable a very wi[de] range of reactions to be considered from a comm[on] point of view.

DARWIN MEDAL, AWARDED TO PROF. JOHANNES SCHMIDT.

Dr. Johannes Schmidt is at the same time a distinguished oceanographer and a recognised research worker in genetics of animals and plants. The number and extent of the voyages in small research vessels which Dr. Schmidt has accomplished with success; his large and varied collections of the pelagic fauna and flora, and the remarkable series of observations made under his direction, on the physical and chemical phenomena of the sea, give him an undisputed place in the first rank of those scientific explorers whose labours have built up our knowledge of the oceans of the world. His researches on the life-history of the fresh-water eel and the discovery of its breeding places far out in the Atlantic are widely known. Dr. Schmidt's breeding experiments on the tropical fresh-water fish, *Lebistes*, carried out in the Carlsberg Physiological Laboratory at Copenhagen, are of much interest, whilst his investigations on the local races of the viviparous blenny (*Zoarces viviparus* L.) are of outstanding importance and originality.

HUGHES MEDAL, AWARDED TO SIR VENKATA RAMAN.

Sir Venkata Raman is one of the leading authorities on optics, in particular on the phenomenon of the scattering of light. In this connexion, about three years ago he discovered that the light's colour could be changed by scattering. This had been predicted theoretically some time before, but in spite of search the change had not been found. The 'Raman effect' must rank among the best three or four discoveries in experimental physics of the last decade. It has proved, and will prove, an instrument of great power in the study of the theory of solids.

Polar Front Analysis.

FIVE years ago Dr. J. Bjerknes, of Bergen, Norway, visited the forecasting branch of the London Meteorological Office to demonstrate the methods of weather forecasting that had been developed by him and his colleagues. These methods had been arrived at in the first place because of a dearth of telegraphic reports from foreign countries during the War, which made it possible to progress only by securing more numerous local telegraphic reports giving an unusual wealth of information about conditions in Norway. Such a direction of development is contrary to that generally followed in synoptic meteorology in other countries, the natural course during the past few decades having been constantly to extend the network of stations to cover an increasingly large area, as it has been realised more and more that many weather phenomena can only be explained by tracing the past history of the wind currents involved during several days, which may involve the construction of 'trajectories' several thousand miles in length. Sir Napier Shaw has been prominent in these developments, and his "Life History of Surface Air Currents" is a notable landmark of progress on those lines. Nevertheless, as was shown by the French meteorologist Durand Gréville at a competition in weather forecasting held at Liège in 1905, it is equally true that many phenomena can be explained only by a very detailed study of local variations of wind and pressure in a portion of a single cyclonic depression, and this line of advance has not been followed nearly to the extent that it deserves.

Dr. Bjerknes has left as a memento of his visit to London a paper * which deals with three meteorological situations analysed by his 'polar-front' method, full use being made of the large number of autographic records of wind, pressure, temperature, etc., that are maintained in Great Britain. The spacial distribution of the masses of 'polar' and 'equatorial' air that according to the Norwegian school of meteorology are the fundamental elements of the cyclonic depressions of middle and high latitudes, and possibly even of tropical cyclones, is not the main subject matter of this paper, which is concerned rather with a demonstration of certain ways in which a 'front', that is, the line or band separating such different air masses, may be modified either by downward movement of air within the cold polar air mass or upward movement of air in a transitional band separating polar and equatorial air masses. Three cases covering the periods Mar. 30–April 1, 1925, Feb. 10–11, 1925, and Jan. 22–23, 1926, are analysed.

It is not possible in a short space to give more than an outline of the subject matter of the paper. As some of the ideas introduced are published here for the first time, the paper should be read by all who wish to follow the progress of this interesting school of meteorological thought. It is doubtful whether the pursuit of this method of analysis is likely to lead to an understanding of the causes of formation and maintenance of depressions, but it is none the less almost indispensable for explaining certain weather sequences, and as an aid to greater precision in making forecasts for periods up to about twenty-four hours ahead, and especially for periods of six or twelve hours ahead. The application to longer periods is normally unpracticable, because the complexity of meteorological conditions makes it impossible to get much beyond a kind of extrapolation of tendencies revealed by a sequence of synoptic charts. The causes of acceleration or retardation of fronts, which last are so important in controlling the upward and downward motion of the air masses on either side of a front, are still obscure.

* Practical Examples of Polar-front Analysis over the British Isles in 1925–26, by Dr. J. Bjerknes. Meteorological Office Memoirs, No. 50. (London: H.M. Stationery Office, 1930.)

Body and Mind.

IN a paper read before Section J (Psychology) of the British Association at Bristol, Dr. H. Banister discussed the psychology of the tuberculous patient. He quoted various authorities who have attributed to tuberculosis a great variety of mental changes. The disease has been regarded by some to be stimulating to intellectual activity, even to the extent of producing the genius; others consider it to be the cause of neurasthenic syndromes, hysterical manifestations, certain types of psychosis, and homicidal tendencies. As his own view, Dr. Banister insisted that the mental mechanisms of tuberculous patients are the same as those of the healthy individual. Their apparently peculiar psychology is not dependent on tubercle infection; it is the ordinary reaction of the mind to the inhibitions, restrictions, and difficulties which inevitably accompany the disease, and is absent only in those who can readily adapt their outlook and their lives to the new and limiting circumstances. In some persons such adaptation, coupled with a tendency to day-dreaming which can be present during any chronic illness, may bring out the creative tendencies of the individual, expressed in literature and the arts. The state of undue exaltation and optimism often stated to be characteristic in phthisis, is very infrequent, and is simply a manifestation of the dissociation which might follow any severe mental stress.

Considering the effects of the mental attitude of the tuberculous, Dr. Banister stated dogmatically that the patient with a hopeful outlook has a far better chance of arresting the disease than the one who is constantly in a state of despair and anxiety. This points to an extremely important line of treatment. The patient must be encouraged to aim for a life of useful though limited activity, to beware of invaliding himself beyond the degree required, and to avoid anxiety and worry. This is not always easy for the rich; for those of limited means it is, in the home, almost impossible; but that it can be successful under suitable conditions is fully confirmed by the results obtained at Papworth Village Settlement.

A related topic was discussed in a paper before Section I (Physiology) of the Association by Mr. P. Watson-Williams, who referred to chronic toxæmia as a cause of mental disorder and alteration in character. He pointed out that chronic infections can give rise to mental changes and produce disorders of conduct resulting in the unfortunate victim being charged with misdemeanours or criminal actions. As a typical illustration, he cited the well-known character changes which often follow epidemic encephalitis in children. Of equal importance, but more readily overlooked, is toxic absorption from some focus of sepsis. The results of such toxæmia vary within wide limits, from a mild depression to a certifiable psychosis with suicidal tendencies.

While recognising that there must be convincing evidence before attributing misconduct to a toxic mental breakdown, Mr. Watson-Williams emphasised the necessity for expert medical examination to determine whether a delinquent should be dealt with in a hospital rather than before a magistrate.

ordinances founding a chair of psychology and a chair of geography in the University.

Dr. J. Duncan White was appointed as University lecturer in radiology in succession to Dr. J. M. Woodburn Morison.

Intimation was received of a bequest by Mrs. A. M. Cameron, widow of the late Surgeon Lieut.-Col. Lewis Cameron, the bequest to be for the constitution of a Lewis Cameron Fund for a prize in connexion with bacteriology or the diagnosis of disease, as the Court may from time to time decide.

On the recommendation of the Senatus, the Court resolved to institute a course of twenty-five lectures in acoustics in the Department of Natural Philosophy for students in music.

Having consulted the General Council, the Court concurred in a proposal of the Scottish Universities Entrance Board to adopt a regulation including natural science among the subjects of the Preliminary Examination.

Fishes from the *Dana* Expedition.

DR. C. TATE REGAN and Miss Ethelwynn Trewavas have described a large and unique collection of fishes in "The Fishes of the Families Stomiatidæ and Malacosteidæ" (The Danish *Dana* Expedition, 1920–22, in the North Atlantic and Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee, No. 6).

The closely related families Astronesthidæ and Chauliodontidæ have already been dealt with, and the present work is a complete systematic revision of the Stomiatidæ and Malacosteidæ, except for the ... The report is based on the *Dana* collection and on the specimens in the British Museum (Natural History), and in addition several type specimens have been examined from elsewhere. Four new genera, twelve new sub-genera, and seventy-three new species of the Stomiatidæ and four new species of the Malacosteidæ are here described, the new species exceeding in number those previously known. They are all oceanic and probably predaceous, mostly living at no great depth below the surface.

Of the nineteen genera described by Dr. Tate Regan and Miss Trewavas, all but one are known to occur in the North Atlantic. The presence of a barbel is general, and there are two series of photophores on each side of the lower part of the body and a single series on the tail. Behind the eye is a large organ with luminous surface which can be turned downwards and inwards into a pocket and so concealed. The authors suggest that the serial photophores possibly serve as recognition marks, enabling the members of a shoal to keep in touch with one another, and that the post-ocular luminous organ may give light for vision, but the use of the barbel in these fishes of the upper and middle layers of the ocean is more difficult to see. It is suggested that it may be sensory, perhaps receiving impressions that indicate the approach of other fishes, or, when very long and simple, may be tactile. The bulbs and swellings which often occur on the barbel are glandular, similar to the luminous organs on the body, and are probably also luminous, serving as lures. In some species, especially those belonging to the genus *Eustomias*, the form of the barbel is the chief distinguishing mark.

Very interesting changes are shown in some of the young stages of these fishes. In *Aristomias* in the family Malacosteidæ and *Eustomias* and *Idiacanthus* in the Stomiastidæ there are young specimens of the same species with juvenile characters which are as large or larger than those with the structure of the adults, indicating a rapid transition from one stage to another, possibly accompanied by a decrease in size.

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Physics and Chemistry has appointed Dr. R. G. W. Norrish, of Emmanuel College, to be Humphrey Owen Jones lecturer in physical chemistry for three years.

The General Board recommends (1) that a professorship of geography be created as from Jan. 1, 1931, that the stipend attached to the professorship be £1200 a year, and that the present reader in geography, Mr. F. Debenham, be the first holder of the chair; (2) that a professorship of experimental psychology be created as from Jan. 1, 1931, that the stipend attached to the professorship be £1200 a year, and that the present reader in experimental psychology, Mr. F. C. Bartlett, be the first holder of the chair.

DURHAM.—Lord Londonderry has been appointed Chancellor of the University in succession to the late Duke of Northumberland.

EDINBURGH.—At a meeting of the University Court held on Nov. 24, it was resolved to proceed with

... Pleistocene deposits ... in East Anglia ...

ROBINSON.

ACCORDING to the Report of the Board of Management of the London School of Hygiene and Tropical Medicine, presented to the Court of Governors on Nov. 28, the financial situation of the School is satisfactory up to a point, the Court of the University having secured to the School an Exchequer grant for a term of years at the rate of £40,000 per annum. The School, however, has to supplement this by voluntary effort, not only to meet the cost of the present programme, but also to meet the cost of developments, especially in regard to industrial medicine and hygiene, which are already pressing for attention. The report on the work of the School during the first year of occupation of the premises, the gift of the Rockefeller Foundation, which were opened by the Prince of Wales in July 1929, stated that no less than 217 post-graduate students had attended the courses and a further 75 non-medical persons proceeding to the tropics had attended the lectures in tropical hygiene. Reference was also made to the assistance rendered by the Seamen's Hospital Society, and to the extension it has recently made to the Hospital for Tropical Diseases, which provides a valuable centre for the teaching of tropical medicine in association with the School. A beginning has been made with the teaching of industrial physiology and medical industrial psychology.

THE annual conference of the Geographical Association will be held on Dec. 31–Jan. 5 at the Imperial Institute, South Kensington, S.W.7, and the London School of Economics, Houghton Street, W.C.2, under the presidency of Mr. B. B. Dickinson, who will deliver his presidential address on Jan. 1. The programme includes a discussion and exhibition on school journeys, exhibition of maps showing agricultural distribution in Scotland (Mr. H. J. Wood), regional study of the Chod villages of south-west Bohemia (a Leplay House group), lantern lecture by Major R. W. G. Hingston on the 'tree-roof' of the Guiana forest and by Miss R. M. Fleming on regions of Russia, a paper on the distribution of houses in England and Wales as a population index (Dr. P. W. Bryan), a discussion for secondary school teachers of Mr. B. C. Wallis's paper on geography from the point of view of the examiner, and another for primary school teachers on geography and the extension of the school age. Reference is also made to the discussion on the teaching of geography arranged by the Conference of Educational Associations for Jan. 5 at University College, Gower Street, W.C.1. A publishers' exhibition of books and apparatus will be open upon Jan. 1–3. Information regarding the meeting of the Geographical Association can be obtained from the Clerk of the Association, Municipal High School of Commerce, ... Street, M...

Historic Natural Events.

Dec. 7, 1663. High Tide.—Pepys records that 'last night was the greatest tide ever known in the Thames; all Whitehall was drowned".

Dec. 7, 1873. "Cattle-Show" Fog. During the whole of the week beginning Dec. 7, the British Isles were under the influence of an anticyclone. Hard rosts and dense fogs occurred over the whole country. In London the fog was continuous throughout the week, which was that of the annual Cattle Show, and caused great inconvenience. It was followed by a great increase in the number of deaths from respiratory diseases.

Dec. 7, 1879. Great Cold in Central Europe.—December 1879 was the coldest month of the century France and central Europe. The frost began on Nov. 22 25, and reached its greatest intensity on Dec. 7, when it extended over France, Switzerland, Italy, and even northern Africa, for snow fell in Tunis. At Montsouris, Paris, a temperature of $-11°$ F. was recorded in the shade, and farther east, at Langres, $-22°$ F. In Paris there were 75 days of frost, 33 in succession, and in France 50 persons died of cold. The Seine, Yonne, and Loire were frozen. There was heavy snow in Paris. The Dutch waterways were frozen for 54 days. On Dec. 8 the Zuider Zee became an ice lake. By way of contrast, the winter was not cold in Russia. A second period of cold came at the end of January, but February was very warm. The beginning of December was very cold in England and Scotland (see Dec. 4), but afterwards the cold was not excessive and the Thames was not frozen over.

Dec. 8-9, 1886. Storm and Low Barometer over Eastern Atlantic.—This storm was notable for its great extent, the low barometer in its centre, its duration, and the violence of its winds. It appeared off the west of Ireland on the evening of Dec. 7 and travelled due eastwards across the south of England. At Belfast on the afternoon of Dec. 8 the barometer to 27·38 inches (927·2 mb.). The average wind velocity reached 80 miles per hour at Fleetwood from 8.30 to 9.30 A.M. on Dec. 9, and exceeded 70 miles per hour from 8 A.M. to 4 P.M. The gale extended over the whole area from Stornoway to Corunna, more than 1100 miles. A sharp squall with thunder, lightning, and hail passed over London at 9 A.M. on Dec. 8. On the coasts no fewer than 217 vessels were recorded as lost or damaged, while two lifeboats were capsized near Fleetwood, with the loss of 27 lives.

Dec. 9-11, 1671. Glazed Frost in Somerset.—Although there was no ice on any water, the rain of these days in Somerset froze as it fell. An ash branch weighing three-quarters of a pound had 16 pounds of ice on it, the ice being five inches in circumference. Vast numbers of trees were destroyed by the weight of the ice.

Dec. 10, 1149. Severe Winter in England.—The winter of 1149-50 was very severe in England and the Netherlands. The Thames was frozen from Dec. 10 until Feb. 19, and was used as a highway for carriages and horses. The sea off Holland was frozen three miles from the shore. The winter caused a severe famine, and the whole year was very unfavourable.

Dec. 12, 1901. Snowstorm over England.—A deep barometric depression travelled eastward along the English Channel on Dec. 12-14, and during these three days strong north-easterly winds prevailed over the British Isles, while a violent snowstorm raged over most of England, especially the north Midlands. Enormous damage was done to telegraph wires, the north of England being isolated from London, while railway traffic was completely disorganised. Great drifts were formed in hilly districts, blocking roads and causing the loss of many sheep.

Dec. 13, 1795. Meteorite.—The controversy as to whether so-called 'thunder-bolts' ever actually fell from the sky was ended in 1795, when an aerolite was observed to fall on Dec. 13 at Wold Cottage, Thwing, near Scarborough. This aerolite, which weighs 56 lb., is now in the British Museum (Natural History).

Societies and Academies.

LONDON.

Mineralogical Society, Nov. 4.—**Arthur Russell**: An account of British mineral collectors and dealers in the seventeenth, eighteenth, and nineteenth centuries. A first instalment of a series of short biographies dealing with:—Nehemiah Grew, F.R.S. (1641 1712), William Borlase, F.R.S. (1696 1772); Rudolf Erich Raspe (1737–1794); and Philip Rashleigh, F.R.S. (1729 1811). **M. H. Hey**: On cupriferous melanterite from the Skouriotissa mine, Cyprus. A crystallographic study of a well crystallised specimen from an ancient working (perhaps Roman) in the Skouriotissa mine, revealed a very peculiar habit tabular to $b(010)$, and the presence of the new forms $x(161)$, $y(231)$, $g(112)$, $q(102)$, and $\beta(150)$. A partial analysis shows the presence of 7·7 per cent. $CuSO_4{,}7H_2O$.—**C. E. Tilley**: On the dolerite-chalk contact-zone of Scawt Hill, Co. Antrim. The production of basic alkali rocks by the assimilation of limestone by basaltic magma. (With chemical analyses by **H. F. Harwood**): Assimilation of limestone at the contact of a dolerite intrusion with the chalk at Scawt Hill gives rise to a hybrid zone built up of pyroxene-rich rocks (pyroxenites), titanaugite-melilite rocks, and basic rock-types bearing nepheline (theralite and nepheline-dolerite assemblages). The segregation of a basic alkali residuum is the complementary process in the precipitation of magnesia-rich pyroxene in the pyroxenites. Plagioclase is resorbed and gives place to a titaniferous lime-augite rich in alumina, melilite, and nepheline, while perovskite, aegirine, and wollastonite are other products in the hybrid zone. **Frank Smithson**: A simple method of observing the magnetic properties of mineral grains. The tests are made with softened steel needles attached to the poles of a horse-shoe magnet, a strong field being obtained when the points are 1 mm. or so apart. The attraction is observed under the microscope. **M. H. Hey**: On studies of the zeolites (1). General review. A short review of the general properties of the zeolites, with some suggestions on the interpretation of the available data, and a comparison of the zeolites with the clays, ultramarines, permutites, and 'artificial zeolites'.

Royal Meteorological Society, Nov. 19. J. Edmund Clark, I. D. Margery, R. Marshall, and C. J. P. Cave: Report on the phenological observations in the British Isles, December 1928 to November 1929. A year of extreme conditions resulted in average results for 1929. Winter migrants, such as fieldfares and redwings, fled from usual haunts to avoid the cold, but reappeared as welcome guests in south Ireland and south-west England. Sharp spells of cold in April, May, and June neutralised the alarming number of queen wasps. In the table of flowering dates, all are late in England and Wales, though decreasingly so: from 17 to 14 days for the hazel and coltsfoot in February, to 1 and 2 days for the devil's bit scabious and ivy in early August and late September. That the determining factor was cold of continental type

spreading exceptionally in proportion to propinquity is well shown by the district values. Our earliest bird record, the song of the thrush, and the honey bee date for insects, tell the same tale. The exceptional nature of the March warmth and sunshine is best illustrated by the insects: on the average the queen wasp appears two days after blackthorn blooms; in 1929 ten days earlier. It was more than a month early in Scotland W., and the orange tip butterfly nearly as much in Scotland E. The year's results in farm and garden as to quantity and quality showed a small balance on the credit side, due chiefly to the superb September. But to drought in the south-east was due a shortage of hay and straw, while in the far north, late comparatively in its harvest-time, the October deluge played sad havoc.—**A. V. Williamson** and **K. G. T. Clark**: The variability of the annual rainfall of India. Variability is defined as the percentage departure—irrespective of sign—from normal annual rainfall which has occurred at a given station in half the years of the period 1890–1923. Two generalisations are submitted: (1) the lower the rainfall the greater variability tends to be; (2) rainfall is less reliable when it is characteristically concentrated than when it is well distributed in time. A map of India divided into zones by means of "lines of equal-variability" has been prepared.

PARIS.

Academy of Sciences, Nov. 3. **Bigourdan**: The Technological Institute of I. Porro. Historical account of the astronomical equipment of this observatory. **E. L. Bouvier**: The systematics of the Saturnioides of the family of Hemileuca. **Georges Claude**: The utilisation of the thermal energy of the sea. An account of the laying an iron tube, 2 km. in length, in the Bay of Matanzas, for the purpose of extracting cold water from the sea floor, to be utilised by the Claude-Boucherot plan.—**C. Camichel, J. Leclerc du Sablon**, and **L. Escande**: Experiments on the pipes supplying water to the Miègebat power station. **N. Achieser**: The polynomials of Tchebyscheff for two segments.—**Henri Dumas**: The generalisation of a theorem of Mandelbrojt.—**Mandelbrojt**: Some theorems on holomorph analytical functions limited in an infinite region.—**Jean Chazy**: The velocity of propagation of the Newtonian attraction.—**G. Wataghin**: The relations of indetermination in the theory of quanta.—**L. Goldstein**: The distribution of the electrons in the atom.—**Pan-Tcheng Kao**: The vibrations of piezoelectric quartz along the optic axis. Quartz possesses three fundamental frequencies related to the three axes, and this is not in contradiction with Curie's law.—**A. Dargenton**: The refraction of pencils of right lines.—**A. Couder**: Spectrograph with a non-inclined plate. **R. Tréhin**: The absorption of aqueous solutions of hydrochloric acid in the ultra-violet.—**R. Zouckermann**: The phosphorescence phenomena presented by fused silica discharge tubes. The phenomena described are analogous with those described by Curie as resulting from the action of radium rays on various substances and by Wiedemann and Schmidt when studying the action of the cathode rays.—**J. Giuntini**: The compounds of tartaric acid and copper. Solutions of the copper tartrates were prepared by dissolving increasing proportions of precipitated copper hydroxide in tartaric acid and these were examined for rotatory power and dichroism. The discussion of the data from the point of view of formation of definite compounds is reserved for a later communication.—**E. Darmois** and **Jean Pierre Pérez**: The variation of the rotatory power of the camphorsulphonates in the presence of neutral salts.—**Jean Becquerel** and **W. J. de Haas**: The paramagnetic rotatory power of crystals of xenotime at very low temperatures and on the paramagnetic saturation. The temperatures were taken down to 4·2° abs. (liquid helium) with a magnetic field of 27,000 gauss. Under these conditions the paramagnetic saturation is almost complete. Curves have been obtained representing the rotations as functions of H/T, where H is the magnetic field and T the absolute temperature.—**H. A. Kramers**: Paramagnetic rotation in uniaxial crystals of the rare earths.—**Desmaroux** and **M. Mathieu**: The X-ray study of the gelatinisation of nitrocellulose.—**A. Kling** and **A. Lassieur**: The hydrogen exponent (pH) of water. In two earlier communications the authors have found by two independent methods a value 5·8 for the pH of water. This figure has been criticis[ed] on the ground that the experiments may have bee[n] vitiated by the presence of a trace of carbon dioxi[de] in solution. An experiment is described in which th[e] water used was directly distilled from a platinu[m] vessel after addition of caustic soda, the distillatio[n] being carried out in a current of pure hydrogen. Th[e] water again gave a pH of 5·8 by a zero electrometr[ic] method, confirming the previous results.—**Al. Yak[i]mach**: A complex compound of quadrivalent van[a]dium cyanide. The preparation of the compound $K_2V(CN)_6$ is described. **Joseph Robin**: The migration of the amino groups in the arylamines derived from the diarylarylethinylcarbinols. The constitution of the compounds obtained. **Paul Bruère**: The colorimetric micro-reactions of the glutenogen proteids and of the cellulose gels of the wheat grain.—**J. Beauverie** and **J. Treyve**: The survival and development of green plants during periods up to nearly two years in hermetically closed receivers. **Fontaine**: The parallelism existing in fish between their resistance to variations of salinity and the independence of their interior medium.—**H. Laugier** and **Mlle. L. Lubinska**: Reflex excitability and refractory phenomena in the nerve centres.—**Georges Blanc** and **J. Caminopetros**: The sensibility of *Citillus citillus* to the Mediterranean kala-azar. This marmot is so sensitive to kala-azar infection that it is undoubtedly the best experimental animal for the study of this disease and its mode of transmission.—**J. Magrou** and **Mme. Magrou**: Action at a distance and the development of the egg of the sea urchin. New experiments.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 15, 1930.—**V. Ipatjev**: Cellulose from sugar. An analysis of the cellulose obtained by Prof. E. Schmidt, Munic[h], from monosaccharides.—**A. Čičibabin**: Acids in petroleum.—**A. Karpinskij**: (1) Studies of [prob]lematic objects and phenomena: a study of the [rem]nants of *Helicoprion*.—(2) A problematic fossil f[rom] the Palaeozoic deposits of the northern Ural[s]: description and discussion of *Proamphibia proble[ma]tica*, represented by a fossilised scaly skin.—(3) [A] cast-iron resembling in structure a piece of w[ood]. Chemical, metallographic, and microscopic analys[is of] an object found in a furnace and representing a [piece] of cast-iron, with all the details of structure of wo[od].—**V. Chlopin** and **B. A. Nikitin**: The radium conte[nt of] the petroliferous waters of the Grozny area. [The] concentration of radium in some samples was high, namely, 1/28, 3/28, and 1/31.—**V. Verna[dskij]**: Radioactivity of petroliferous waters. The c[oncen]tration of radium in natural waters must be con[nected] with some biological processes on the surface [of the] earth.—**A. Grosse**: The X-ray spectrum [of] element 91, ekatantalium (1), Series L.—**G. P[...]**: A generalisation of Jacobi's method of the i[ntegra]tion of complete systems of linear homog[eneous] equations.

Official Publications Received.

BRITISH.

Harper Adams Agricultural College, Newport, Shropshire. Pp. 96. (Newport.)

Journal of the Chemical Society. October. Pp. iv+2217-2401+x. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 47: A Study of Fungi found in Butter. By M. Grimes and V. C. E. Kennelly and H. A. Cummins. Pp. 549-569+plates 22-23. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

[I]ndian Journal of Physics, Vol. 5, Part 3, and Proceedings of the [Ind]ian Association for the Cultivation of Science, Vol. 14, Part 3. Con[duc]ted by Sir C. V. Raman. Pp. 237-388. (Calcutta.) 3 rupees; 4s.

[C]atalogue of Indian Insects. Part 19: Gyrinoidea. By Georg Ochs. [Pp.] 39. (Calcutta: Government of India Central Publication Branch.) [..]nas, 1s. 3d.

[B]othalia: a Record of Contributions from the National Herbarium, of South Africa, Pretoria. Edited by Dr. I. B. Pole Evans. Vol. 3, . Pp. 156. (Pretoria.) 7s. 6d.

[Tran]sactions of the Institute of Marine Engineers, Incorporated. [Sessio]n 1930, Vol. 42, October. Pp. 663-740+xli. (London.)

FOREIGN.

[Det] Kgl. Danske Videnskabernes Selskab. Mathematisk-fysiske [Medde]lelser, Band 11, Nr. 1: Radiometer Pressure and Coefficient of [Accom]modation. By Martin Knudsen. Pp. 75. (København: Andr. [Fred. H]øst and Son.) 3.60 kr.

[Public]ationer og mindre Meddelelser fra Københavns Observatorium. [..] Librationstheorie des restringierten Dreikörperproblems. Von [..] Wintner. Pp. 639-667. (København.)

L'Observatoire de Genève, 1772-1830 1930. Par Raoul Gautier et Georges Tiercey. Pp. 172+26 planches. (Genève: Albert Kundig.)

U.S. Department of Agriculture. Technical Bulletin No. 176: The Citrus Rust Mite and its Control. By W. W. Yothers and Arthur C. Mason. Pp. 56. (Washington, D.C.: Government Printing Office.) 1[.] cents.

CATALOGUE.

Mercury Switches and Relays for Industrial and Laboratory Control. (List No. M. 1030.) Pp. 32. (London: Isenthal and Co., Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. G. Riddoch, Dr. A. B. Rosher, and others: Discussion on Intracranial Complications of Otitic Origin: Neurological and Pathological Investigation.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—M. Fahmy: A Point of Analogy between the Equations of the Quantum Theory and Maxwell's Equations.—B. K. Johnson: Sources of Illumination for Ultra-violet Microscopy.—W. A. Wood: The Influence of the Crystal-orientation of the Cathode on that of an Electro-deposited Layer.—C. A. Kloss: Relations between the Fundamental Physical Constants.—Demonstration by Prof. G. B. Bryan of some Stroboscopic Effects.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—U. R. Evans: The Protection of Metals by Painting.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. S. Turner: Machinery and Methods of Manufacture of Sheet Glass.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. T. Callan: The Estimation of Minute Traces of Copper.—Dr. F. C. Wood: (a) The Reaction of Formaldehyde Derivatives with Cellulose; (b) The Formation of Cellulose Monomethylene Ether; (c) The Action of Grignard Reagent on Cellulose.—C. M. Whittaker: Some Notes on Viscose Dyeing.—J. M. Preston: A Skin Effect on Viscose Rayon.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7. Discussion on The Camera for the Pictorialist.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—O. Howarth: The Metering of Three-Phase Supplies.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. L. Mayston: Oil Burning for Domestic Central Heating.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. A. K. Wells: A Journey through South and West Africa, with special reference to Igneous Phenomena (Lecture).

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—G. F. O'Riordan: Recent Developments in Chemical Engineering.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.

SATURDAY, DECEMBER 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (1): The Country and its History.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—S. H. Russell: Foundries—and Foundries.

[INSTI]TUTE OF BRITISH FOUNDRYMEN (Scottish Branch) (at Royal Technical [Co]llege, Glasgow), at 4.—A. Harley: The Production of an Aluminium [Al]loy Casting.

[C]HEMICAL SOCIETY (in Department of Physiology, London Hospital [Medic]al College), at 5.—H. Chick and A. M. Copping: Observations on the Water Soluble B Vitamin Complex.—G. T. Calthrop and J. R. Marrack: Carotinæmia in Diabetes.—J. R. Marrack and F. Campbell Smith: Quantitative Aspects of Immunity Reactions.—Prof. C. Lovatt Evans, Chao Tsai, and F. G. Young: The Influence of Adrenaline on Glycogen Distribution in the Cat.—Demonstrations:—F. Campbell Smith and E. R. Holiday: Photo-electric Spectrophotometry of the Ultra-violet using the Hydrogen Discharge Tube as the Source of Radiation.—J. R. Marrack and F. Campbell Smith: A Kataphoresis Apparatus.—K. S. Thompson: A Precipitin Reaction with Bee Stings.

INSTITUTE OF BRITISH FOUNDRYMEN (West Riding of Yorkshire Branch) (at Technical College, Bradford), at 6.30. F. Griffiths: Some Aspects of Modern Foundry Practice.

MONDAY, DECEMBER 8.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—L. H. Gray: The Photoelectric Absorption of Gamma Rays.—L. G. Vedy: On the Rotation of Dielectrics in Electrostatic Fields and Related Phenomena.—*Papers to be communicated by title only*:—W. G. Welchman: On Elliptic Quartic Curves with Assigned Points and Chords.—Dr. S. Verblunsky: Note on Continuous Functionals.—A. Oppenheim: Note on some Linear Diophantine Inequalities.—Prof. C. G. Darwin: The Diamagnetism of the Free Electron.—Prof. J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Parts VII., VIII.—G. de B. Robinson: On the Rotation Groups of Four Dimensions.—Prof. L. M. Milne-Thomson: On the Operational Solution of Linear Finite Difference Equations.—Dr. D. R. Hartree: The Propagation of Electromagnetic Waves in a Refracting Medium in a Magnetic Field.—H. R. Hassé: The Calculation of the van der Waal Forces for Hydrogen and Helium at Large Interatomic Distances.—Dr. G. S. Carter: Aquatic and Aerial Respiration in Animals.—Von Gottfried Fraenkel: Die Mechanik der Orientierung der Tiere im Raum.—G. C. Hirsch: The Theory of Fields of Restitution with Special Regard to the Phenomena of Secretion.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. J. W. Gregory: The Earthquake off the Newfoundland Banks.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—H. C. Armitage: Machine Tools from the Manufacturing Users' Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. O. Gibbon, Lt.-Col. K. Edgcumbe, and others: Discussion on Impulse *versus* Synchronous Time Service.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in University, Liverpool), at 7.—O. Howarth: The Metering of Three-phase Supplies.—J. Urmston: The Electrical High-pressure Testing of Cables and the Localisation of Faults.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—S. G. Brown: Loud-speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University, Birmingham), at 7.—D. B. Hoseason: The Cooling of Electrical Machines.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—Dr. W. J. S. Naunton: Antioxidants.

ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: Modern Domestic Scientific Appliances (Cantor Lectures) (3).

CHARTERED SURVEYORS' INSTITUTION, at 8.—A. T. A. Dobson: The Land Drainage Act, 1930.

TUESDAY, DECEMBER 9.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5.—Discussion on The New Mercurial Diuretics and their Uses in Medicine.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. A. Milne: Stellar Structure and the Origin of Stellar Energy (2).

INSTITUTE OF MARINE ENGINEERS, at 6.—Dr. J. Tutin and A. C. Hardy: Modern Developments in Ship Design, with Special Reference to Propulsion.

INSTITUTE OF METALS (Swansea Section) (at University College, Swansea), at 6.15.—W. Andrews and H. Martin: Copper Welding.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—S. G. Brown: Loud-speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Dr. J. J. Rudra and Prof. M. Walker: The Theory and Performance of Phase Advancers.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—P. G. Fairhurst: Paper.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Display of New Apparatus. Projection of Films.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (Burnley Section) (at Municipal Technical College, Burnley), at 7.15.—F. Harris: Survey in Making of Light Castings.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—E. V. Pannell: Light Alloy Piston Development.

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Prof. H. V. A. Briscoe: Properties of Coke.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—D. D. Hoseason: The Cooling of Electrical Machines.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. D. M. S. Watson: Endocrine Organs (Lecture).

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. N. H. M. Burke: Stigmata of Degeneration in relation to Mental Deficiency.

WEDNESDAY, DECEMBER 10.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—Dr. J. S. Owens: Atmospheric Pollution due to Combustion of Fuel, and Methods of its Prevention.
TEXTILE INSTITUTE (Midlands Section) (at Colleges of Art and Technology, Leicester), at 6.—W. Kershaw: Research in the Textile Industry.
TELEVISION SOCIETY (at University College), at 7.—T. Thorne Baker: Television in Natural Colours and the Fundamental Problems involved.
INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—Dr. H. E. Merritt: Trends in the Transmission.
BACUP TEXTILE SOCIETY (at Natural History Rooms, Bacup), at 7.30.—Dr. J. H. Kitson: Factory Hygiene.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—H. W. Taylor: Voltage Control of Large Alternators.
ROYAL SOCIETY OF ARTS, at 8.30.—A. L. B. Ashton: Persian Textiles.
EUGENICS SOCIETY (at Linnean Society), at 8.30.—Dr. M. Radford: Heredity in Education.
ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (jointly with Faraday Society).—D. J. Macnaughtan: The Determination of the Porosity of Electrodeposits.—D. J. Macnaughtan and R. A. F. Hammond: The Influence of Small Amounts of Chromic Acid and of Chromium Sulphate in the Electrodeposition of Nickel.—D. J. Macnaughtan and A. W. Hothersall: 'Stopping Off' Materials for Use in the Electrodeposition of Nickel. S. Glasstone and J. B. Speakman: The Electrodeposition of Cobalt-Nickel Alloys.—W. J. Shutt and J. Stirrup: The Time Factor in Anodic Passivation of Metals.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—Prof. J. Bordet: Les Théories des Bactériophages (Croonian Lecture) (*in English*).
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: An Extension of Meissel's Expansions in Kapteyn Series, and Some Similar Expansions.—Dr. R. A. Fisher and J. Wishart: The Derivation of the Pattern Formulæ of Two-way Partitions from those of Simpler Patterns.—Prof. L. M. Milne-Thomson: Ten Figure Table of the Complete Elliptic Integrals K, K', E, E'.—V. C. Morton and Dorothy S. Meyler: Quadrics and Quadric Cones of a Set of Three Associated Steiner Trihedral Pairs.—R. F. Whitehead: Ramanujan's Approximation for e^n.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir John Russell: The Agricultural Development of the Empire (2): Conquest of the Drought.
CHEMICAL SOCIETY (at Imperial College of Science), at 5.30.—Prof. W. A. Bone: Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930) (Liversidge Lecture).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—D. R. Pye: The Origin and Development of Heavy Oil Aero-Engines.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (in Chemical Department, University, Bristol), at 6.30.—S. Stephens: Modern Water Treatment.
INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—E. W. Causton: Types of Internal Combustion Engines.
INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—E. J. Dobbs: Plating.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour and Kinematograph Groups), at 7.—Kinematograph Group: S. G. French: Some Kodacolor Films of the Italian Lakes.—Colour Group: Instantaneous Colour Photography. Some Comparative Tests of Bead and other Lantern Screens.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Section) (at University College, Dundee), at 7.30.—A. V. Reis: Electricity and Mining—a Story of Progress.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Teesside Branch) (Informal Meeting) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—J. Crichton and others: Discussion on Shipbuilding in Japan and Russia.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—T. H. Court and Dr. M. von Rohr: New Knowledge on Old Telescopes.—Mrs. E. Gifford: On Interpolating Refractive Indices.—H. Buckley: On the Determination of the Transmission Factors of Coloured Step Lenses.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.
INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—C. C. Hall: The Fabrication of Plant in Acid-Resisting Steels.
INSTITUTE OF METALS (London Section) (jointly with Institute of British Foundrymen) (at Chemical Society), at 8.—E. Player: Magnesium Alloy Castings.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Major G. Shanks: Demonstration on the Pathology of Epidemic Dropsy in Bengal.—Sir Aldo Castellani: Minor Tropical Diseases.

FRIDAY, DECEMBER 12.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department Lecture Room, Imperial College of Science and Technology), at 2.30.—The Purification of Waste Waters from Beet-Sugar Factories:—D. W. Cutler: Microbiological Aspects.—E. H. Richards: Biochemical Aspects.
ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—A. Wigglesworth: India's Commercial Fibres.
ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: (*a*) On the Relation of Colour and Spectral Type in the Different Galactic Latitudes; (*b*) On the Axial Rotation of the Stars; (*c*) Some further Remarks on the Rotation of the Stars.—Prof. H. N. Russell and R. S. Dugan: Apsidal Motion in Y Cygni and other Stars.
MALACOLOGICAL SOCIETY (at Linnean Society), at 6.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—V. E. Pullin: X-Rays in Engineering Practice.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. J. Rees: Refractories for Boiler Furnaces.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—W. D. Oliphant: Laboratory Method as met with in Wireless Technique.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Literary and Philosophical Society, Manchester), at 7.—Short Papers.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Royal Institution, Liverpool), at 7.—A. W. C. Harrison: The Incorporation of Dry Pigments into the Medium.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry) (at Thomas' Cafe, Swansea), at 7.30.—Dr. P. M. Davison: The Structure of Molecules.
JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Henry George Lyons: Technical Museums and their Value to Engineers (Presidential Address).
INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University, Sheffield), at 7.30.—R. B. D. Barklie and A. E. Nicol: Studies in the Electrodeposition of Silver. Throwing Power. The Behaviour of Silver Anodes, with special reference to Blackening and its Prevention.

SATURDAY, DECEMBER 13.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (2): Art and Literature.

PUBLIC LECTURES.

SATURDAY, DECEMBER 6.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—Dr. Cyril Norwood: The Value of Exactness (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Prehistoric Man in Minorca.

MONDAY, DECEMBER 8.

IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES, at 5.30.—Dr. M. A. Hogan: Supports for Underground Workings in Coal Mines. (Succeeding Lectures on Dec. 9, 10, and 11.)
IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Life of the Past (Swiney Lectures). (Succeeding Lectures on Dec. 10, 12, 15, 17, 19, Jan. 5, 7, 9, 12, 14, and 16.)

TUESDAY, DECEMBER 9.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Social and Economic Life.

WEDNESDAY, DECEMBER 10.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Hubert Bond: The Prevention of Mental Illness.
ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of Regent Street Polytechnic, Little Titchfield Street), at 5.30.—Lord Raglan: Nilotic Tribes of the Anglo-Egyptian Sudan.
BELFAST MUSEUM AND ART GALLERY, at 8.—C. W. Harvey: Linen Damask: Historical Sketch.

THURSDAY, DECEMBER 11.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: Positive and Negative Control of Conception in its various Technical Aspects.
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 6.—Dr. W. J. Pinard: Tests of Character.—C. B. Fox: Industrial Psychology applied to the Blind.
BIRKBECK COLLEGE (Celebration of Foundation), at 8.15.—Sir Josiah Stamp: The Responsibility of Knowledge (Foundation Oration).

FRIDAY, DECEMBER 12.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene, 28 Portland Place), at 5.30.—A. S. Comyns Carr: Education for Management, to be followed by a discussion.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—H. Ll. Bassett: Nitrogen in Nature and Industry.

SATURDAY, DECEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Bird Life in and around London.

CONGRESSES AND EXHIBITION.

DECEMBER 5.

BRITISH INSTITUTE OF RADIOLOGY (at Central Hall, Westminster).
Friday, Dec. 5, 10.30 to 12.30.—Dr. H. A. Harris: The Growth of Bone as illustrated by Radiography.
Dr. D. Hunter: Changes in the Bones in Hyperparathyroidism and Hyperthyroidism.
At 4.30.—Dr. A. E. Barclay: The Danger of Specialisation (Silvanus Thompson Memorial Lecture).

DECEMBER 5.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—The Utilisation of Trade Wastes.
Friday, Dec. 5, at 10.30 A.M.—Dr. D. J. Lloyd: The Problem of Tannery Waste.
O. Wans: The Use of Wood Waste for Heating and Generation of Power.
At 2.30.—E. B. Busenburg: The Utilisation of Waste Rubber.
Prof. J. W. Hinchley: The Recovery of Metal from Waste Materials.

SATURDAY, DECEMBER 13, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

No. 3189, Vol. 126]

Central Research Stations in Tropical Agriculture.

ONE of the features of the post-War administration of the tropical possessions of the British Empire is the increasing attention which is being paid to the application of science to agriculture. This is no longer the sole concern of the Colonial Office, as a number of new organisations, official and commercial, such as the Empire Marketing Board and the Empire Cotton Growing Corporation, are devoting every year large sums of money to research. The new movement gained considerably, both in impetus and in direction, when the Imperial Agricultural Research Conference met for the first time in London in 1927 (Nature, Oct. 29, 1927). One of the main recommendations of this Conference, as regards research, was a proposal for the establishment, as funds and staff permit, of a chain of central tropical and sub-tropical research stations which should, in the main, " confine themselves to long-range and wide-range investigations, or, in other words, should concentrate on (1) problems requiring more prolonged research than can normally be expected from the technical staff of any single administrative department, and (2) problems arising in more than one territory of the Empire towards the solution of which the comparative method may be expected to make an effective contribution ". On the relations between the proposed central stations and the local agricultural departments, the Conference laid down some general directions. The work of the central stations was expected to be developed as a reinforcement of the undertakings of the local agricultural departments and in no sense as a substitute for such activities. It was felt that such a policy would not only prevent friction but also would make overlapping impossible.

The recommendations of the Imperial Agricultural Research Conference were, with commendable promptitude, duly endorsed by the Committee on the Colonial Agricultural Service appointed by the Secretary of State for the Colonies, under the chairmanship of Lord Lovat. The first of the chain of Imperial Agricultural Research Stations, to be devoted solely to research, was started at Amani in East Africa in 1927. Steps were taken to develop and expand the estate and buildings taken over from the Germans at the armistice of 1918. The reports of the new station for the period Mar. 2, 1927, to Mar. 31, 1930—a little more than three years—have just been issued by the Colonial Office.*

* East African Agricultural Research Station, Amani. First Annual Report, 1928–29. Price 6*d*. net. Second Annual Report, 1929–30. Price 1*s*. net. London: His Majesty's Stationery Office, 1930. (Colonial, Nos. 50 and 51.)

These papers contain the fullest details of the history, purpose, and progress of the Amani Institute, and should be carefully studied, not only by all research workers concerned with tropical agriculture, but also by the administrative officers of the Colonial Services interested in the development of the regions entrusted to their care.

Although the original experiment station at Amani, founded by the Germans in 1902, passed through a period of neglect and vicissitude from November 1918 until March 1927 when the new scheme started, nevertheless the station generally was found to be in a surprisingly good condition when the present Director, Mr. W. Nowell, took over charge. The roads and plantations were in good order; the laboratories, library, and the botanical and entomological collections were well cared for. These circumstances have not only lightened the heavy work involved in the formation of a modern agricultural experiment station, but have also assisted the Director and the staff of the Institute in formulating a programme of work and in setting in motion a number of interesting investigations on such subjects as the rôle of shade trees in coffee cultivation, the nature and spread of the virus diseases of plants, the best methods for the study of soil erosion, and the maintenance of the fertility of tropical soils—a matter of the first importance in the future development of the African continent. One important extension of the research station has already been carried out. The neighbouring coffee estate of Kwamkoro has been taken over, connected with Amani by a motor road, and considerably developed. Plans for additional sub-stations at Tengeni and other places are being rapidly matured. The Amani Station is settling down to serious work and already the need for more workers is beginning to be felt.

As is inevitable in such undertakings, the new station has had to contend not only with local difficulties of a particularly trying nature, but also with a certain amount of adverse criticism. Much time and energy have had to be expended in improving the communications of the station itself and in making it accessible to visitors. The supply of local labour is scanty, as the climate of Amani is unpopular with the inhabitants of the lower levels. The experiment station has not yet been provided with a fully qualified medical officer and has to rely in all cases of emergency on the medical staff of the Universities' Mission at Tongwe. This is a great defect in organisation and one which should be dealt with by the authorities without delay. Adequate medical arrangements are not only imperative for the scientific workers and their families, but also would help in attracting a better supply of native labour. A good deal of local criticism, to the effect that Amani is not representative of East African conditions and that the results obtained cannot possibly apply to the six dependencies which contribute to its support, has had to be met. The Director points out that such criticisms would apply to any other site that could be selected, and that no alternative has yet been suggested with advantages which would offset the roads, buildings, equipment, and plantations which were already in existence at Amani in 1927 and which cost no less than £100,000 sterling.

A critical study of the Amani reports discloses one administrative weakness which is of considerable interest both to the scientific worker and also to the general public, namely, the incompatibility of long-range and wide-range research with the preparation of a detailed annual report. So little progress can be made in such work in twelve months that the submission of an annual report is almost ridiculous. Further, the practice leads t the waste of much valuable time, and also expo s the workers to the risk of uninformed comme and to undeserved criticism. It would seem th an important improvement in administration co be made, and that a reform long overdue co be carried out, if these annual reports could abolished altogether so far as research is concerne. If the workers at Amani could be asked to furnish instead a well-thought-out quinquennial review in which the purpose, equipment, progress, and cost of the station could be set out in clear and definite form, the present annual reports could be replace by a brief account of important administrative events, to which a statement of the annual receipts and expenditure, with the usual auditor's certificate, could be attached. This would provide fo any necessary administrative control of the station

From the point of view of the scientific investigator such an innovation has obvious advantages The workers overseas would then receive adequate protection, and they would be able to work ou their own salvation under conditions approximatin to those obtaining in the research centres of Grea Britain. The growing volume of annual reports now such an alarming feature of agricultural re search in the Empire, would be replaced by th five-yearly review, which would soon find a per manent place in the literature of the subject Further, such reviews would provide an effectiv documentation both for the Press and for th general public interested in the work, and woul

also prove invaluable as a basis for the deliberations of the Imperial Agricultural Research Conference, the next meeting of which will take place in Australia in 1932. A beginning in the direction indicated might be made next year. If quinquennial reviews of the various experiment stations in Australia and New Zealand for the period ending Mar. 31, 1931, could be prepared and circulated in time, visitors to the antipodes in 1932 would be provided with all the information they need for the study of the local experiment stations and of the results obtained. If other parts of the Empire adopted the same practice, the 1932 meeting of the Imperial Agricultural Research Conference would mark a distinct step in advance in providing that effective publicity which is now becoming so necessary in scientific work, not only for the workers themselves, but also for the public from whom the funds are ultimately derived.

Chemistry for the Layman.

(1) *Chemistry for Beginners.* By Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. xi + 223 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s.* 6*d.*

(2) *In the Realm of Carbon: the Story of Organic Chemistry.* By Prof. Horace G. Deming. Pp. x + 365. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

(3) *The Spirit of Chemistry: an Introduction to Chemistry for Students of the Liberal Arts.* By Prof. Alexander Findlay. Pp. xvi + 480. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s.* 6*d.*

AT the beginning of the present century there were few works on chemistry written in such a manner as to appeal to the intelligent layman; so that, in spite of such earlier works as Scoffern's "Chemistry No Mystery" (1839), chemistry remained a decided mystery to the average educated person. The text-books of the period were dressed in the trappings of an unimaginative formalism, and to layman and aspiring chemist alike the subject appeared to be far removed from the activities and interests of everyday life. Little attention was paid at that time to the historical evolution of the science or to the personalities of its creators. Such a system of instruction was capable of transforming a chemical enthusiast into a chemist, but it aroused no general interest in chemistry.

The texts of thirty years ago were designed originally for the training of chemists. In recent years, particularly since the War, there has been a growing recognition of the importance of chemistry as a subject of general education. As a result, it is no longer sufficient to provide treatises and courses for the training of the professional chemist: it has become necessary to consider the needs of the increasing number of pupils and students who require courses in what may be called cultural chemistry. Thus, the last few years have witnessed a striking popularisation of chemistry, and there is now available, particularly in the English language, a considerable variety of works on chemistry which may be read with pleasure and profit by the general student and by the educated layman. The publication of works of this kind has influenced in turn the character of the more formal text-books of chemistry. Altogether, the last decade has been characterised by a strong movement towards a brighter and more arresting presentation of chemical facts and theories, and at the same time there has been an equally marked growth of interest in the historical and humanistic aspects of chemistry.

(1) The three books under notice illustrate some of the main tendencies to be observed in the modern methods of presenting chemistry in the school, to the general reader, and to the lay student. In discussing methods of increasing the interest of pupils in school chemistry, an American writer (Collier, *Journal of Chemical Education*, 1930, 2141) states that "the foundation of a course is laboratory work. It is here the student at the start is given an opportunity to satisfy his curiosity and indulge in the interesting manipulation of chemical materials." Dr. Holmyard voices the same opinion in the preface to his little book: "Every opportunity has been taken to press into service those attractive phenomena in which chemistry is so rich; but if a boy or girl assimilates the fare provided, he or she will have acquired a knowledge of scientific method more difficult to appreciate than the beauty of the phenomena." Thus, already on p. 9, following an account of common laboratory apparatus, we find descriptions of an "astonishing experiment" with iodine and aluminium and an "exciting" chemical reaction with ammonium dichromate. We begin to realise, in fact, that "chemistry is a joyous adventure . . . rich in spoils". At appropriate intervals the narrative is projected against the background of history: when we visit Priestley, for example, we wear powdered wigs, travel in sedan chairs, and retail the current society gossip of Bath. Again, "our experiments with oxygen, simple as they are, represent the work of many different men,

of many different countries and ages ". From the chemical laboratory, Dr. Holmyard passes in succession to chemical changes, combustion, oxygen, hydrogen, formulæ and equations, water, acids, bases and salts, carbon dioxide, and air. The result is a very efficient and attractive little book with an excellent selection of illustrations.

We have often wondered, by the way, why Jan Ridd's vivid description of a " winkey " has never been commended to their pupils, in these days of *laissez-faire*, by writers of popular school texts, in dealing with the phenomenon of combustion. " This is the manner of a ' winkey ', which I here set down, lest child of mine, or grandchild, dare to make one on my premises ; if he does, I shall know the mark at once, and score it well upon him. . . . Anon, as he reads by that light his lesson, lifting his eyes now and then it may be, the fire of candle lays hold of the peter with a spluttering noise and a leaping. Then should the pupil seize his pen, and, regardless of the nib, stir bravely, and he will see a glow as of burning mountains, and a rich smoke, and sparks going merrily ; nor will it cease, if he stir wisely, and there be good store of peter, until the wood [of his desk] is devoured through, like the sinking of a well-shaft " (" Lorna Doone ", Chap. i.).

(2) Returning from Blackmore to our American writer, we read that little do the modern secondary students " care whether oxygen weighs 1·429 grams per liter, or that lead has a specific heat of 0·0305. Far more important to them is the fact that hydrogen used to be used in balloons and is now used to make oleomargarine and ammonia gas. Material must be presented in a modern way if it is going to stick and mean anything to the student in later life. The applications must be stressed rather than the actual physical and chemical properties of the various elements. . . . The uses of materials that affect the life of the student should be stressed rather than simply the building bricks of chemistry, namely, the study of the elements and their properties." We cannot accept these statements at their face value. The principle outlined, however acceptable to the chemical propagandist, should be applied with caution by the teacher of chemistry. This principle is the *leitmotif* of such works as Slosson's " Creative Chemistry ", and it is discernible in Prof. Deming's new book, which " is intended for the general reader who would like to know something of the manner in which organic chemistry grew and developed, and something of its contributions to the comforts and conveniences of modern life ".

Prof. Deming, however, has skirted the pitfall which has swallowed divers of his countrymen who have sought to popularise chemistry ; for, although he emphasises the material achievements of organic chemistry, he is not led thereby to shut his eyes to the importance of the theoretical foundations and the historical development of the science. He has, indeed, produced a proportioned and readable story of organic chemistry, written around the sub-titles : How the foundations were laid ; The organic chemical industries ; and, The chemical activities of living cells. The numerous illustrations include several original drawings which are intriguing if not always quite convincing in detail. We wonder, for example, whether Pasteur actually sorted his dextro- and lævo-rotatory crystals with the aid of two slips of paper labelled ' L ' and ' R '.

(3) Prof. Findlay's book is a comprehensive text for British and American " students of the liberal arts " who are studying chemistry " as an element of general culture rather than as a part of their professional or technical training . . . the purpose of the book is not so much to impart a detailed knowledge of a wide range of facts as to create a scientific spirit ; a spirit of toleration and of co-operation, of intellectual adventure and of intellectual honesty, which seeks ever to enlarge our knowledge of the external world and to found that knowledge, not on tradition or authority, but on a basis of ascertained fact." A mere glance at this admirably produced work, with its 480 pages, 88 figures, and numerous portraits and illustrations, gives an indication of the thorough manner in which the author has handled a task of considerable difficulty. The first three chapters deal with the aim and method of science and with the historical development of chemistry ; fundamental laws, atomic weights, atomic constitution, and the states of matter are next discussed. The historical setting which is a feature of the whole treatment assumes a prominent place in Chap. x., which treats of the atmosphere and of combustion. The ensuing discussion leads naturally to a consideration of matter and energy and of fuels and illuminants. Without enumerating further headings, it may be said that the book constitutes a facile and consecutive narrative embracing and illustrating the fundamental principles, materials, and achievements of chemistry, inorganic, physical, and organic.

In reading this work, we were impressed particularly by its logical and balanced treatment of so wide a field, its apposite quotations, its historical background, and in general by its scholarly and literary presentation of a scientific theme. The book contains several illustrations of historical

interest which are not readily accessible elsewhere; we may here mention Cruikshank's interesting caricatures concerning the introduction of coal gas and the effects of laughing gas. As an example of the author's attention to detail, we commend his footnote on van Ostade's painting of "The Alchemist", incorporating an interesting observation which will e new to many admirers of this well-known picture: "On the sheet of paper lying on the floor he artist, with ironic humour, has painted the words, *oleum et operam perdis*, thou labourest in ain".

From these comments it will be realised that the book is not of the sugar-coated variety, which aims at sparing the reader all thought and effort and nds by giving him at the best a superficial smattering of the subject. It is, on the contrary, a sound and carefully planned treatment of chemistry for the non-professional student, framed withal in a ery attractive and readable form. In evolving it, he author has carried out a noteworthy experiment in chemical exposition, and, in our opinion, has mply fulfilled the purpose indicated in his preface. Ve hope that in due course he may have an opportunity of expounding, in a complementary publication, his views concerning the practical work appropriate for the students for whom this book has been ritten.

JOHN READ.

Older Tectonic Geology of North-Western Europe.

Geologie von Europa. Von Prof. Dr. Serge von Bubnoff. (*Geologie der Erde*, herausgegeben von Prof. Dr. Erich Krenkel.) Band 2: *Das ausseralpine Westeuropa.* Teil 1: *Kaledoniden und Varisciden.* Pp. xii + 691 + 4 Tafeln. (Berlin: Gebrüder Borntraeger, 1930.) 49·50 gold marks.

THE fourth of the volumes of Prof. Krenkel's monumental work, "Geologie der Erde", is the first part of the second volume of Prof. von Bubnoff's "Geologie von Europa" and is a valuable monograph on the older geology of the extra-Alpine regions of north-western Europe. It is entitled the "Kaledoniden und Varisciden" and dopts the term Caledonids in the extended sense for all the pre-Permian mountains and not only for those of the Middle Palæozoic. That extension involves a double use of the word and makes it applicable to a greater range in time than when for one of the main orogenic epochs—the "Kaledonische Discordanz" (p. 607).

The volume is occupied mainly by a description of the pre-Permian and, for some areas, also of the Lower Permian geology of north-western Europe. The first two chapters deal with the Caledonids of Norway and some parts of Sweden, and with the British Caledonids: it summarises the Palæozoic geology of the British Isles except of southern Ireland, Cornwall, and part of Devon, which are grouped tectonically with north-western France as part of Armorica. The further chapters deal with Brittany, the Central Plateau of France, the Ardennes and the Middle Rhine, and the mountain blocks beside the Upper Rhine, comprising the Vosges, the Black Forest, and some of the hilly uplands of south-western Germany, including the Spessart and the Odenwald; further chapters describe the Harz Mountains, the Bohemian mass and its bordering mountains—the Sudetes on the north-east and the Thuringer Wald on the west. The last chapters are on the older rocks of Poland, which are less well known as the Sventokrizer than under their old name of the Lyssa Gora. The final chapter discusses the influence of these old mountain remnants on the structure of western Europe.

Each chapter gives an account of the pre-Palæozoic and Palæozoic stratigraphy of the area, and of its structure and economic geology, with a bibliography which is especially useful as it gives reference mainly to the later literature. The book is not only a compendium but also a critical re-examination of the main evidence and states the conclusions regarding various questions of stratigraphical classification by an authority whose knowledge of European stratigraphy is unusually wide. The stratigraphical successions and their correlation are clearly stated in four large folding tables. On the controverted question of the Silurian-Devonian boundary the author divides the Downtonian into two and places the upper division, including the Ludlow Bone Bed and the beds above it, in the Devonian; but as he correlates them with the Foreland Sandstones and the Dartmouth Slates, and includes the Whitcliff Flags (which he calls the Whitecliff) in the Downtonian, he does not take quite the same ground as those British geologists who extend the Devonian down to the Ludlow Bone Bed.

The term Silurian is not much used, as according to the author it includes everything between the Cambrian and Devonian, and thus the rocks which British geologists regard as the Silurian he calls Gotlandian.

In dealing with the claims for extensive rock metamorphism by the Variscan movements, the author notes but does not accept the view of the upper Palæozoic age of the schists and gneisses

which form the dominant constituents in the Moldavian-Danubian belt; and in re-affirming the pre-Cambrian age of the granulites of Saxony he notes the conclusion of Pietzsch (1922) that the quartzites and arkose of middle Saxony, which have been generally classified as Lower Carboniferous (Culm.), are also pre-Cambrian.

Each chapter concludes with an interesting account of the economic geology; the author notes that of the coal of Europe the British shelf contains 11·2 per cent, as compared with 87 per cent in the fields associated with the Variscan blocks, mainly in Germany and Upper Silesia. As regards the disputed genesis of the Rammelsberg ore-body, he quotes the recent conclusion of Frebold that it is of sedimentary origin but has undergone fundamental dynamic metamorphism; this view takes up a position intermediate between the old syngenetic and the metasomatic theories. As the book includes only rocks up to the top of the Rotliegende, the Kupferschiefer which lies upon that horizon is not considered.

British geologists naturally turn first to the British section, which is the least complete. The author makes a heroic attempt to deal with the problems of the Scottish Highlands and gives summaries of the various classifications. Prof. von Bubnoff appears to favour the views of Frodin, according to whom the Scottish metamorphic rocks conform with the conclusions of those Scandinavian geologists who accept the Palæozoic age of large areas of their crystalline schists. The book reproduces a sketch map by Frodin that represents the schists of the Scottish Highlands as the metamorphosed representatives of the Ordovician and Silurian rocks of the Southern Uplands. The evidence from Ireland appears, however, to negative that view conclusively.

There are occasional verbal slips in the British section, such as 'in Lancaster' instead of Lancashire, and 'scherts' for cherts, while 'Jorkian' is unfamiliar for Yorkian, and 'Canal' for English Channel. The volume is large and expensive, but it is illustrated by 201 excellent figures, which are mostly sketch maps and sections, with theoretical diagrams to summarise the author's interpretation of the epeirogenic movements that controlled the depth and character of the deposits. Unfortunately, the map of the German Variscan Mountains, which like many others is after Kosmat, has been printed upside down in reference to the legend, so that use of this instructive figure requires constant inversion of the book to compare its elaborate shading with the explanation.

J. W. G.

Bird Studies.

(1) *British Birds.* By F. B. Kirkman and F. C. R. Jourdain. Pp. xvi + 184 + 202 plates. (London: T. C. and E. C. Jack, Ltd., 1930.) 21*s.* net.

(2) *The Birds of Tropical West Africa: with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria.* By D. A. Bannerman. Published under the authority of the Secretary of State for the Colonies. Vol. I. Pp. lxxv + 376 + 10 plates. (London: The Crown Agents for the Colonies, 1930.) 22*s.* 6*d.* net.

(1) THE shelf of works of reference on British birds is now so crowded that a new book must have special merit to be welcome as an addition. This requirement is well fulfilled by the volume which comes from two well-known authorities, Mr Kirkman and Mr. Jourdain, with two hundre[d] coloured plates by a group of artists Winifr[ed] Austen, G. E. Collins, H. Goodchild, H. Grönvol[d], G. E. Lodge, and A. W. Seaby. The plates, amo[ng] the best of their kind both for utility and for pi[c]torial merit, were published nearly twenty yea[rs] ago in the monumental "British Bird Book" edit[ed] by Mr. Kirkman. Their reappearance here, ex[cel]lently reproduced, in a single volume of moder[ate] size, will be convenient even to possessors of t[he] larger work, and will also bring them within t[he] reach of a wider public.

The text is new and adequate to the purpose. [It] consists of a brief account of the appearance, ran[ge] and habitat, nest and eggs, food, and usual notes, [of] each species, conveniently placed to face the cor[re]sponding plate. The information given is accur[ate] and up-to-date within its scope, but no gene[ral] description of habits is attempted. There is te[xt] also for the rarer species which are not figured, a[nd] at the end there is a series of plates showing the eggs of British breeding birds. Altogether, most excellent value for a guinea; but the alphabetical table of contents has not been revised with sufficient care.

(2) In writing a book on the birds of West Africa, Mr. Bannerman is breaking practically new ground, but he has immediately set a high standard. The bulk of the volume consists of a systematic account of the species, giving for each the distinguishing characters, particulars of range, and a summary of the information available as to habits. The volume before us covers only eight natural orders, and, with the Passeres among those still to be treated, several further volumes are to be expected. It is to be hoped that, despite the immense labour that must be involved, the author will be able to

complete the work in the near future and so let it achieve its full measure of utility.

That the work will be most useful cannot be doubted. Mr. Bannerman has aimed not only at setting down existing information, in which there are necessarily many gaps, but also at facilitating further additions to knowledge of the subject. At present, many potential observers in our West African colonies are hampered by the lack of means for identification, and opportunities for gaining valuable information on habits and economic status are thus wasted. Mr. Bannerman has therefore supplemented the account and figures of the species by the addition of two useful 'keys', one pictorial and the other verbal, to assist the observer to classify and identify the birds. The practical ortance of the subject, from an economic point iew, is encouragingly recognised by the financial port to publication given by the West African ernments, and by the preface contributed by the tary of State for the Colonies.

Matter of much general interest is to be found in preliminary chapter in which Mr. Bannerman y discusses the relation of vegetation belts to the ribution of bird life. The region includes belts desert, either wholly barren or with the scant haran vegetation; of savanna, either of the orn-scrub type or grass-woodland; and of rain-rest; while smaller areas show the mangrove, the eshwater swamp, or the 'montane' types of egetation. Each kind of area has its character-tic bird association. The virgin forest, with its closed canopy' above and its twilit, almost im-enetrable depths, has indeed two distinct associa-ons, the hornbills and parrots of the tree-tops being lmost in a different world from the guinea-fowl and round-doves that walk below: a third type of vifauna is found in secondary forest.

Several general points stand out. The vegetation belts stretch mainly right across the continent, so that latitude makes more difference to bird-life than longitude. Then there is the similarity of the avifaunas of the various widely separated mountain ranges. Striking, too, is the statement that equatorial forest constitutes a greater barrier even than utter desert to the spread of native species or to the passage of northern migrants: the extent and continuity of the forest zone in the west as compared with the east, indeed, seems to be one of the chief factors influencing routes of bird-migration in Africa. Truly, as Mr. Bannerman says, "Naturalists who find themselves in West Africa need not allow time to weigh heavily on their hands!" His book will certainly help to direct their activities.

Our Bookshelf.

Handbuch der Pharmakognosie. Herausgegeben von A. Tschirch. Zweite, erweiterte Auflage. Lieferung 1. Pp. 112. (Leipzig: Bernhard Tauchnitz, 1930.) 8 gold marks.

PROF. TSCHIRCH'S handbook of pharmacognosy, the publication of which was commenced in 1909, has proved to be such a mine of information to all interested in crude drugs that the appearance of a new edition will undoubtedly meet with general approval. In the course of the twenty-one years that have elapsed since the issue of the first part, the study of drugs has been so vigorously prosecuted and with such important results that many additions and corrections were necessary; in fact the early parts were in many respects out-of-date. It is obvious that the task of revising a work comprising some 4000 pages and embracing pharmacognosy, botany, chemistry, and several other sciences, was an almost impossible task for a single individual, and the news that the author has obtained the collaboration of other experts for certain sections of the book will be universally welcomed. It is expected that the revision will be completed in about three years and that the size of the work will be increased by about 1000 pages.

On comparing the first part now published with the corresponding part of the first edition, it is evident that this revision is being very carefully carried out and that much new matter is being incorporated. Entirely new, for example, is the truly remarkable list of medicinal plants used in the allopathic and homœopathic treatment of disease. The section on the collection and cultivation of medicinal plants has been entrusted to Dr. W. Himmelbaur, who, with Prof. de Graaff and others, has contributed so much to the revival of interest in this department of pharmacognosy. In this section numerous additional maps and illustrations have been incorporated. Quite apart from the information given in the text, the very complete bibliography will be invaluable to research workers; for example, in the list of plants grown in East Prussia the number of references has been more then trebled. The utility of microchemical reactions, of microsublimation and of examination by means of the quartz lamp, all methods of comparatively recent introduction, receive adequate attention, which serves to show the thoroughness with which the revision is being carried out. The author and his collaborators are to be congratulated upon the results of their work.

A Narrative History of Aviation. By John Goldstrom. Pp. xii + 319 + 32 plates. (New York: The Macmillan Co., 1930.) 17*s*. net.

"A NARRATIVE History of Aviation" is a title both bold and comprehensive enough to suit the most captious person. Unfortunately, this book falls far short of justifying either of these adjectives. One of the most essential requirements of the historian is a sense of proportion, unless he is producing an encyclopædic production continuing to many volumes. 'Scissors and paste'

may have legitimate functions, but they are not for the writer of history, as their use means sacrificing whole batches of facts contained in the lopped-off portions. 'Precis' is rather his refuge.

The author's extensive use of inverted commas admits that his book is principally culled from other sources, as indeed any history must be; but his editing of the subject matter at his disposal is out of proportion. He states that "Countless centuries of heroic failure . . . must be summarized in a chapter", and then proceeds to devote whole chapters to such subjects as "Women in Aviation" and "The American Air Mail". Such things have occurred only in the last few years, and are then merely episodes.

Lack of perspective is marked in the author's choice of subjects and illustrations. American aeronautics receives a far larger proportion of pages than its share in the world's aeronautical history merits. This is understandable in a book written and published in the U.S.A. National pride is wholly admirable, but it is out of place under the title that this book carries. The book goes even further than this in publishing a photograph of the author with a delivery of U.S.A. air mail. Surely the decision as to the historical importance of that could better have been left to posterity.

Its limitations are redeemed, to a certain extent, by an extensive bibliography, which mentions other sources of historical knowledge, but this is by no means up-to-date, especially with regard to European publications.

As a collection of short historical studies the book provides instructive and amusing reading. It should never have been submitted to the world of serious technical history under so ambitious a title. *Coram non judice.*

The Electric Wiring of Buildings. By F. Charles Raphael. Pp. x + 258. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 10*s*. 6*d*. net.

THERE are many practical hints in this little book which appeal to common sense, although from the point of view of the ordinary electric wireman they are quite unorthodox. The author points out, for example, that the wiring of many houses is spoilt by placing the wall sockets indiscriminately without regard to the position or character of the apparatus to be connected to them. It is as absurd to place the wall socket for a floor standard lamp or vacuum cleaner three feet from the floor as to put one for a table standard at floor level, if the table is to be against the wall. It is quite right to put the wall socket for an electric fire on the skirting, but the almost universal practice of placing the switch there as well is foolish. It is true that this saves the cost of a wood block and a few feet of wire, but this saving of a shilling or two on capital cost is only effected by compelling people for ever afterwards to stoop down to the floor when they want to switch on or off the electric fire. The book finishes up with a useful chapter on bells, telephones, fire alarms, and radio. As a rule, it is advisable to have all these kinds of wiring done before the building is actually furnished. In the case of telephones, however, it is sometimes difficult to tell which is the most suitable place for them before the house is furnished, and hence surface wiring is very frequently used for telephone work. The proper wiring of all electric radio receiving sets deserves special care. Unless the Institution of Electrical Engineers Wiring Regulations, published in June 1928, be followed, there may be danger from shock or fire.

Calculus. By Prof. Egbert J. Miles and James S. Mikesh. Pp. xiii + 638. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 18*s*. 9*d*. net.

To the student reading natural science as his main object, this book will have a definite appeal. A considerable number of well-chosen examples of the use of the derivative in hydrostatics and in pumping machines is an unusual feature. The authors state that, in the earlier part of the book at least, they purposely reject the delta notation, with the object of making the transition from conventional algebra easier for the average reader. This seems a somewhat needless scruple, for it only means greater difficulty at a later stage when the methods of the operator calculus have to be mastered: in these days this branch of the subject is finding new applications.

Nevertheless, one gets the impression that the authors intended to produce their work, in the first place, for the pure mathematician rather than for the physicist or engineer. If this is so, they will be less successful, for the treatment throughout tends to be more careful of the reader's supposed attainments at each stage than is quite compatible with perfect rigour.

That the volume will prove helpful in a variety of ways is certain: a special word of commendation is due to the publishers for the excellence of the graphs, which really do enhance the value of the book.

Optical Rotatory Power: a General Discussion held by the Faraday Society, April 1930. Pp. iv + 265-461. (London: The Faraday Society, 1930.) 10*s*. 6*d*.

THE reports of discussions held by the Faraday Society are always welcome. Naturally, a series of individual contributions lacks unity of aim to some extent, but a certain freshness of outlook results, which is all to the good. The meeting itself has been described at some length in our columns (NATURE, May 17, 1930, p. 762); little therefore remains but to direct attention to the appearance of the papers in book form.

The memoirs by Dr. Temple, Dr. Kuhn, and Prof. Ewald contain the vital points at issue; probably, however, in no case has the last word been said on a subject unusually intractable. Right- and left-handed forms of active molecules certainly possess stability, and yet the new mechanics has no solution of these facts to offer. Workers will be grateful, none the less, for the results of a decidedly interesting conference.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Constitution of Tungsten.

AFTER many earlier unsuccessful attempts, I have now obtained the mass-spectrum of tungsten. As in the cases of the lighter members of the same group, chromium and molybdenum, success was made possible by the preparation of the volatile carbonyl, $W(CO)_6$, by Dr. A. v. Grosse, of Berlin. It was to be expected from the greater atomic weight that the photographic effect would be feeble, and only by means of very sensitive plates were lines of satisfactory intensity obtained.

Tungsten proves to have four isotopes, of which the strongest two give lines of practically identical intensity. The mass numbers and provisional relative abundances are as follows:

Mass number . .	182	183	184	186
Percentage abundance	22·6	17·2	30·1	30·0

The packing fraction has not been measured with accuracy, but the position of the lines relative to those of mercury proves their correspondence to whole numbers within one part in two thousand, and the packing fraction curve also suggests a zero value. Adopting this, we get for the atomic weight on the chemical scale 183·96, in good agreement with the value 184·0 now in use.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, Nov. 28.

The X-Ray Interpretation of the Structure and Elastic Properties of Hair Keratin.

RECENT experiments,[1] carried out for the most part on human hair and various types of sheep's wool, have shown that animal hairs can give rise to two X-ray 'fibre photographs' according as the hairs are unstretched or stretched, and that the change from one photograph to the other corresponds to a reversible transformation between two forms of the keratin complex. Hair rapidly recovers its original length on wetting after removal of the stretching force, and either of the two possible photographs may be produced at will an indefinite number of times. Both are typical 'fibre photographs' in the sense that they arise from crystallites or pseudo-crystallites of which the average length along the fibre axis is much larger than the average thickness, and which are almost certainly built up in a rather imperfect manner of molecular chains—what Meyer and Mark [2] have called *Hauptvalenzketten*—running roughly parallel to the fibre axis.

Hair photographs are much poorer in reflections than are those of vegetable fibres, but it is clear that the α-keratin, that is, the unstretched form, is characterised by a very marked periodicity of 5·15 A. along the fibre axis and two chief side-spacings of 9·8 A. and 27 A. (? mean value), respectively; while the β-keratin, the stretched form, shows a strong periodicity of 3·4 A. along the fibre axis in combination with side-spacings of 9·8 A. and 4·65 A., of which the latter is at least a second-order reflection. The β-form becomes apparent in the photographs at extensions of about 25 per cent and continues to increase, while the α-form fades, up to the breaking extension in cold water, which is rarely above 70 per cent. Under the action of steam, hair may be stretched perhaps still another 30 per cent, but no other fundamentally new X-ray photograph is produced. The question is thus immediately raised as to what is the significance of a crystallographically measurable transformation interpolated between two regions of similar extent where no change of a comparable order, so far as X-ray photographs show, can be detected.

The elastic properties of hair present a complex problem in molecular mechanics which up to the present has resisted all efforts at a satisfactory explanation, either qualitative or quantitative. Space forbids a detailed discussion here of the almost bewildering series of changes that have been observed, and we shall merely state what now, after a close examination of the X-ray and general physical and chemical data, appear to be the most fundamental.

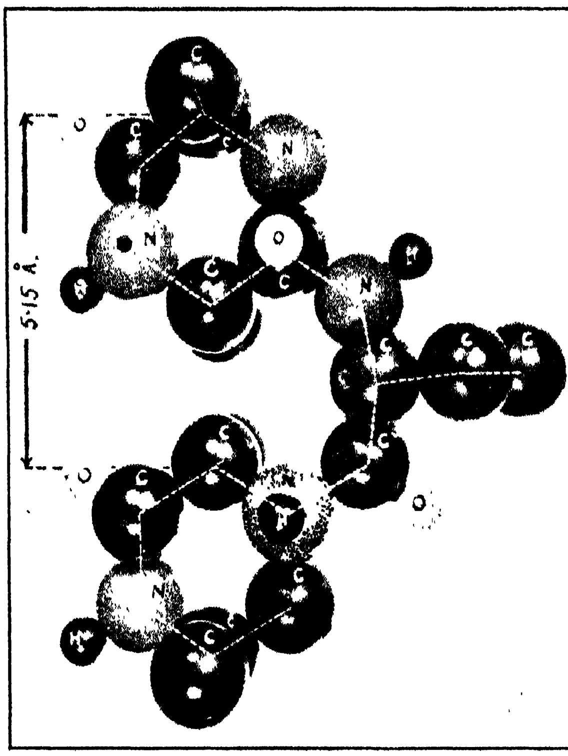


FIG. 1.

(1) Hair in cold water may be stretched about twice as far, and hair in steam about three times as far, as hair which is perfectly dry. (2) On the average, hair may be stretched (in steam) to about twice its original length without rupture. (3) By suitable treatment with steam the discontinuities in the load/extension curve may be permanently smoothed out, the original zero is lost, so that the hair may be even contracted by as much as one-third of its original length, and elasticity of form may be demonstrated *in cold water* over a range of extensions from −30 per cent to +100 per cent. (4) The elastic behaviour in steam is complicated by 'temporary setting' of the elastic chain and ultimately by a 'permanent setting' of that part which gives rise to the fibre photograph. (5) That part of the elastic chain which is revealed by X-rays acts *in series* with the preceding and subsequent changes.

On the basis of these properties and the X-ray data, it is now possible to put forward a 'skeleton' of the keratin complex which gives a quantitative interpretation of the fundamentals, and may later lead to a correct solution of the details. The skeleton model is shown in Fig. 1. It is simply a peptide chain folded into a series of hexagons, with the precise

nature of the side links as yet undetermined. Its most important features may be summarised as follows :— (1) It explains why the main periodicity (5·15 A.) in unstretched hair corresponds so closely with that which has already been observed in cellulose, chitin, etc., in which the hexagonal glucose residues are linked together by oxygens. (2) When once the side links are freed, it permits an extension from 5·15 A. to a simple zigzag chain of length $3 \times 3{\cdot}4$ A., that is, 98 per cent, and also allows for possible contraction below the original length, without altering the interatomic distances and the angles between the bonds. (3) It explains why natural silk does not show the long-range elasticity of hair, since it is for the most part already in the extended state,[3] with a chief periodicity of 3·5 A. We may now hope to understand why it is that the photographs of β-hair and silk are so much alike. (4) It gives a first picture of the 'lubricating action' of water and steam on the chain, since X-rays show that the direction of attack is perpendicular to the hexagons and that this spacing remains unchanged on stretching. Furthermore, it now seems clear that the new spacing, 4·65 A., is related to the old by the equation $27/(3 \times 4{\cdot}65)$ $3 \times 3{\cdot}4/5{\cdot}15$ (very nearly), that is, the transformation elongation takes place directly at the expense of the larger of the two side-spacings. In the particular arrangement of the hexagons shown in the model, the side chains occur in pairs on each face, and it may well be that the action of water is the opening-up of an internal anhydride between such adjacent side chains. (5) The chain being built up of a succession of ring systems stabilised and linked together in some way by side chains of the various amino acids, we have here an explanation of the well-known resistance of the keratins to solvents and enzyme action. In addition, each hexagon is effectively a diketo-piperazine ring, an interesting point in view of the evidence which has been brought forward by Abderhalden and Komm[4] that such groups pre-exist in the protein molecule. It may also throw light on the stimulating researches of Troensegaard.[5] (6) There are three principal ways of constructing the model, according to which group lies at the apex of a hexagon. It thus affords an explanation of the apportioning of a transformation involving a 100 per cent elongation into three approximately equal regions which may be opened up in turn under the influence of water and temperature and other reagents. The modification shown in the model must be ascribed to the crystalline phase, since it would, alone of the three, be expected to give rise to a strong reflection at 5·15 A., as in the α-photograph.

A detailed account of the above work will be published shortly.

W. T. ASTBURY.
H. J. WOODS.

Textile Physics Laboratory,
The University, Leeds,
Nov. 15.

[1] W. T. Astbury, *J. Soc. Chem. Ind.*, **49**, 441; 1930.
[2] Meyer and Mark, "Der Aufbau der hochpolymeren organischen Naturstoffe".
[3] Meyer and Mark, *Berichte*, **61**, 1932; 1928.
[4] Abderhalden and Komm, *Z. physiol. Chem.*, **139**, 181; 1924.
[5] Troensegaard, *Z. physiol. Chem.*, **127**, 137; 1923.

Electrode Potentials in Air-free Electrolyte.

THE following somewhat wide problem is of very considerable practical importance.

What potential will a metal surface assume when it is immersed in a salt solution which contains none of its own ions, under different conditions of aeration, pH and salt concentration, and what conditions control this potential? Such practical matters as corrosion, and in general the behaviour of metal surfaces in ordinary circumstances, depend on the answer.

Work was undertaken in this laboratory some time ago with the view of discovering the controlling factors in connexion with the above problem, for though a great deal of special experimental data is available, very little systematic knowledge seems to exist regarding the potential of a metal in such a solution. It was recognised that the problem must be attacked in two sections, first, with the solution completely air-free, as an oxide film in most cases greatly modifies the electrode potential, and secondly, in the presence of air.

It is felt to be worth while at this stage to review the conclusions so far arrived at in air-free conditions. They are drawn from a certain amount of unpublished work, together with some that has been published. The conclusions are arrived at principally as the result of a study of the three metals iron, zinc, and cadmium, although rough experiments have been made with other metals. They are as follows:

(i.) *A steady reproducible potential can be obtained in air-free solution.* When an electronegative metal, previously exposed for some time to air, is immersed for some hours in an air-free electrolyte which is not strongly alkaline, it attains a steady reproducible potential, even in the absence of its own ions in the body of the electrolyte, and even when its salt with the anion of the electrolyte is soluble. Exceptions arise in the case of metals made strongly passive by exposure to air, such as aluminium and stainless steel.

(ii.) *Dependence of reproducible potential on pH.* When the electrode has a low hydrogen overvoltage, this reproducible potential is determined by the pH of the solution and varies with it. As might be expected, it is independent of the pH, except in concentrated acid, when the electrode has an overvoltage high compared with its deposition potential, like cadmium or zinc. It must be remembered that this discussion applies to rigidly air-free conditions, and in such a case with the electronegative metals investigated, the overvoltage of which is high, there was no indication of behaviour as metal metal oxide electrodes. Iron, on the other hand, when the electrolyte was alkaline and the electrode was probably not behaving directly as a hydrogen electrode, did give evidence of acting as a metal-metal oxide electrode, and variation of potential with pH still took place.

(iii.) *Effect of anion concentration.* The concentration of the anion in the solution does not affect the electrode potential where this is controlled by pH, but it does do so to some extent where such is not the case; for example, the potential of a pure cadmium electrode is about 70 millivolts more positive in $N/2000$ normal potassium chloride than it is in normal potassium chloride. In $N/2000$ potassium chloride, the electrode is at a potential corresponding to a concentration of about $N/2000$ cadmium ions. It appears probable that there is a thin layer of ions of the metal of the electrode in close contact with its surface, the concentration of the layer being determined by the anion concentration in the body of the solution.

(iv.) *Potential not determined by electrode metal ions in body of solution.* In the case of a metal having a low hydrogen overvoltage, the potential as expected is much more positive than can be accounted for by metal ions which have come into the electrolyte by solution from the electrode itself or from an oxide film.

But this was found to be the case with metals of high overvoltage as well; for example, when the potential of a cadmium electrode was such that the

concentration of its ions according to the Nernst theory should have been $N/10{,}000$, it was actually [illegible] by direct chemical analysis to be less than $N/100{,}000$.

Attempted generalisation of whole position. When there is no sensible concentration of the ions of a metal electrode in a solution, and the electrode is not covered by an oxide film, its potential is determined by pH if its hydrogen overvoltage is positive to the deposition potential which it would have in a solution of the order $N/1000$ in its own ions. When this is not the case, the potential is controlled by anion concentration, probably acting through a film of electrolyte in contact with the metal with a concentration of electrode metal ions of the order of $N/10{,}000$.

It is hoped later to investigate further the reason for the reproducible potential attained by high overvoltage metals, but for the present it is intended to study aerated conditions, and for this reason it has [b]een thought well to summarise previous work in [w]hich air was strictly excluded.

Our best thanks are due to the Commonwealth [C]ouncil for Scientific and Industrial Research [A]ustralia), which, by a generous grant, has made this [wo]rk possible.

A. L. McAULAY.
G. L. WHITE.
E. C. R. SPOONER.

Physics Laboratory,
University of Tasmania,
Sept. 13.

McAulay and Bast[...], *J.C.S.*, p. 85, 1929. McAulay and White, [*J.*]*C.S.*, p. 91, 1930.

Raman Spectra of Pinene.

IN a series of researches to be published in full [sh]ortly on the Raman spectra of *d*- and *l*-pinene [in] the liquid condition, we have observed near the [li]ne $\nu = 23257$ (corresponding to the Raman $\nu = 1454$ [ex]cited by the line λ 404·6 of mercury) a series of

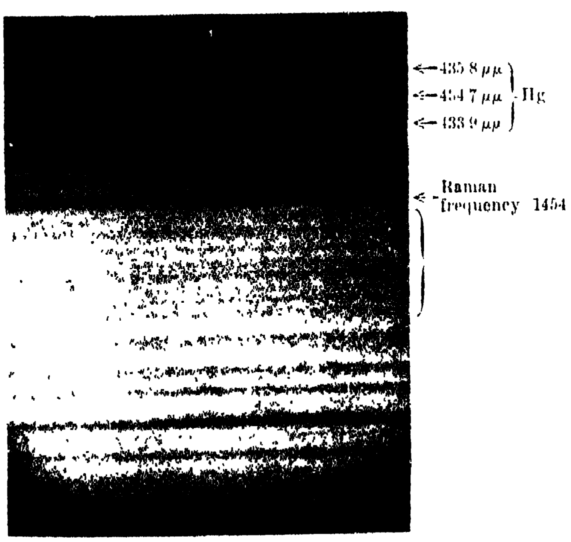


FIG. 1.—Raman spectrum of pinene.

[e]ight lines, very weak, sensibly at the same distance, [a]nd the distances of which from the Raman line [a]bove mentioned can be represented to a good ap[p]roximation by the relation $\Delta\nu = B(4m+4)$,[1] which, [a]s is well known, corresponds to the series of Raman [f]requencies of rotation relative to the rotator with [f]ixed axis. By putting $B = 6{\cdot}15$, the mean differ[e]nces between calculated and observed values amount [t]o $\pm 0{\cdot}017$ per cent. The value of m should correspond to the even series, namely, 2, 4, 6, 8, etc. Supposing the rotator composed by two atoms of H of one CH_2 rotating round the carbon atom (considering that the Raman frequency $\nu = 1454$ is attributed [2] to the transverse oscillations of the two H atoms in the group CH_2), we calculate, from the value of B, that the distance between the atoms of hydrogen and carbon in the CH_2 group is $1{\cdot}16 \times 10^{-8}$ cm., in good accordance with the values published by Mecke,[3] namely, $1{\cdot}13 \times 10^{-8}$ cm. In view, however, of the difficulty of obtaining good vibration and rotation spectra in liquids with complex molecules, we merely direct attention to the coincidence observed (working with a spectrograph with small dispersion); we intend to repeat the work with higher dispersion, before giving a definite interpretation to the results.

G. B. BONINO.
P. CELLA.

Laboratory of Physical Chemistry
of the Royal University,
Bologna, September.

[1] V. P. Pringsheim, "Ramanspektra". "Handb. der Physik", Bd. 21, p. 629; and Schrodinger, *Ann. der Phys.* (4), **79**, p. 520; 1926.
[2] Dadieu u. Kohlrausch., *Ber. Deut. Chem. Ges.*, **63**, p. 262; 1930.
[3] Mecke u. Hedfeld, *Zeits. f. Phys.*, **64**, p. 161, note.

The Wave-length of X-Rays.

IT is well known that determinations of the wave-length, λ, of X-ray spectral lines, which have recently been made by means of line gratings, do not agree with those found by crystals, the crystal values being 0·1 to 0·3 per cent less than the line grating values. In this use of line gratings the angles of incidence and diffraction have been small and have proved difficult to measure, but the accuracy attained in some of the observations of λ (for example, that of Backlin for aluminium $K\alpha$) is probably not less than 1 in 1000. In the crystal method, relations of the form $n\lambda = 2d \sin\theta$ and $d^3 = eM/\rho F$ (e, electronic charge; F, faraday; M, molecular mass; and ρ the density of the crystal) are used to find λ, and the angle of reflection θ has been measured with high accuracy. Since M, ρ, and F are subject to smaller errors than e, the disagreement in the values of λ found by the two methods is usually attributed to an error of 0·3 to 0·9 per cent in the accepted value of e. If the precision of the grating method could be increased, these relations would be available to find the electronic charge more accurately than it is known at present.

The precision with which the wave-lengths of the lines of the spectrum in the optical region are known has enabled many problems in physics to be solved, and it is probable that improvement in the absolute accuracy of X-ray wave-lengths will prove of similar value.

In X-ray spectrometry up to the present the grating appears always to have been used to measure wave-lengths not relatively but absolutely, and this involves the precise determination of small angles. In the light of experiments we have performed, it would appear to be possible to use Rowland's method of the coincidence of lines in different orders of the grating spectrum over the whole spectral region from the optical to X-rays. It should be noted that the absolute errors in Rowland's wave-length tables do not imply any failure of this method, and from Kayser's comparison of Rowland's values of λ with interferometer values it appears that the method has a precision of one in a million in relative determinations in the optical region.

One of the difficulties to be anticipated in extending the methods to the X-ray region is that, owing to the small angle at which X-rays are reflected at the surface of a solid, the method would fail in that region. Using

a plane glass grating of 10,800 lines to the inch, a vacuum spectrograph, and X-ray tube with a graphite target in the same vacuum, we find that the K line of carbon can be photographed from the 18th negative order to the 13th positive order, or over a range of $n\lambda$ from 0 A. to 810 A. In this way, using a small dispersion, the carbon K line has been compared with the copper $L\alpha$ and Ll lines in their second and fourth orders, the wave-lengths 44·7 A. and 44·8 A. being obtained for the carbon line relative to 13·32 A. for the copper $L\alpha$ line. The approximate coincidence of different orders has also been used to compare the wave-length of the first order K lines of aluminium lines reflected from a sugar crystal with the wave-length of the $K\alpha_1\alpha_2$ copper lines in the 5th and 6th orders. We find Al $K\alpha_1\alpha_2$ 8·315 A. relative to Cu $K\alpha_1\alpha_2$ = 1·5392 A.

T. H. LABY.
R. BINGHAM.

University of Melbourne,
Oct. 17.

Structure of Hydrogen Sulphide, Hydrogen Selenide, and Nitrogen Dioxide at Liquid Air Temperature.

IN connexion with previous determinations of the structure of solid α-nitrogen [1] and of solid carbon monoxide, we have during last year carried out a structure analysis of solid hydrogen sulphide, hydrogen selenide, and nitrogen dioxide by means of powder diagrams obtained with an apparatus described in a previous paper. A more complete description of the results will appear elsewhere, but I want here briefly to state some of the principal results.

Solid hydrogen sulphide and selenide are both isomorphic with a cubic elementary cell containing four molecules. The sulphur and selenium atoms are arranged in a face-centred lattice. If the hydrogen atoms are to be given definite positions in the lattice, a discussion of all possible arrangements leads to the result that the atoms of a molecule must be situated on a straight line.

The most probable space group would be T^4, if the molecule is asymmetric, and $T^6{}_2$, if it is symmetric. For the side of the cell (a) and the density (ρ) we found for hydrogen sulphide, a = 5·76 A.; ρ = 1·17; for hydrogen selenide, a = 6·10 A.; ρ = 2·34.

These determinations were finished in July this year.

Solid nitrogen dioxide has also a cubical structure, but much more complicated than that of hydrogen sulphide and selenide.

The side of the elementary cell (a) is 7·77 A. The density (ρ) of solid nitrogen dioxide was determined separately to be 1·93, which gives six molecules in the cell. All lines observed fulfil the condition : Σh = an even number, which means that the lattice may be regarded as composed of cube centred lattices.

After having discussed all space groups fulfilling these conditions, we find T^5 to be the only one possible. This space group gives one parameter for the nitrogen atom, and three parameters for the oxygen atoms. By making certain assumptions regarding the limits for the nearest approach of the atoms, we have succeeded in determining the parameters so as to give a remarkably good agreement between observed and calculated intensities.

A more detailed description of this rather complicated structure will be reserved for a subsequent paper.

L. VEGARD.

Physical Institute, Oslo,
Nov. 6.

[1] L. Vegard, *Zeit. f. Phys.*, **58**, 497; 1929.

Isomorphism and Chemical Homology.

IN April 1929 I published a paper on "Monofluorphosphoric Acid and the Similarity of its Salts to the Sulphates" in the *Berichte der Deutschen Chemischen Gesellschaft*, p. 793. I stated that I had succeeded in preparing the monofluorphosphates, which I described in detail and also that the ion PO_3F'' shows all the properties of SO_4''. I pointed out that the salts of monofluorphosphoric acid resemble completely the salts of sulphuric acid and that the crystallographic investigation of the new salts was being carried out. I considered that the reasons for the similarity of chemical properties of the two ions lay in the similarity of the radii of the two central atoms, in the equality of their co-ordination number and of the electric charges of the anions and also in the equality of the volumes of O'' and F'. At the end of the paper I stressed the fact that this investigation was still in progress. The direction in which the investigation was being continued is revealed in a petition which I addressed on April 29, 1929, to the *Notgemeinschaft der deutschen Wissenschaft* which contains this statement: "monofluorphosphoric acid H_2PO_3F resembles sulphuric acid H_2SO_4 so closely that it even gives alums, which are isomorphous with ordinary sulphate alums". Since the discovery of alums was to be foreseen by anyone after the publication of these facts, I delayed immediate publication of the new results, since they did not involve any new point of view.

I was, therefore, surprised to see in NATURE of Aug. 30, p. 310, a paper by Sir P. C. Ray on monofluorphosphates in spite of my notice that my work was being continued. Amongst other matters he prepared the alums which were to be foreseen. He also described as quite new facts his results, which he obtained with the aid of the conclusions which I had already indicated, without any mention of my name or acknowledgment of my work. Moreover, he did not give the method by which he prepared the PO_3F'' ions. I can only suppose then that Sir P. C. Rây is unaware of my work, although it appeared in one of the most widely circulated journals, and was indeed abstracted in *British Chemical Abstracts*, vol. A, p. 663, and in the *Chem. Zentralblatt* I. p. 2626, and in *American Chemical Abstracts*, vol. 23, p. 4903.

WILLY LANGE.

Chemisches Institut,
Universität Berlin,
Oct. 30.

Raman Lines of Simple Polyatomic Molecules.

IN the course of a study of the structure of simple polyatomic molecules, the Raman spectrum of hydrazine, N_2H_4, was obtained with the view of finding the Raman line or lines which correspond to the symmetrical vibration N-N in polyatomic molecules. We should expect to find a line in the neighbourhood of 1600 cm.$^{-1}$, but the hydrazine spectrum showed three lines of roughly equal intensity at 3196 cm.$^{-1}$, 3270 cm.$^{-1}$, and 3344 cm.$^{-1}$, along with a very doubtful line at 1720 cm.$^{-1}$. These three lines are obviously due to N-H vibrations, and it seems curious that the symmetrical vibration should be so weak (if present at all) in the spectrum of this molecule.

Hydrazine hydrate, $N_2H_4H_2O$, gave the same three lines but with very much weaker intensity for comparable times of exposure. Both gave much continuous background, especially the latter. It appears from the results of other workers on polyatomic molecules that the vibration frequencies which turn up with greatest intensity in the Raman effect are those which correspond to symmetrical (inactive)

vibrations of the molecule. It had been hoped that a comparison between the hydrazine and the hydrazine hydrate spectra would show a difference in the intensity of the line corresponding to the N-N vibration in each molecule, but the results are so far indecisive on this point.

It is of interest to compare the three lines of hydrazine with the three lines which Daure (*Trans. Faraday Soc.*, Dec. 1929) gets in liquid ammonia, namely, 3210 cm.$^{-1}$, 3300 cm.$^{-1}$, and 3380 cm.$^{-1}$. Ammonia gas shows only one line at 3330 cm.$^{-1}$, according to Wood (*Phil. Mag.*, 7, 1929) and other workers; and it has been suggested that the triplet in the liquid is the result of association into molecules of the type H_3N-NH_3. On the surface, the hydrazine result would seem to strengthen this view, but one cannot be certain until the structure of hydrazine has been more fully worked out from its infra-red, as well as from its Raman spectrum. The work for this molecule is now being carried out here along with similar work for other simple molecules and upon the results it is hoped that a description of the exact selection rules will be obtained.

G. B. B. M. SUTHERLAND.

Laboratory of Physical Chemistry,
Cambridge, Nov. 11.

The Activity of Surfaces.

IN recent years a good deal of attention has been given to the relation between the catalytic effect of a surface and its structure, and in this connexion it is perhaps of interest to point out that the general idea underlying many theories was published by me in 1911 (*J. Chem. Soc.*, 475 ff., 1911) in a qualitative form. The hypothesis in relation to the specific problem studied, the dehydration of a salt crystal, was based on the view that the lattice structure of such a system was disturbed, and that the rearrangement of the surface (described as 'amorphous', in harmony with the prevailing views before the application of the X-rays to crystal analysis had been discovered) underwent a recrystallisation, a process which required time. It was further pointed out that "a treatment of somewhat simpler systems than the present, such as occur, for example, in the 'ageing' of deposited catalytic surfaces, would probably present points of interest"; and such has, in fact, proved to be so. This view of a catalytic surface is incompatible with a smooth 'chess-board' surface. The latter has now been recognised as inadequate. The application of the idea to heterogeneous reactions has been considered by Slonim (*Z. Elektrochem.*, p. 439, 1930). The examination of all such surfaces by X-ray analysis would, clearly, throw much light on the general problem, as Slonim shows in a particular case. The method contemplated had, however, the use of reaction velocity in mind.

J. R. PARTINGTON.

East London College,
University of London,
Nov. 14.

Evolution and Ethics.

THE correspondence in NATURE of Nov. 29 under the heading "Heredity and Predestination" raises a topic of surpassing interest.

An ethical system of some kind is an essential adjunct of every social organisation. Apart from the social organisation to which it is related, any ethical system is a mere abstraction. On the other hand, a species without social organisation can have no ethical system. For such a species ethical values do not exist.

Ethical systems are in general just as much a product of evolution as are the bodies of individual organisms. If it were possible to view our own ancestry sufficiently far back, we should be able to trace an unbroken series commencing with a creature without social organisation or the possibility of ethical standards of conduct and proceeding by gradual steps to the present stage of organisation with its related standards, which, in conformity with the well-known dictum of Heraclitus, is no more permanent than its precursors.

Viewing the world of the present day, it is obvious that a variety of differing ethical systems are in actual operation in the human as well as in other social species. It is also obvious that the number of ethical systems which are theoretically possible is unlimited. The only condition that must be satisfied is that the ethical system must be in harmony with the society to which it applies. Failing such harmony, instability would ensue, with results which need not now be pursued.

Within the sphere of any ethical system the term 'good' applied to conduct means simply that the conduct is in accordance with the dictates of the system. The same conduct under another ethical system would possess a certain value, but would not necessarily be 'good'. Considered apart from all ethical systems no conduct can be assigned any ethical value.

So far as the comparison of ethical systems is concerned, it is impossible to condemn one or to favour another on ethical grounds. This is a field in which an ethical court can have no jurisdiction, as there are no ethical principles on which it can proceed. If one were to assume the superiority of one ethical system, it would be easy to condemn all others, but such a procedure would be transparently naïve.

On the other hand, there exists a court which does exercise jurisdiction in this field. As there is no appeal against its decisions, it is perhaps deserving of rather more consideration than it receives. The authority of this court depends on the fact that ethical systems have a most potent selective influence over the individuals composing the society in which the systems function. The existence of the social organisation shields the individuals comprised within it from many of the hazards that arise from the external environment. The selective effects of the external environment are thus minimised and their place is taken by the internal selective activity of the society itself, exercised in accordance with its ethical system. The more highly developed the social organisation the more far-reaching will this activity become. Ultimately the evolutionary trend—whether upwards or downwards—of the individuals composing the society will be controlled principally through this type of social selection. One ethical system will lead to degeneration and ultimately extinction, while another will lead in the opposite direction. We have here the *natural* criterion for discriminating between ethical systems. We are thereby enabled to apply the term 'good' or 'bad' to any ethical system, but it should not be overlooked that in such application neither term possesses an ethical connotation.

I will conclude by quoting in translation one of the less familiar fragments of Heraclitus:

"The Ephesians would do well to hang themselves, every grown man of them, and leave the city to beardless youths; for they have cast out Hermodorus, the best man among them, saying: 'We will have none who is best among us; if there be any such, let him be so elsewhere and among others'."

HUGH BIRRELL.

Huntington,
Ascot, Berks.

Determinism.

THE wide circulation and attractive style of Sir James Jeans's book, "The Mysterious Universe", will probably mark a step in the crystallisation of ideas towards the rejection of any mechanical system. But many will ask, Why go so far, and go no farther? Why have we dethroned a mechanical system and set pure mathematics to reign in its stead? The essence of a mechanical system, or to give it its more general name, Determinism, requires a single time sequence, proceeding in one direction, and postulates that each state is an inference from any past state, the necessary major premiss being Causation. One immense consequence of Einstein's ideas has scarcely yet been touched,—as the quantum theory undermined Causation, so relativity undermines Determinism and every other ethical theory by abolishing the time sequence.

Pure mathematics differs from this in possessing no time sequence; all its statements are interconnected so that each implies the others, and no statement is made at all other than the original axioms out of which it was evolved. Therefore it assumes the possession of complete knowledge of the theme before it makes any statement at all. If this leads to mysteries in the description of the universe, as well it may, it is hard to see why it too should not be rejected as unsuitable for the purpose, in the same way as we have rejected the animism and anthropomorphism of our ancestors. Pure mathematics is the last thing we would reject—if it goes, number goes, for the logic of pure mathematics depends upon number; and if number and the separation of objects of thought is discarded, all experience merges into one changing whole, incapable of exact description and communication to others. Apparently physical science owes its success to having elected to describe Nature on the lower plane of abstraction, where exact communication is possible. This is the alternative we may have to embrace. We can say with Faust, *Im Anfang war die Tat*, and nothing more. R. A. S.

Edinburgh.

Embryology and Evolution.

I HAVE read with much interest Prof. MacBride's review entitled "The Problem of Epigenesis", and I should like to make a few remarks upon what he says at the end. First of all, I wonder if the following analogy will help him, as it has helped me, to reconcile the conceptions of the geneticist with those of the embryologist. In a modern motor works the cars, so I understand, move along a track past a series of workmen, each of whom has one particular job to do, which is related to what has already been done and also to what is going to be done afterwards. Now if we imagine that all the parts and materials which are going to make up the finished car represent the substances in the developing embryo and that the workmen are the genes, we have an analogy which can be carried surprisingly far. Not only will it give us a picture of normal development, but we can see, by altering one of the parts, how a variation may occur; by altering a workman, how 'sports' may arise; and, by adding a new workman with a new job, how progressive evolution may take place.

There is no need for me to occupy space in working the analogy out, for anyone can do it for himself: what is more important is to point out where the analogy fails. A motor-car is adapted for life on the road, and, until it is completed, it has, for all practical purposes, no environment at all comparable with that which bears upon an embryo throughout its development. So whereas a feature of a car is simply due to the action of the workman on the materials, a feature of an animal is the result of the combined action of the genes and of the environment upon the materials of the embryo. Genes without the appropriate materials can produce nothing; genes with the appropriate materials can only produce a partially developed structure; but genes with the appropriate materials and environment can produce the fully developed functional character. Hence it is that in the development of the frog, for example, the gill-clefts, etc., are full developed, whereas in the Amniota, with the radical change in the environment of the early stages, such structures are only partially developed and the stages, to quote Prof. MacBride, are smudged.

Looked at from this point of view, two other conclusions of great importance are unavoidable. The first is that the recapitulation of an ancestral stage of the evolution of an animal, as distinct from the repetition of an ancestral character, will only occur when the early stage of development is passed in the same environment as that of the ancestor, which environment is different from that of the present-day adult. Only under such conditions will the genes responsible for the adult ancestral characters give rise to them all together without any great admixture of other features; though it must always be borne in mind that such stages in the life history, being larvæ, may evolve on their own account and, therefore, may have features which the ancestor never had. In parenthesis, I should just like to add here that, so far as I know, a larva has never been properly defined: such a definition would be "A free-living stage in an animal's life history which fends for itself and possesses certain characters which it has to lose before it can become a young adult": the possession of *positive* characters distinguishes a larva, not its lack of adult ones.

The other conclusion is reached thus. The appearance of a functional feature is dependent, as we have seen, upon the interaction of three things: the materials of the embryo, the genes, and the environment. Now the facts of Mendelian inheritance give clear evidence that there need be no change in the materials of an embryo for a new gene to modify the form, so, in discussing the origin of a new feature, there is no need to consider a change in the materials as one of the essential factors. The tortuitous appearance of a gene without the appropriate environment would produce a partially developed character, but, in actual experience, we do not find features in a partially developed condition which *have never been functional* at any period in the history of the race. So the genes must, in actual fact, only arise after the suitable environment is present; and the only conclusion to be drawn from that is that there is a causal relation between the two; that is, that the environment is in some way responsible for the appearance of the gene, which is surely nothing more or less than the basis of a new proof of the inheritance of acquired characters. G. L. PURSER.

The University, Aberdeen,
Oct. 29.

I HAVE read with interest Mr. Purser's thoughtful letter on the subject of my review. If he will substitute the term 'race-memory' for 'gene', we shall not be far apart. But the gene of the Mendelian stands out as something that is never functional. "No one", said the late Sir Archdall Reid, "ever heard of a useful gene." When one takes into consideration the fact that the Mendelian genes in *Drosophila* have been shown to increase in their damaging effect on the viability of the organism in proportion to the structural change which they involve, and when further it is discovered that genes can be artificially produced by irradiating insect eggs with X-rays—a

process which kills most of the eggs—one is driven to the conclusion that a gene is germ damage of which the outward manifestation is a mutation. The only effect that natural selection would have on such aberrations would be to wipe them out. In my opinion, mutations and adaptations have nothing to do with one another and only adaptations are recapitulated in ontogeny. E. W. MACBRIDE.

Administration and Anthropology in India.

THE leading article in NATURE of Nov. 22 appears at a critical moment and must be deeply appreciated by everyone who knows anything of the present state of affairs in India, political or academic. It rightly stresses the literary bias of research in India, in answer to which it may be pointed out that, whereas the older universities teach Indian languages, the University of London is the only English university to accept Indian cultural studies for the B.A. degree (Hons. Archaeology, Sect. H). It is true that field-work is non existent in India, and that, therefore, the bulk of the anthropological research carried out must be more or less arid, because it is at second-hand and divorced from the facts. As an outcome of this, we are now faced by the peculiar prospect of listening to a lengthy debate, and of accepting willy-nilly a decision of sorts, upon a subject that is nothing else than a problem in applied anthropology, that is, the organisation of a federal India; and we are forced to do so with the knowledge that the facts are not accessible. Whatever is done must, therefore, be done in the dark. The action taken will be political and not scientific. One would have liked to have heard Huxley's views on such a state of affairs!

The problem has, however, been foreseen by many people, most of them harassed government officials, who, following the magnificent Anglo-Indian tradition of Tod, Sleeman, Cunningham, and Meadows-Taylor, have found time to make themselves acquainted with scientific thought, but were never free to undertake research. In spite of Risley and Thurston, and the solitary excellence of Sarat Chandra Roy, it is not possible, in the present state of our knowledge of India, even to begin to discuss the basic problems of Indian ethnology. The district gazetteers are a mine of information, but they are uncorrelated compilations. The very terminology is lacking, because no body of scientific opinion has ever been brought to bear on Indian studies. If the delegates of the Round Table Conference were to be suddenly and blessedly converted to science, it is doubtful whether six people could be brought before them who could speak with authority upon India as a whole. It is not enough to explain the dearth of Indian scholars by saying that India is a continent in itself and a whole compound of races, beyond the ability of one man's compass. So are China and Africa, both of which are academically well represented. The only answer is that India has been academically neglected. The remedy is in the hands of the teaching bodies.

Incidentally, should not a candidate for the Indian Civil Service know a very great deal about the history and culture of the peoples to whose welfare he is devoting his life? It may be asked, Where *does* the Indian administrator get his knowledge from? The answer is that he picks it up. He certainly does not get what he needs from the older universities.

K. DE B. CODRINGTON
(Hon. Sec., India Research Committee
Royal Anthropological Institute).

Claire Cottage, North Road,
London, N.6,
Nov. 29.

Foaming of Beer.

I DO not know sufficient of chemistry to appreciate the full inwardness of Sir Robert Robertson's commentary on my letter in NATURE of Sept. 20, but I am convinced that the phenomena in question are not purely chemical, and that a physical, and even a directly mechanical explanation, is at least partly appropriate. I have in mind the air lift pump.

As a matter of interest I tried pouring a gassy beer into a champagne glass and it was quite flat. But more convincing was a letter from a well-known professor at Harvard, who states that the mid-west 'hobo' sought to combat short measure by greasing the inside of his tin can or pail with ordinary soap. These 'hobos' argued that they got enough fresh air without drinking it. The Harvard professor, whose initials coincide with my first two, experimented on foaming phenomena and found that something like 20 per cent could be gained by soaping. He was told that the quality of the beer was such that the taste was not unpleasantly affected.

It is permissible to observe that the 'hobo' did not use a glass vessel, and to judge by his name, he would not allow sufficient time for soap to be absorbed or dissolved by the beer. Moreover, my Harvard correspondent does not explain why a slippery container kills froth. H. S. ROWELL.

39 Spencer Road, Chiswick, W.4,
Nov. 9.

Ball Lightning.

IN view of the interesting letter from Dr. A. Russell on the above subject in NATURE of Nov. 22, and his remarks as to the undesirability of touching these mysterious globes, the following case (quoted from Flammarion by Prof. Ignazio Galli in *Mem. Pont. Acc. Rom. N. Lincei*, **30**, 281-2; 1912), when the experiment was actually tried, might be of interest.

During a storm at Beugnon (Département Deux-Sèvres, France) about the year 1904, a globe approached the door of a cattle-shed where were sheltering two children. "One of the children had the courage to touch it with his foot; immediately a frightful detonation shook the walls of the farm, the two children were thrown to the ground, without any wound, but eleven head of cattle were killed in the stable."

Prof. Galli also quotes (*ibid.*, 272) many cases of globes accompanied by a sound variously described as blowing, whistling, roaring, buzzing, and crackling.

CICELY M. BOTLEY.

"Guildables," 17 Holmesdale Gardens,
Hastings, Nov. 24.

A Toy Balloon's Long Flight.

SOME fourth form boys here have recently been carrying out several simple researches. One such research, on air currents, included the liberation of coal-gas-filled balloons. One flight is sufficiently remarkable to be worth recording.

A Woolworth threepenny balloon was liberated near Johnstone, 12 miles south of Glasgow, 100 feet above sea-level, on Oct. 26, at 12.30 P.M. It reached Stony Stratford, in Buckinghamshire, after a journey of at least 310 miles, and was picked up next day at 10.30 A.M.

Alan Hird, the experimenter, remarks: "The day was fine and sunny, in fact it was the only officially 'dry' October day in this part of Renfrewshire, and a strong, steady N.W. wind was blowing."

EDWARD P. KAYE.

Glasgow Academy.

The De-Nationalisation of Helium.

By HENRY B. MILNER.

THE disaster to the British airship *R101*, still fresh in the public mind, torn between sad memory and impatience to learn the findings of experts now holding a court of inquiry, has had, as it was bound to do, world-wide repercussion. Everywhere dirigible construction, either in project or in progress, has received an abrupt check. Whatever may be the ultimate technical findings of this court, it is safe to assume consensus of opinion on at least one point: the danger of hydrogen, the urgency of helium. In Germany the Zeppelin Company was engaged in laying down a new airship to be known as *LZ128*, but the lesson was quickly learnt. Complete revision of plans of construction was undertaken, in which the salient factors were provision for the exclusive use of helium and heavy, virtually non-inflammable, oil-fuel, in place of hydrogen and the 'Blau' gas fuel hitherto employed in Zeppelins. Clearly, even at the expense of a year's delay, Dr. Eckener is in no mind to chance a re-enactment of the deplorable tragedy which we have just witnessed.

At the same time, such plans might well be frustrated and progress reduced to complete standstill if resources of helium were not forthcoming. Since the United States holds a virtual monopoly of this valuable gas, then clearly the question of future supplies is the crux of the situation for everyone concerned. Dr. Eckener announced to the American Chamber of Commerce in Berlin last month (*Times*, Nov. 6) that the embargo on helium export from the United States had just been removed, which made practicable the execution of the revised plans for *LZ128*. It is interesting to review the situation and the chain of events which have made possible this release.

The original law relating to the export of helium from the United States is contained in Section 4 of the Act approved March 3, 1927 Public, No. 758, 69th Congress which states: "That hereafter no helium gas shall be exported from the United States . . . until after application for such exportation has been made to the Secretary of Commerce and permission for said exportation has been obtained from the President of the United States, on the joint recommendation of the Secretary of War, the Secretary of the Navy, and the Secretary of Commerce. . . ." The Act also authorises "the conservation, production, and exploitation of helium gas, a mineral resource pertaining to the national defence . . .", and places the jurisdiction of Government plant under the Bureau of Mines, from which Bureau the Army, Navy, and other branches of the Federal service will requisition it as required.

Specific mention of the Government plant recalls the existence of the U.S. Helium Production Plant near Fort Worth, Texas, the helium being actually extracted from natural gas of the Petrolia-field, Clay County, Texas. Until 1928, practically all the helium produced came from this source, but it was then found that this source of supply was inadequate to international demands. The effect of the Act was to stimulate investigations by the Bureau of Mines into supplementary resources, and in April of that year a contract was made between the Government with the Amarillo Oil Company of Amarillo, Texas, to exploit the gas from leases on what is known as the Cliffside Structure in that region. While it was a vital matter to develop such helium-bearing gas resources as could be found, questions of the prospective life of such supply, also facilities for disposing of the 'treated' gas, had to be faced. The estimates proved satisfactory so far as the first point is concerned, and the Company having agreed to take care of the treated gas, developments went ahead, so that in August of that year the new plant-site was selected at Soney, some six miles from Amarillo, and almost coincidently the Company brought in a new gas well having an open flow volume of more than seven million cubic feet per day, with a helium content of about $1\frac{3}{4}$ per cent by volume, the average for gas produced from this particular structure.

By May of last year the first tank-car filled with about 200,000 cubic feet of helium was dispatched from Soney to a place in Virginia. This helium was transported under a pressure of 2000 pounds per square inch and ultimately discharged into stationary containers for use in connexion with the U.S. Army dirigibles. Thereafter the new plant continued more than ever to justify initial confidence, both in itself and in the quality of the gas handled. In September 1929 there was produced from Amarillo 874,840 cubic feet of helium with the remarkable factor of 97·7 per cent purity, at an operating cost of 17·63 dollars per thousand cubic feet of contained helium, a much reduced cost compared with that previously involved. In January 1930 the output of helium was more than a million cubic feet of gas with a purity factor of 97·85 per cent, at a still further reduced cost of 9·64 dollars per thousand cubic feet.

The significance of this purity factor will be more readily understood when it is realised that a Navy dirigible (U.S.) of $6\frac{1}{2}$ million cubic feet capacity has about 5 tons more lift when filled with helium of 98 per cent purity than when the purity factor is only just over 95 per cent, the average of the Fort Worth product.

A Department of Commerce 'Press release', dated Aug. 20, 1930, shows that the helium output for the fiscal year ending June 30, 1930, attained the high figure of 9,801,060 cubic feet, the largest ever achieved, and it is pointed out that the plant was only operated at a fraction of its real capacity, the latter determined almost entirely by the U.S. Army and Navy demand. This communication also contains the statement, "Under present conditions it costs less to operate Government airships with non-inflammable helium than it would cost to operate them with flammable hydrogen". At this point we leave this amazing record of progress

until *R101* showed the vital need of de-nationalisation of helium.

With such resources at her command, with her service and commercial needs amply provided for, an international call for exported helium could not remain for long unheeded, in the interests both of humanity and the future of the airship. On Oct. 11, 1930, the Department of Commerce, apparently satiated with inquiries relative to the helium export situation, cleared the air by publishing a memorandum setting forth the provisions to be observed when sanction for export was requested. These provisions are entirely reasonable, including among others, the quantity to be exported, the purpose for which the helium was destined, and the country to which it was being sent. It is therefore obvious that Section 4 of the Act is to all intents and purposes inoperative, and that this invaluable commodity is henceforward available to all *bona fide* demands.

The Testing of Wood Preservatives.

THE problem of carrying out tests in the laboratory to give a rapid indication of the probable effectiveness of any material as a wood preservative is one which has arisen on many occasions in different countries and a number of different methods have been evolved. Unfortunately the results obtained have frequently been in no way comparable and efforts are being made to standardise the different methods. Following a conference of American workers, early this year at St. Louis, on the standardisation of laboratory methods for the measurement of the toxicity of wood-preserving materials, the wish was expressed that the European investigators should gather together at a similar congress to discuss the conclusions which had been reached at the American meeting, and to describe the methods up till now used in Europe, which differ considerably from those used in America.

The conference, which was convened on the initiative of Dr. Hermann von Schrenk of St. Louis, met in June at the Biologische Reichsanstalt, at Berlin-Dahlem, and included representatives from Austria, Denmark, Germany, Great Britain, Holland, Japan, Norway, Switzerland, and the United States of America. The Department of Scientific and Industrial Research was represented by Mr. W. P. K. Findlay, of the Forest Products Research Laboratory, Princes Risborough. The matter for discussion was put forward under the following three heads:

1. Which method of investigating wood preserving materials appears, in the light of experience so far obtained, to be the most certain and the most reliable?

2. Which wood-destroying fungi should be used for carrying out these experiments?

3. What conclusions as to the value of a wood preservative in actual practice may be drawn from a determination of its toxicity?

1. METHODS.

It was stated, according to the conclusions of the American conference referred to above, that in the United States the fungicidal power of wood preservatives under test is determined only by the method of using petri dish cultures of certain fungi upon agar medium containing the preservative The reason for accepting this method is the exactitude with which the amounts of preservative and the point of inhibition may be determined. Experiments have, indeed, been made in the United States using the wood block method customary in Europe, but the results obtained there by this method have not proved satisfactory, because the use of different species of wood, or of woods of the same species of different resin contents or containing different proportions of spring and summer wood, or, finally, of woods with a varying capacity for impregnation, has introduced so many variables into the method that strictly comparable results could scarcely be expected. The use of sawdust, or of discs made of wood meal, has certainly lessened these difficulties, but, nevertheless, the agar method is considered as far exceeding all others in accuracy and as particularly convenient, because results can be obtained from it in a shorter time than from any other method.

In opposition to the American point of view, all the European research institutes were of the opinion that the wood block method should have first place in importance, the following arguments being advanced in support of this view:

All laboratory experiments on the preservation of materials should in general be carried out on the material in question, using as the attacking agent the appropriate micro-organism concerned. Experience has shown that a preservative may easily inhibit the growth of a micro-organism in agar or gelatine for example, while this same organism will develop quite unchecked by the preservative used in another substratum. The difference in behaviour may be due to such causes as chemical reactions, absorption phenomena, changes in the coefficient of dispersion, and so on, which cannot always be foreseen. Such phenomena have been observed in the case of wood-preserving materials and a number of instances were quoted during the discussions. It was shown by means of tables and figures how some wood preservatives may have the same effect in wood as in agar, while others produce a many times greater effect in agar than in wood. Values obtained in agar cannot, therefore, be taken as applying for wood without further investigation; it was considered that an opinion as to the preservative properties of an antiseptic can only be established by experiments carried out with all necessary precautions upon wood blocks.

Against the objection of the American workers, put forward by Dr. von Schrenk, that the use of wood blocks introduces too great a variability into the experiments, which is absent in the agar method, it was shown that while the undeniable variability of wood may introduce differences amounting to

approximately 10 to 20 per cent, these differences are without significance in comparison with differences of 1000 per cent or more which might easily appear when conclusions are drawn as to the toxicity of a material in wood from figures derived from agar tests. The agar method may in this way lead to false conclusions.

In addition to the agar and wood block methods which had been discussed, mention was also made of methods involving the use of cooked rice or of sawdust as nutritive substrata. At Zurich a modification of the latter method is customary, in which the wood-destroying fungi are cultivated on sawdust prepared from impregnated wood, and as a measure of the amount of the fungus attack, the xylan and the cellulose contents are determined before and after the growth of the fungus.

2. CHOICE OF FUNGI.

As the first standard fungus, *Fomes annosus* was chosen in America because this fungus is considered to be specially resistant and easy to grow. In addition, other species of fungi (species of *Lenzites*, *Polyporus*, *Polystictus*, *Coniophora*, etc.) have occasionally been used for comparative experiments.

Against the use of *Fomes annosus* general objection was raised because this fungus does not, in practice, come into consideration as a destroyer of dead, constructional timber and it cannot, therefore, be regarded as a typical wood destroyer. Neither can *Fomes annosus* be regarded in general as particularly resistant, since, while it may be very resistant against certain antiseptics, in respect of others it is surpassed by other fungi. On account of the varying behaviour of different fungi to the same antiseptic, it is not sufficient to carry out the experiments with only one fungus; it is much better that several species should always be used. Not only do the values determined for the inhibition point of any particular material in agar fail to agree with the values obtained in wood blocks, but the relation between the agar value and the wood block value may be different for one and the same material for different fungi. It is, therefore, not possible to determine the inhibition points for numerous fungi by the agar method and for a single fungus by the wood block method in order to calculate, from the relation determined for this one fungus, the inhibition points in wood for the other fungi. Several fungi should, therefore, be used in each wood block test against any one preservative. The fungi should be chosen after consideration of the use to which the timber treated with the particular preservative will eventually be put (whether in sleepers, poles, or as building timber). Obviously the choice will also depend upon the species of wood used (frondose or coniferous).

Further, it was shown that not only do species of fungi differ in their resistance and virulence, but that the strains of one species may also show differences amongst themselves, in consequence of which it will be necessary for the different research institutes to make use of the same strains of fungi of known origin, if the values are to be internationally comparable. The Biologische Reichsanstalt at Berlin-Dahlem expressed its willingness to supply strains of fungi having the same origin, if the research institutes could come to an agreement as to the species and strains or races to be used.

Until now the effectiveness of preservatives has been tested only against infection by mycelium; tests against spore infection are equally important and deserve further consideration.

3. INFERENCES FROM TOXICITY DETERMINATIONS.

It was agreed that the inhibition figures determined by the wood block method are only of value for practical application if the laboratory experiments are supplemented by field experiments and by investigations to determine the liability to leaching and to evaporation, and the physical and chemical stability in wood, and so on. But from a consideration of all these points valuable conclusions may be drawn as to the probable preservative power of a material in practice, especially when it is possible to compare the new material under test with other known materials of the same type.

CONCLUSIONS.

The conclusions reached were as follows:

1. The wood block method (using the Kolle flasks), which was thoroughly discussed by the conference, should be considered as a suitable means for estimating the effectiveness of a wood preservative against fungi. The agar method should only be considered as of value for the preliminary investigation of the toxicity to fungi of any new material.

The inhibition point in the wood block method shall be expressed as kilograms of preservative per cubic metre of wood. In the agar method the inhibition point shall be expressed as the interval between that concentration of the material under test, in the artificial medium, at which growth just takes place and the next concentration above it in the series, which prevents all growth.

2. It should not be considered sufficient to carry out the tests under consideration with one fungus only. Much rather should it be the aim to carry out all tests on impregnated wood with two fungi; the exact species still to be decided upon, but one of them should be *Coniophora cerebella*.

3. The conference was unanimous that the determination of the toxicity to fungi of any material is not alone sufficient to determine its value as a wood preservative, and that investigations as to its susceptibility to leaching, and on its physical and chemical stability in the wood, must also be taken into consideration.

In view of the wide field for discussion, the conference resolved not to regard the two days' discussion as in any way final, but rather to look upon itself as a sort of permanent working committee of people interested in the subject. In order to make the work easier, the following committee was set up: Prof. Liese, of the Forestry School, Eberswalde; Prof. Nowak, of the Wood Industry Technical and Chemical Research Institute, Vienna; Dr. F. Peters, of the Rütgers Company, Berlin; and Dr. A. Rabanus, of the I.G. Farbenindustrie A.G., Uerdingen.

Crust-movements connected with Tango (Japan) Earthquake of 1927.

IN no other earthquake have the movements of the crust been studied so exhaustively as in the Tango earthquake of Mar. 7, 1927. In several districts, such as those of the Californian earthquake of 1906 or the Kwanto earthquake of 1923, the series of levellings have been repeated once, but after the Tango earthquake they have been repeated again and again, with a lavish expenditure of trouble for which seismologists are deeply indebted to the Land Survey Department of the Imperial Japanese Army. Series of precise levellings were carried out during April-June, June-July 1927, Mar.-April 1928, and Aug.-Oct. 1929, while the re-triangulation of the central district was made during May-June, Aug.-Sept., and Oct.-Nov. 1927, and April-Sept. 1928. The results of the repeated measurements have been studied by Prof. C. Tsuboi, of the Earthquake Research Institute, in an admirable series of papers published in the *Bulletin* of the Institute (vol. 6, pp. 71-83: 1929; and vol. 8, pp. 153-220, 338-345; 1930).

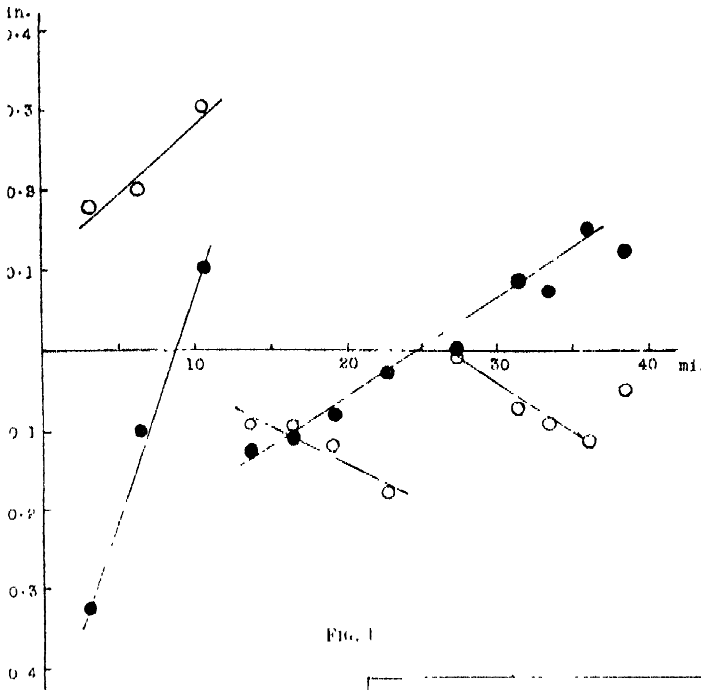


FIG. 1

The first of these memoirs is confined to the vertical displacements that occurred during the intervals between the first and second and the second and third series of levellings. Diagrams are drawn representing these displacements along nearly straight portions of the levelling route. One of them is reproduced in Fig. 1, in which the small black dots indicate the displacements during the first interval and the small circles those during the second. It is clear from this and similar diagrams (i) that the points lie nearly on segments of straight lines, and (ii) that the ends of these segments lie on the same ordinates for both series of graphs. These features are well explained on the supposition that the crust is made up of a number of blocks, each of which behaves as a nearly rigid body and, at any rate after the earthquake, was able to move with comparative ease apart from its neighbours. The boundaries of the various blocks have been drawn, and it is remarkable how closely they agree with the known fault-lines of the district. Two other points of some interest are also evident from Fig. 1 and other diagrams, namely, (iii) the tilting of the blocks in some cases takes place in opposite directions in the two intervals considered, while

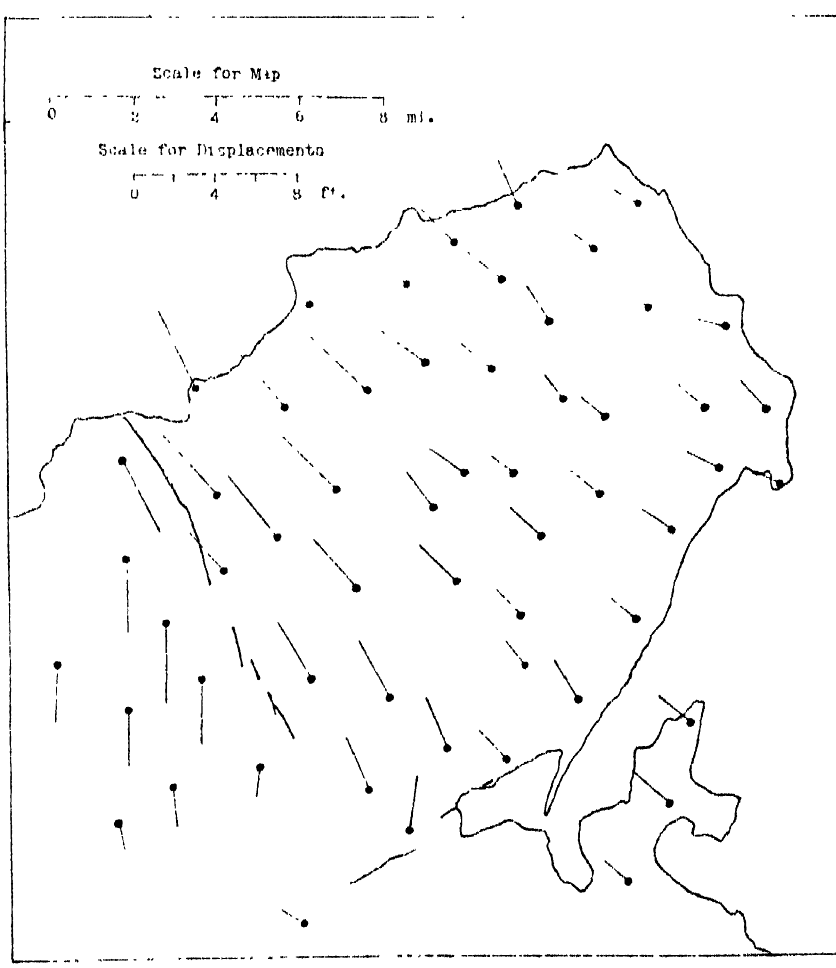


FIG. 2

(iv) Fig. 1 shows that two blocks were subjected to a common tilting during the earlier stage but moved separately during the later.

At the time of the earthquake, two remarkable faults were renewed along old lines of dislocation. They are represented by the thick lines in Fig. 2. The Gomura fault, or series of faults, is 11 miles long, and runs in the direction S. 30° E. along the western boundary of the Oku-Tango peninsula. Relatively to the other side, the crust to the west of the fault was shifted as much as 8 ft. 2 in. to the south and uplifted about 1 ft. 8 in. The Yamada fault is about 4½ miles long, and runs in the direction N. 55° E. along the southern boundary of the peninsula. The crust on the north side of the fault was raised by as much as 2 ft. 3½ in. with respect to that on the other, and shifted 2 ft. 7½ in. to the east.

The main line of levels crosses both faults. The vertical displacements of the bench-marks between 1888 and the first series of levels after the earthquake show that the ground to the west of the Gomura fault has been generally tilted westwards, while the block bounded by the two faults has been tilted to the north by as much as 20″. Similar curves have been drawn for each of the three intervals between successive series of levellings, and it is worthy of notice that, while the curve for each interval differs materially from that up to the first series, the curve representing the total displacements between the first and fourth series resembles it very closely.

No less interesting are the results of the repeated triangulations of the district. Assuming that two points some distance to the south have remained stationary, the displacements of the various points after the fourth triangulation are represented in Fig. 2. From this, it is seen that the mass of the Oku-Tango peninsula has been displaced as a whole, with but slight deformation in itself, in a nearly north-west direction. Maps for the intermediate periods are also given, but they show no tendency to uniformity of displacement like that during the longer interval. One of the most striking features of the map is the discontinuity in the horizontal shifts along the Gomura fault. The greatest displacement measured (of 5 ft. 4½ in.) occurred at Asago, close to the Gomura fault. At two points, Simooka and Yosizawa, one on either side of the fault, displacements of 4 ft. 1 in. and 3 ft. 7 in. occurred in opposite directions nearly parallel to one another and to the fault. The sum of these amounts (7 ft. 8 in.) does not differ much from the total shift of 8 ft. 2 in. observed in a neighbouring portion of the fault.

C. DAVISON.

Obituary.

PROF. PAUL APPELL.

OF the three eminent mathematicians who dominated French science at the beginning of this century, Paul Appell, who died on Oct. 23, aged seventy-five years, will pass down to posterity as an analyst of genius, whose personal charm was equal to the excellence of his teaching. Together with Henri Poincaré, whose mathematical achievements have still to find their equal, and Emile Picard, whom destiny has now left alone to represent the glory of his generation, Paul Appell has laid the foundations upon which a succession of research students and mathematicians have built. Indeed, his masterly "Traité de Mécanique Rationnelle" (1893-1896) maintains its position as a standard text, side by side with the "Traité d'Analyse" of Picard, and the "Méthodes Nouvelles de la Mécanique Céleste" of Poincaré.

Many of our own text-books on pure and applied mathematics still use Appell's lucid demonstrations of difficult problems, such as, for example, the finding of the area of a closed surface, or of the area swept by a moving line, on which is based the theory of the planimeter. But Appell went further than that in his wonderful work: guided by a remarkable intuition, he developed in unusual directions some of the subtlest parts of mechanics, although no experiments of that time could be quoted in support of his views. So he prepared the way for Einstein, whose theories he confirmed later in a supplementary volume on mechanics which he wrote in collaboration with his former pupil, Prof. Thiry.

The fundamental ideas of Paul Appell on higher analysis, which are scattered in a large number of monographs and contributions to learned publications, can be found in his "Théorie des Fonctions Algébriques et de leurs Intégrales" (1895), written in collaboration with Prof. Goursat, and in his "Principes de la Théorie des Fonctions Elliptiques" (1897), written in collaboration with Dr. Lacour. Functions of an analytic point, series and definite integrals, periodic functions and functions of several variables, differential equations and their invariants, equations with partial derivatives, and the theory of potentials, are among the abstruse questions which he attacked successfully; and one should not forget his brilliant memoir on higher analysis, with which he secured the second prize in the international mathematical competition organised in 1889 by the King of Sweden, when Poincaré carried the honours of the day.

It is, however, with his thesis on pure geometry that Appell began his mathematical career in 1876, when he generalised the notion of involution discovered by Chasles, and made some remarkable applications of it in the theory of cubics. He was then awarded the degree of Doctor of Science and became lecturer in mathematics at the University of Dijon. In 1881 Appell was appointed to the chair of applied mathematics at the École Normale Supérieure in Paris, and in 1885 he was awarded the *Prix Bordin* for his memoir on the solution of a special problem first suggested by Monge.

In 1892 Appell was elected to the Paris Academy of Sciences, and in 1903 he became Dean of the Faculty of Science, and, soon after, a member of the Higher Education Council, in which capacity he exercised a far-reaching influence over the whole field of university education in France. In 1920 he

was appointed Rector of the University of Paris, whence he retired some years after on account of ill-health. On several occasions Paul Appell received the highest distinctions from French and foreign universities; and in 1924 Oxford conferred on him the honorary degree of Doctor of Science.

As a teacher, Paul Appell knew how to win the affection of his students by his patience, his kindness, his readiness to discuss difficulties, and his extraordinary ability in finding illuminating explanations for the most complicated questions he had to deal with. Those who were privileged to know him more intimately were not long in discovering his high moral virtues and also the secret sorrow of his heart. For Paul Appell was born in Strasbourg in 1855: and as a result of the Treaty of Frankfurt, sixteen years later, he was prompted to abandon his "petite patrie" for the sake of his "grande patrie, la France", to the restoration of which he was determined to devote his strength and energy. He tells his poignant story in his charming book, "Souvenirs d'un Alsacien", which makes his biographers' task an easy and pleasant one, and shows in all their simplicity and greatness his patriotic feelings. But more qualified pens will one day describe what his country and science owe to Paul Appell. These few inadequate notes are only meant as a respectful homage to the memory of a great man who was revered and admired by all who knew him. THOMAS GREENWOOD.

PROF. J. H. TEACHER.

By the premature death on Nov. 21, at the age of sixty-one years, of Prof. John Hammond Teacher, the School of Medicine of Glasgow has lost a valuable member of its personnel. Educated at the Glasgow Academy and the University of Glasgow, he graduated in arts in 1888 and in medicine with 'High Commendation' in 1893. He took the higher degree ten years later and was awarded honours and a gold medal for his thesis.

It is probably true to say that of his teachers Dr. Joseph Coats was the most influential in determining Dr. Teacher's bent. From the first his interests centred in the problems of pathology. After serving as house surgeon and for a time as medical officer of the Rio Tinto Company in Spain, where he had the opportunity of observing the life-history of the malaria organism, he returned to undertake an important duty for his University. The celebrated Anatomical and Pathological Collection of William Hunter had long stood in need of reconditioning and rearranging. Dr. Teacher was appointed to do this, and after some years of work, produced a valuable two-volume catalogue of the collection, with descriptions and annotations which testify to the care and insight with which he had carried through the work. The volumes are prefaced by an interesting and scholarly introduction on William Hunter and his school in relation to the collection.

Dr. Teacher next spent some years as assistant to the professor of physiology, being chiefly engaged in the histological work. Here he was able to perfect his microscopic technique, which was of a high order. About this time he entered upon a study of the remarkable disease known as chorionepithelioma, and to further this he travelled abroad to make acquaintance with all the early human embryos then known. Presented as a thesis, this memoir received recognition from his University, and was acknowledged an important contribution to the subject. In 1904 he joined the staff of Prof. Muir, and in view of his special proficiency and interest in microscopic work he was nominated by him for the lectureship in pathological histology. In 1909 he was appointed pathologist to Glasgow Royal Infirmary, and this appointment was followed in 1911 by his election to the St. Mungo (Notman) chair of pathology instituted in 1910. As St. Mungo professor he was *ex-officio* pathologist to the Royal Infirmary, and his professorship was inaugurated by the opening of the excellent new Pathological Institute, for the planning and organisation of which he was largely responsible.

Teacher's work on chorionepithelioma gave him a special interest in the history of the chorion in early development, and this was greatly enhanced by his discovery in 1907 of a very young embryo, the youngest hitherto known, in a minute piece of decidua sent to him for examination. The specimen was described in a memoir published in 1908 in conjunction with the writer of this notice. In 1923 he discovered another young embryo at an autopsy, and published in the *Journal of Obstetrics and Gynæcology* of the British Empire (1924) a very able and beautifully illustrated memoir on the history of the trophoblast and on the implantation of the blastocyst in the human subject. The contributions he made in these two memoirs to the problems connected with the earliest phases of human development have left his name permanently and honourably inscribed in the literature of the subject.

Apart from the reputation he won in this field, Teacher acquired merit for the able manner in which he conducted his routine duties as pathologist to the Royal Infirmary. To the literature of pathology he from time to time contributed papers (too many to be enumerated in this short notice), which were invariably characterised by accurate observation and careful presentation. His special interest, determined by the studies already referred to, was in gynæcological pathology, and he had accumulated a large amount of material for a book on the subject. It is a great misfortune that he was not granted time to carry this work to completion. T. H. B.

CAPT. OTTO SVERDRUP.

OTTO SVERDRUP'S name, like those of his fellow-countrymen, Nansen and Amundsen, ranks high in the story of polar exploration. In a long course of arctic voyages, he had become the most experienced ice-master of his time, and his knowledge was sought by many expeditions.

Sverdrup, who died in Norway on Nov. 26, was

born on Oct. 31, 1855, on a farm in Helgeland, Norway. He went to sea at the age of seventeen and sailed for many years in American and Norwegian ships, besides having experience in fishing boats. For some years he had left the sea, when in 1888 he was chosen by Nansen for his memorable expedition across the ice-sheet of Greenland. The party reached the west coast after their crossing, and then Sverdrup and Nansen made a daring journey in a crazy and scarcely seaworthy boat to Godthaab to bring help to the other men.

In 1893 Sverdrup was chosen by Nansen to command the *Fram* in her drift across the Arctic Ocean. When Nansen left the ship in lat. 84° N. with Johansen as a companion in an attempt to reach the north pole, Sverdrup took over command of the expedition, and eventually extricated the ship from the pack-ice and brought her safely to Norway after a three years' drift. The highest latitude reached by the *Fram* was lat. 85° 57′ N., which is still the northern record of any vessel.

In 1898 Sverdrup returned to the arctic with the *Fram* in an attempt to explore the north of Greenland. Ice in Robeson Channel barred the way, and Sverdrup transferred his attention to Ellesmere Island and the unknown regions lying to the west. During the first year, from a base at Cape Sabine he explored much of Ellesmere Island, and in the two years following he charted much new land to the west and threw light on the nature of that part of the arctic. The islands he discovered are known collectively as the Sverdrup Islands. The *Fram* returned safely to Europe in 1902.

Sverdrup's next important arctic voyage was in 1914, when he was charged by the government of Russia with the task of searching for the lost Russian explorers, Brussilov, who had sailed in *Ste. Anna* in 1912, and Russanov, who sailed the same year for the Kara Sea. Sverdrup in the *Eclipse* passed through the Kara Sea, reached the Yenisei mouth, and eventually wintered in lat. 76° N., long. 92° E. In August 1915 the ship was liberated from the ice and resumed the search, which, however, proved fruitless. This expedition made several discoveries, but most of the detailed records were sent to Russia and have never been published. In 1920 Sverdrup again took an expedition to the Kara Sea, to bring help to a Russian ice-breaker imprisoned in the pack. He gave valuable advice in the rescue of the survivors of the *Italia* airship in 1928.

Sverdrup was a silent man and his great store of knowledge was not easy to reach. His chief book was "New Land" (London, 1904), and he wrote nothing on many of his expeditions. He was an honorary LL.D. of the University of St. Andrews.

R. N. R. B.

MR. JAMES EDGE-PARTINGTON.

WE regret to record the death of Mr. James Edge-Partington, which took place at Beaconsfield on Nov. 4, at the age of seventy-six years. Mr. Edge-Partington was an authority on the material culture of the Pacific, and at one time was the owner of a very extensive collection of objects from the South Seas, which included many rarities. This was dispersed during his lifetime, part going by purchase and gift to the British Museum and part to the Auckland Museum. A second collection of books and prints relating to Australasia went to an Australian museum. Mr. Edge-Partington's contributions to scientific literature, which were numerous, were mostly descriptive, but they were characterised by extreme accuracy, critical acumen, and a common sense which was allied with a sound appreciation of the bearing of the analytical study of material culture on the problems of ethnology. His most important contribution to anthropological literature, however, was an ethnographic album of the Pacific in which tools, implements, personal ornaments, and other objects in European collections, especially his own and that of the British Museum, were reproduced by lithography from his own drawings. It was issued in three series, which appeared in 1890, 1895, and 1898 respectively. It is now extremely rare, very few copies remaining in private hands. Mr. Edge-Partington's interests were not confined to the Pacific; he was also a keen student and collector of objects illustrating the culture of the European peasantry, and had devoted much attention to the peasant industries of the Chiltern area in which he lived. For many years he was a valued voluntary worker in the ethnographical department of the British Museum, and a very active member of the council of the Royal Anthropological Institute.

PROF. WALTER HERZ.

DR. WALTER HERZ, professor of physical chemistry in the University of Breslau, died on Sept. 7, aged fifty-five years. From the *Chemiker-Zeitung* we learn the following particulars of his life. Herz was a native of Breslau and at the University of that city he studied under Ladenburg, who quickly recognised his ability both as an original worker and as a teacher. Under Ladenburg's direction, it was only natural that Herz should direct his attention first to organic chemistry, but after graduation his interests in other branches of the subject were awakened by F. W. Küster and R. Abegg. Under their influence he began to devote himself to investigations in physical chemistry, particularly to problems of solubility, chemical equilibria, partition coefficients, viscosity, and critical states. In 1903 Ladenburg appointed him first assistant in the Chemical Institute at the University of Breslau. In 1909 he was transferred to the Pharmaceutical Institute, but in 1919 he returned to the University as director of the department of physical chemistry in the Chemical Institute. Herz was the author of numerous volumes, the best known of which is his "Leitfaden der theoretischen Chemie". In conjunction with Abegg he compiled a "Chemisches Praktikum" and with Gadamer a work on chemical toxicology. He succeeded Ahrens in editing the *Sammlung chemischer und chemisch-technischer Vorträge.*

News and Views.

AT the anniversary meeting of the Royal Society, Sir Ernest Rutherford, the retiring president, announced that by an alteration of the existing statute regulating the election of fifteen fellows annually, and enacted in 1847, the number to be recommended for election in future would be seventeen. This new version of a particular statute takes us in retrospect to a very early period, namely, 1682, when it was decided that "Every person that would propose a candidate shall first give in his name to some of the Councell, that so in the next Councell it may be discoursed *vivâ voce* whether the person is known to be so qualified as in probability to be usefull to the Society. And if the Councell return no other Answer but that they desire further time to be acquainted with the gentleman proposed, the Proposer is to take that for an Answer". Repeal this reading occurred in 1728, the substance of alteration being that persons for election should first be proposed at a meeting of the Society, approved by the council, and recommended by three members, at least one of them a member of council. Soon after (1730) there was another change, mention of council being omitted, the requirement being that every person to be elected should be proposed and recommended at a meeting of the Society by three or more members, and qualifications were necessary to be set forth. The several elections of individuals were by ballot, not immediate, but at intervals.

IN 1830, no fewer than forty-two fellows, on a home list, were elected to the Royal Society between January and December (within these months, by the the way, Charles Darwin and J. J. Sylvester were included). Only four foreign members were elected. In 1841 the astonishing total of forty-four individuals was registered for the fellowship, whilst not a single foreign member appears in the list. In 1847 the number elected dropped to twenty-three, a result indicative, one may surmise, of impending changes in the mode of entry. In 1848 a drastic alteration in the system of the annual election came into operation, due to the regulations adopted the previous year. Fifteen candidates were duly selected; actually there were fourteen persons only who took up fellowship in that year. The meeting was notable as being the occasion of the valedictory address of the Marquess of Northampton, who had served ten years as president. It was already known that the latter held strong objections to the innovation, and he did not fail to express them in the course of his address. We have referred above to the fact of the election of only fourteen individuals. The president stated that—"It is rather a singular circumstance, that, since our selection was made, one of the gentlemen whom we had chosen, Mr. Syme, should have withdrawn his name. . . . The possibility of occurrence of such a case had not arisen in the minds of the former council when the new rules were framed, but it may perhaps be considered next year whether it ought to be provided against, or whether it is likely to occur so seldom as not to require any special provision." It is of interest to add that this "Mr. Syme" was James Syme, the eminent Scottish surgeon, to whom Joseph Lister had early acted as house-surgeon at Edinburgh, and whose daughter Lister afterwards married.

THE considerations which to-day bear upon the present slight increase in numbers admitted annually to the Royal Society may be briefly given; they are, however, recognised generally. The advance of science during the past half-century has provided new aspects and new fields of knowledge. In course of time it has led to an almost exclusive nomination from the lists of candidates of those (in various departments) who are comprised in the broad category of research workers attached to home and overseas universities; coupled, in lesser measure, with others who have entered industrial technical organisations where the exercise of expert training is required. The issues arising from the recurrent claims underlying specialisation have long occasioned serious thought. It has been stated that the council was able at one time to bring in annually a proportion at least of distinguished men outside the academic or professional sphere, whereby, it was claimed, a useful discriminating leaven and freedom from standardisation was maintained. Although the new enactment changes the existing situation in the annual election of candidates for the fellowship, it does not appear to involve abandonment or modification of the statutory provision of 1902, which, while it repealed an old rule for the election (at any time) of privy councillors, gave the council power to recommend to the Society for election, in alternate years, two persons who either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society.

BY 255 votes against 225, the House of Commons has confirmed the Government's decision to allow the Dyestuffs (Import Regulation) Act to lapse in January next. Sir P. Cunliffe-Lister opened the debate on Dec. 4 by moving an amendment to provide for its extension for five years; the matter, he said, raises grave national issues, and is not merely a question of free trade. The industry is in origin British, and it has already once been lost to German foresight and wisdom; that loss was, at the outbreak of War, about the greatest handicap with which we had to contend. Sir H. Samuel, while admitting the possibility that foreign competitors might make the purchase of certain dyes dependent on the acceptance of dyes of cheaper quality, and that by selling at low prices they could stop valuable work in research and development now being pursued in Great Britain, nevertheless found no reason why the measure should be extended; his views were, he said, based mainly on the report of the Dyestuffs Industry Development Committee, to the effect that the building up of a substantial dye industry under the protection of the Act has temporarily laid a serious burden on the user of dyes. The President of the Board of Trade, Mr. Graham, said that the problem on which the

Government had to pronounce was the balance of advantage, and they were satisfied that the dyestuffs industry could continue in perfect strength and safety. The fact that the industry is able to offer virtual guarantees concerning price and quality is an indication that the central part of the case for protection has gone. He could not bring himself to believe that the industry will either collapse or operate under very great difficulties, because there has been a considerable measure of concentration of production. He was advised that there may be an agreement or understanding between British and German producers, and that that agreement may well be independent of whether the Act continues or lapses.

MR. GRAHAM, in the course of his speech on the Dyestuffs Act, referred to a memorandum on the subject submitted by professors of chemistry in the universities of Great Britain, in which the fear was expressed that if the industry is weakened by the lapse of the Act, they would lose a great deal of the advantages of training in research and of the effort to link science and industry together. He replied that it would be the duty of the Government to see that research is fully safeguarded; he suggested, for example, the formation of a research association under the auspices of the Department of Scientific and Industrial Research. Until more is known as to the proposed method of implementing Mr. Graham's promise, no useful comment can be made. Sir John Simon said that everyone would agree that the Act has produced a very efficient industry, that it has very materially promoted research, and that it has done something to develop British science; he advocated some continuance of the Act pending an effective inquiry. Mr. Henry Mond said that dye makers would be perfectly satisfied if this suggestion were adopted. There are altogether 10,000 known dyes, some 4000 being in current use, and about 2500 are made in Great Britain. Extension depends on the supply of trained scientific workers, and it would be impossible to provide the necessary school for the purpose until there is a well-established and a sound organic chemical industry. The future of industry is based upon the organic chemical industry. Mr. Wise expressed disappointment that the Government had not taken the opportunity to review the whole position in regard to dyestuffs, continuing to give to this vitally important trade a measure of protection in a non-fiscal sense which would enable it to develop what is a key-industry, and using the occasion to acquire for the benefit of the community a much greater control over the operations of a tremendously powerful corporation. Major Tryon regretted that, at a time when so many great problems in the dyeing industry alone are unsolved, the work should be broken up and part of the staff disbanded; it would set back a great experiment in the infinite field of undiscovered science. The debate was concluded by the Secretary for War, Mr. Shaw; no one, he said, was against any reasonable expenditure on research needed for guaranteeing the safety of the country, but those who want research should pay for it.

THE commemoration in London of the centenary of the death of Simon Bolivar, whose name is written so large across the geography of South America, and who died on Dec. 17, 1830, has been organised by a committee of the diplomatic representatives of Bolivia, Colombia, Peru, Ecuador, and Venezuela, together with the Spanish ambassador and others. The programme is to include a requiem Mass in Westminster Cathedral on Dec. 17, and the laying of wreaths at the Cenotaph in remembrance of the British soldiers who fought in Bolivar's army, and at the statue of Canning, who was the first to recognise the free States of South America. A commemorative tablet will also be unveiled in Apsley House, where, in 1810, Bolivar, representing the *Junta Suprema* of Caracas, met Marquess Wellesley, Secretary of State for Foreign Affairs. The following day a dinner is to be given by the Latin American Society of Great Britain to celebrate Bolivar's achievements and the old friendship between Great Britain and the republics he liberated. Bolivar, who was born at Caracas on July 24, 1783, came of a noble family of Venezuela, and after being educated at Madrid visited France and the United States. By 1811 he held the rank of colonel during the struggle for the independence of Venezuela, and thenceforth he was associated with the efforts which led to the formation of the republics of Colombia, Ecuador, Peru, and Bolivia, the last of which was named after him. After holding the dictatorship of Colombia, he resigned office on Jan. 20, 1830, and died the same year at Carthagena on his way into exile. His grave is in the cathedral of Caracas, the capital of Venezuela.

THE second triennial congress which is being called by the International Industrial Relations Association at Amsterdam in August 1931 should meet under favourable auspices. The Association was formed for the study and promotion of satisfactory human relations and conditions in industry, and thus has aims allied to those of the Industrial Welfare Society. The congress will consider the need for scientific adjustment of economic resources, production, and consumption, as essential to satisfactory human relations and conditions in industry. The present widespread unemployment position and lack of purchasing power, at a time when the world's production capacity and economic resources are greater than ever, give pertinence to an attempt to determine whether scientific methods can be used to achieve some balance between resources, production, and consumption. Recent discussions at the British Association meetings on the rationalisation of industry have stressed the human aspects of rationalisation. In the scientific study of the management aspects of rationalisation which is being carried out by the International Management Institute, the human factor and industrial psychology receive due attention, and the subjects chosen for research have included the selection and training of workers, accident prevention, methods of remuneration, welfare devices, etc. The Industrial Health Research Board has also strongly advocated the need for closer co-operation between psychologists and industry; whilst the Committee on

ndustry and Trade in its final report made recommendations for the scientific and practical investigation of the whole range of problems falling under the head of industrial fatigue, in the widest sense.

THE co-operation of scientific workers in this forthcoming congress is definitely invited, and the congress rds such workers an opportunity not merely of collaborating in the development of a technique of satisfactory human relations, including right working conditions, in industry, but also of assisting the formulation of economic policy, along the lines of knowledge place of caprice or prejudice. The participation of scientific workers in such a congress with representatives of employers and of labour should at any rate assist in relating science to practice and practice to science. The important problem of securing national administration in economic and industrial matters long rational and scientific lines appears, however, be rather outside the scope of the congress. Even the World Economic Conference of 1927 has thus far proved abortive so far as any real influence on Government policy is concerned. Once the management of industrial relations has been established on scientific lines, the international organisation and relationship industry may exert a more decisive influence on ational policy and administration, and scientific orkers cannot be indifferent to a congress which holds any prospect of promoting the leadership of ience.

A NOTEWORTHY recent lecture by Prof. R. Willstatter gives a searching analysis of the relations between fundamental scientific research and industry as seen in Germany at the present time. After stressing the debt of modern chemical industry to the scientific work of the universities, Prof. Willstätter analyses the activities of the industrial research laboratories, and pays tribute to the scientific merit of much of the development work carried out by such laboratories in fields which originally were opened up by purely scientific discoveries. The systematic investigation of a defined field—such, for example, as that of hypnotics, following on the discovery of veronal—to determine the substances possessing the most valuable combination of properties, even when carried out along lines of analogy, involves a high standard of scientific knowledge and frequently even more originality and inventive ability than the original and possibly fortuitous discovery. Such developments are as much among the greatest achievements of chemical industry as the elaboration of methods of large scale production for the new substances, and the success of such work depends more than anything else on the director of research.

EVEN in the development of large scale production the improvement of technique, industry has frequently been indebted to academic research, and Prof. Willstätter views with alarm the gradual estrangement between the large industrial firms and the universities which has developed with the growth of industrial organisations and the expansion of their research departments. There is not now the same personal contact between the universities and the leaders of industry, and in some quarters there is a definite tendency to disparage or resent suggestions coming from the universities. This tendency has already had an adverse effect on the financial position of research at the universities, and Prof. Willstatter urges that a more generous policy on the part of the industrial combines and a close contact between industrial leaders and the universities is required to stimulate the fundamental scientific research from which industry itself benefits so largely.

IN an inaugural lecture delivered at the London School of Economics on Dec. 2, Prof. Morris Ginsberg, who has succeeded the late Prof. L. T. Hobhouse in the Martin White chair of sociology, reviewed the present position of instinct in the social sciences. He defended the conception of the instincts as inborn impulses serving the root interests or basic needs of the organism, of which they must be regarded as limitations or specifications. The attempt to reduce instincts to compound reflexes fails, first, since the component parts of instinctive behaviour admit of varied combinations in a series which as a whole has unity and continuity, and secondly, since no adequate account can be given of mental development on the basis of the reflexes alone and their conditioning. The function of intelligence in relation to instinct is (1) to clarify and render explicit the ends of the inborn impulses; (2) to detect relevant relations between the actual situation and the ends; (3) to systematise the ends of the impulses into comprehensive purposes. The objection to instincts as occult forces is based on a false view of causality, which properly interpreted does not imply any notion of mysterious efficacy. That no satisfactory classification of human instincts has yet been produced is true, but irrelevant as an argument against them. None of the critics has in the end succeeded in dispensing with the instincts. Proceeding to a survey of the use made of instinct in social psychology, Prof. Ginsberg showed that: (1) There has been too much readiness to refer highly complex phenomena to single instincts. (2) The instincts have been incorrectly conceived as separate 'forces', thus ignoring the conational continuity of the self. (3) Stress on impulse has led to a disparagement of reason; in truth, impulse and reason are inseparably intertwined. (4) The accounts which have been given of the psychology of morality, of the basis of social life, and of sublimation appear to require restatement in terms of a more adequate definition of the relation between the root interests and the specific impulses which serve them.

RECENT discussion of the antiquity of man in East Africa has served to direct attention once more to the importance of the 'Oldoway skeleton' found by Dr. Hans Reck in the northern part of Tanganyika Territory in 1914. The evidence, geological, palæontological, and anthropological, afforded by this discovery must now be viewed in the light of Mr. Leakey's work in Kenya. The data for such further consideration are furnished by a valuable study of the skeleton and the attendant conditions of its discovery communicated to the Royal Anthropological Institute by

Dr. Reck and presented at a meeting held on Nov. 25. The Oldoway geological series consists of seven horizons, of which the fifth is a fossiliferous bed in which were remains of a variety of *E. Antiquus*, previously known only from Europe and the Nerbudda deposits, and human remains. Above this was a red-earthy deposit, root-infested and therefore undisturbed. The skeleton itself was found only a little above the horizon of *E. Antiquus*. The bones were not highly mineralised. Dr. Reck is now inclined to correlate Oldoway man with Elmenteita man found by Mr. Leakey in Kenya; but he differs from Mr. Leakey on the point of chronology, on the ground that only one pluvial period is represented at Oldoway. He also holds that it is not yet possible to correlate the fauna with that of Kenya. Mr. Leakey himself, on the other hand, detects a non-conformity between the Oldoway sixth and fifth beds suggestive of a temporary land surface. He is inclined to equate the Oldoway bone-bed with the upper part of his 'Gamblian'. It is evident that more field-work is necessary before any definite conclusion can be reached; but if Dr. Reck should be able to pay his projected return visit to Oldoway in Mr. Leakey's company important results may be expected to follow.

ON Dec. 5 the extension of the new spirit building of the British Museum (Natural History), which has been erected out of funds provided by the Empire Marketing Board for the use of the Department of Entomology, was formally opened before a large gathering of entomologists and others interested in the work of the Museum. Nearly four years ago the Board realised that the task of combating insect pests, the depredations of which so grievously hamper commerce either by directly attacking the raw material or the commodities resulting from it, or by injuring the health of the workers, was seriously impeded by the congested condition of the Department of Entomology, which rendered it impossible for the insect collection to be properly arranged and to be readily available for study. Accordingly the Board, in response to the request made by the Trustees of the British Museum, decided to devote an appreciable sum for erecting a suitable building, and in the end about £26,000 was expended. On consultation with the architects of the Office of Works it was decided to be preferable to add a permanent building rather than one which might have to be pulled down as the Museum expanded. For that reason about one-half of the west wing of the new building, which had been provided eight years ago for the collections kept in spirit, was added. It has been adapted to the use of the Department of Entomology: large windows have been pierced in what will eventually be the blank walls of the storerooms, and the mezzanine floors of those storerooms and one wall of the future corridor have been omitted.

THE proceedings were opened by the Director of the Museum, Dr. C. Tate Regan, who directed attention to the importance of insects in human affairs. He said that the collection of insects in the Museum numbers some six million specimens and has outgrown its accommodation; the Empire Marketing Board took no narrow view of its duties and realised the intimate relation of the work of the Department of Entomology to health, agriculture, and commerce. Mr. Ormsby-Gore, M.P., who was chairman of the committee when the Board made the grant, emphasised the necessity for adequate scientific research in the development of the British Empire. The Archbishop of Canterbury, as chairman of the Trustees of the British Museum, expressed their thanks to the Empire Marketing Board and the Office of Works for their help, the value of which could not be exaggerated. The association between the Museum and the Government in the development of the Empire and its resources was appreciated. He hoped that the flow of fit persons would be quickened in the schools and universities to serve the Empire by research in every branch of science.

IT is easy to think of many ways in which the light sensitive properties of selenium can be utilised in the industrial world. When, however, an attempt is made to realise them in the research laboratory and later in the development department of a manufacturing works, many difficulties have to be overcome. We learn from the *Electrical Times* of Oct. 16 that the Radiovisor Parent, Ltd., of 26 Coventry Street, W.1, has surmounted many of these difficulties and perfected apparatus which is being employed commercially for various purposes. The most important application is to sound films. By means of a suitable electric bridge and an amplifier, it is now possible to give faithful reproduction of sound over the working range of frequencies. Another application is to the control of street lighting. There are some fifty street lamps in the Mortlake area, Surrey, which are controlled in this way, and they are also in use in several towns. Another application is a controller which regulates the lighting of clocks, telephone kiosks, signs, etc. Queensbury Church, a well-known landmark in Yorkshire, standing 1300 feet above sea-level, now has its four clock faces illuminated by electric lamps which are controlled automatically by a selenium unit. As selenium operates on both infra-red and ultra-violet light, it can be used as a burglar alarm. A special infra-red lamp is concealed and directs its beam across the object to be protected. Any interruption of the beam by the hand or body of an intruder instantly sets in action a warning device, either a red lamp or an alarm bell. Devices are made for indicating the presence of smoke in ships' holds. They are also officially recognised for the timing of racing motor cars and for dog racing. We understand that many other uses of the radiovisor bridge are being developed.

A LECTURE with novel demonstrations was given by Mr. Grace to the New York Electrical Society last month. It proved so interesting that it was repeated on three nights and very many people were unable to obtain admission. The first experiment was the 'projection' of speech directly into the human brain. This was done by transforming speech into a high

frequency current. The lecturer took hold of one electrode, his assistant held the other, and they placed their free hands against the ears of one of the members of the audience. The latter immediately heard music or speech, although no sound could be heard by any other person present. The explanation given was that the ear drums and surrounding tissues acted like the plates of a condenser receiver, the resulting vibrations of the ear drum due to electrostatic forces producing the sensation of intelligible sounds. Another experiment was the 'inversion' of speech. Ordinary speech was inverted so that the high notes became the low notes and vice versa. This inverted speech is quite unintelligible, but was reinverted into intelligible speech by suitable apparatus. In inverted speech, telephone sounded like 'play-o-fine' and company like 'crink-a-nope'. This method is already in use in transatlantic radio telephony to prevent unauthorised listeners from understanding the messages. Colonel Marshall, an engineer who had the misfortune to lose his larynx and had been provided with an artificial one, gave a short address to the audience from his home in California over the transcontinental telephone, on his method of controlling the floods in the valley of the Mississippi. A very successful demonstration was given of an ordinary carbon arc as a loud speaker. The method was originally discovered by Graham Bell, but hitherto the sound has been too faint. By using amplifiers, Mr. Grace made the talking arc almost as loud as the best modern loud speakers.

ON Dec. 4 a public lecture on "The Evidence of Astronomy and Technical Chronology for the Date of the Crucifixion" was delivered at Oxford by Dr. J. K. Fotheringham, reader in ancient astronomy and chronology in the University. Definite historical data, he said, limited the possible years to the period A.D. 27–34. Of these, the Jewish astronomical reckoning excluded all but the years 29 and 33. The year A.D. 29 was advocated by the late Prof. C. H. Turner, but Dr. Fotheringham gave reasons for dissenting from this view and also from that of the late Sir William Ramsay. He himself inclined to the date of April 3, A.D. 33, as offering fewer difficulties than any other. A point in his argument was the fact that the Jews reckoned the new moon from its first visibility; not from its astronomical position.

A NEW society has been founded in Paris for the scientific study of Africa. The president of the Society, which is to be known as the Société des Africanistes, is to be General Gouraud, and M. P. Lester will act as general secretary. Monthly meetings of the Society are to be held for the reading of papers, and a journal will be issued which, in addition to original memoirs, will contain reports of the proceedings at the meetings, notes and news on things African, and a bibliography of current literature on African ethnology. The Society will consist of patrons subscribing 2000 francs, life members subscribing 1000 francs, and ordinary members who pay an annual subscription of 50 francs, or if residing abroad 60 francs, with an entrance fee of 15 francs. Requests for further information and subscriptions should be addressed to M. P. Lester, General Secretary, 61 rue de Buffon, Paris.

MR. P. H. GRIMSHAW has been appointed Keeper of the Natural History Department in the Royal Scottish Museum in succession to Dr. J. Ritchie, who has recently been appointed to be Regius professor of natural history in the University of Aberdeen.

PROF. WILHELM SCHMIDT took over the chair of geophysics in the University of Vienna and the directorship of the Zentralanstalt für Meteorologie und Geodynamik, Vienna, on Nov. 25. He succeeds Prof. F. M. Exner, who died on Feb. 7 last.

THE following appointments have been recently made by the Secretary of State for the Colonies to the Colonial Agricultural and Forest Services: Mr. A. J. Findlay, assistant director of agriculture, Nigeria, to be deputy director of agriculture, Nigeria; Mr. V. F. Olivier and Mr. A. F. W. Sheffield, to be superintendents of agriculture, Nigeria; Mr. P. A. Allison, Mr. A. F. Ross, and Mr. B. E. A. P. Urquhart, to be assistant conservators of forests, Nigeria.

THE Institution of Automobile Engineers has for some years past been giving advice to parents as to how their sons can enter the automobile industry. This practice has been elaborated, and information can now be obtained of the possibilities of apprenticeship in works in any particular neighbourhood. No charge is made by the Institution, the staff of which can be consulted by appointment, by writing to the Institution, Watergate House, Adelphi, London, W.C.2.

THE War Office announces that there are vacancies for commissions in the Supplementary Reserve of Officers as ordnance mechanical engineers in the Royal Army Ordnance Corps. In addition to qualifications as to character, medical fitness, nationality, etc., candidates must be less than thirty years of age for appointment as subalterns and less than thirty-five years of age for appointment as captains, and must also be fully qualified mechanical engineers. Preference will be given to bachelors of science (Engr.), Whitworth scholars, graduates, and associates of the Institutions of Civil, Mechanical, or Electrical Engineers. Candidates will not be required to undergo training in peace-time, but will be liable to be called out on service when the Army Reserve or any part of it is called out by Proclamation. In return for their obligation, officers will be granted an annual gratuity of £25, payable in arrear. Particulars can be obtained from the Under-Secretary of State for War (A.G.9), the War Office, London, S.W.1.

"EARLY Photomicrographers" is the title of an article by C. H. Oakden in Watson's *Microscope Record* for September (No. 21). The honour of being the first photomicrographer is ascribed to the Rev. Joseph Bancroft Reade (1801–1870), who in 1837 obtained prints of the image thrown by a 'solar' microscope upon paper treated with silver nitrate and infusion of galls, fixing the print with hypo made by himself.

IN the autumn issue of *Sunlight* (Vol. 2, No. 3), the journal of the Sunlight League, a table is given of the

average daily readings for August of the intensity of ultra-violet radiations at various localities in the British Isles. The figures illustrate the high intensity which these radiations sometimes attain in England, figures of about 8·7 being obtained at Cleethorpes and Lowestoft, and of 7·75 at St. Ives and Ventnor. They also illustrate how much the intensity of the radiations must depend on climatic conditions prevailing, for while the figure for Clacton is about 7·0, at Southend-on-Sea it was only 1·0 – the lowest record of all stations. Among other articles, Dr. Kathleen Vaughan writes on the value of sunlight and the open-air life for healthy motherhood.

A SHORT list of nearly 300 books on British and foreign birds has been received from Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1. It includes a few scarce items.

MESSRS. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, have just circulated a list (New Series, No. 23) of many second-hand works, classified under the headings of periodicals and publications of learned societies, miscellanea, zoology, botany, medicine, sport, and addenda. It is obtainable upon application.

WE have received from Messrs. A. Gallenkamp and Co., Ltd., a catalogue of apparatus for testing petroleum and its allied products. The list, which covers 52 pages and is well illustrated, covers nearly all the standard apparatus required for testing such materials, but the Tate specific gravity bottle seems to have been overlooked. The prices are all given.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: – Two inspectors of aircraft under the Union of South Africa – The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand (Dec. 16). An assistant chemist at the sewage disposal works of the County Borough of Reading – The Town Clerk, Town Hall, Reading (Dec. 18). A head of the chemistry department of the Plymouth and Devonport Technical College – The Secretary for Education, Education Offices, Plymouth (Dec. 20). An inspector of alkali, etc., works, under the Ministry of Health – The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Dec. 20). A junior lecturer in the department of pathology of the University of Liverpool – The Registrar, The University, Liverpool (Dec. 24). A whole-time abstractor and translator at Sheffield, under the Safety in Mines Research Board – The Under Secretary for Mines, Establishment Branch, Dean Stanley Street, S.W.1 (Dec. 31). A professor of biochemistry at the Indian Institute of Science, Bangalore – Prof. F. G. Donnan, University College, Gower Street, W.C.1.

Our Astronomical Column.

Magnetic Disturbance, Dec. 3-4, 1930. – A considerable magnetic disturbance, falling into the category of a small storm, occurred on Dec. 3–4. The storm began with a characteristic 'sudden commencement' on Dec. 3 at $1\frac{1}{4}^h$, but apart from this the oscillations of the needles were not appreciable until about thirteen hours later, the most disturbed part of the traces being between 15^h and 22^h on Dec. 3. The range in Declination at Greenwich was 51′. At the time of the storm there was only a smallish sunspot, of area 130 millionths of the sun's hemisphere, a little way past the central meridian. Spectroscopic observations, which greatly increase the range of detection and scrutiny of solar eruptions, were impossible owing to fog or overcast skies. The recent magnetic storm appears to be the largest since that of Mar. 11–13, 1929, though during 1930 a number of disturbances of somewhat lesser intensity have occurred.

Stellar Parallaxes. – *Scientia* for October contains an interesting paper by Prof. S. A. Mitchell, describing the remarkable advance that has been made in recent years in determining the distances of the stars. It is less than a century since Bessel found the distance of 61 Cygni; it was not until the present century that the work was placed on a reliable basis, and the probable error of a parallax reduced to about one-hundredth of a second. Prof. Mitchell states that about three thousand accurate parallaxes have now been found; his own observatory (the Leander McCormick) is the leader with a thousand parallaxes; each of these rests on some fifteen plates, taken at about five seasons six months apart.

Reference is made to Prof. Schlesinger's measures with the Yerkes refractor twenty years ago; since it was not a photographic telescope, yellow screens and isochromatic plates were necessary. The use of colour screens has the advantage of reducing the error arising from the different colours of the stars, which cause difference in refraction; this difference is also reduced by taking all parallax plates near the meridian, and using only the parallax in right ascension. The systematic errors of the results of the leading American observatories were shown by Stromberg and van Maanen to be of the order of 0·003″, which is the angle subtended by one inch a thousand miles away. Other methods have been devised for estimating the distances of objects too remote to show any parallax: spectroscopic parallaxes, the relation between period and absolute magnitude for Cepheid variables, Eddington's relation between mass and absolute magnitude, and the strength of the lines in the spectrum that are due to interstellar calcium; but all of these methods need a number of reliable parallaxes in order to calibrate the curves. Thus the spiral nebulæ are distant millions of light-years, but this estimate is ultimately based on the parallaxes of stars that are only distant about a hundred light years.

Comets. – *Beob. Zirk.*, No. 42, contains observations of comets 1925 II. (Schwassmann-Wachmann) and 1927 IV. (Stearns) made during September and October with the large reflector at Bergedorf, by Dr. W. Baade. Their magnitudes were 17 and 17·5 respectively. These were taken at an interval of $5\frac{1}{4}$ years after perihelion for the first comet, and $3\frac{1}{2}$ years for the second. It will be remembered that the orbit of 1925 II. lies entirely between those of Jupiter and Saturn, its period being about fifteen years. There appears to be a fair prospect of its being observable round the whole of its orbit, which would be a new cometary record. 1927 IV. is affording a record of another kind. It is now outside the orbit of Saturn, and has probably been observed at a greater distance from the sun than any previous comet. Halley's comet was lost soon after crossing the orbit of Jupiter.

Research Items.

Roman Britain.—An account by Dr. R. E. Mortimer Wheeler of the first season's excavations at St. Albans, which appears in *Discovery* for December, admirably summarises the chief points of interest. It was thought that Verulamium, which at one time was the nearest approach to a metropolitan city and the only town in Britain dignified with the title of *municipium*, might well supply evidence of exceptional importance in its bearing upon Romano-British culture and organisation. This has been confirmed already in a striking manner. The 'London Gate', for its size and what must have been imposing appearance, is compared by Dr. Wheeler to the great continental gateways or triumphal arches such as have been found at Arles and Autun. The defences of the city are also impressive, consisting of fosse, wall, and reinforcing bank totalling a width of some 165 ft., and even in one part running to 265 feet. Light is thrown upon economic conditions in the city and its possible relations with Germany by the excavation of a dwelling-house and another building, probably a shop. The house was rebuilt at least thrice during the Roman occupation, and its successive phases show the rise to prosperity and the subsequent decline of the town. Exploration outside the city wall has revealed a cemetery and a prehistoric earthwork. The purpose of the latter is not yet clear, but one of the alternatives suggested is that it may be the site of the settlement of Cassivelaunus, the most important centre of southern Britain in the first century A.D. These latter discoveries have added thirty acres to the area to be investigated, the site within the Roman walls being 200 acres.

The Wishram.—Although the Wishram were one of the tribes earliest met by European explorers of the Columbia River, and their trading establishment was of great importance in the development of the north-west of America, their culture is very little known. Only a few of the Wishram now survive, some on their original site on the Columbia River opposite the Dalles, others on the Yakima reservation in Washington. Information obtained by Dr. E. Sapir in 1905 and Mr. Leslie Spier in 1924 and 1925 from the survivors is embodied in "Wishram Ethnography", Vol. 3, No. 3, of the University of Washington Publications in Anthropology. The Wishram were the easternmost Chinookan tribe on the Columbia River, and their language an Upper Chinook dialect. Dislocation of the tribe began at the end of the eighteenth century as the result of tribal movement so early as, or even earlier than, 1750, which brought the Sahaptin into Washington State. The Wishram depended primarily on fishing for their livelihood, and their culture was entirely a river culture. Fishing was supplemented by seed and root gathering. Hunting the deer and other game took an entirely subsidiary place. They lived in villages on the northern side of the Columbia River, roughly from White Salmon River to Ten-Mile Rapids above the Dalles. Their houses were semi-subterranean lodges built over a circular pit, or mat lodges. The earth-lodge accommodated from one to half a dozen families. As elsewhere on the north-west coast of America, class feeling was strongly marked. There were three classes, besides slaves. The classes were based on wealth; but chiefs were not always among the wealthiest class. There were also war chiefs. The chiefs had considerable power and were implicitly obeyed. They adjudicated in murder cases, assessing fines or other punishment. In cases of murder by witchcraft through a shaman, the shaman was not held culpable, but only the man who employed him.

Tunnies.—Because of their economic importance as food fishes, allied with their peculiar habits, the tunnies have formed the subject of a vast literature, spread over a period of fully two thousand years. Active researches into their life-histories and abundance still continue, and recent workers have felt the need of a reasonably complete bibliography—a need which is now fully met by "A Bibliography of the Tunas", by Genevieve Corwin (*Fish Bulletin* No. 22, Contribution No. 87, from the California State Fisheries Laboratory, Terminal Island, California; 1930). The compiler has endeavoured to find and to catalogue all works written previous to the close of 1929 dealing in any way with the five large tunnies—*Thunnus thynnus*, *Neothunnus macropterus*, *Germo alalunga*, *Euthynnus pelamis*, and *Sarda chiliensis*. All the papers listed, with only a few exceptions, have actually been consulted, and after the title of each a brief note is appended indicating its main theme and general scope. These notes add greatly to the value of the bibliography. A list is given of all the abbreviations used for periodicals cited, and a classified index of subjects facilitates reference to any point upon which information may be desired regarding these fishes.

***Chirocentrus* and its Eggs.**—In *Treubia*, Vol. 12, 1, 1930, Dr. H. C. Delsman describes two fish eggs which, although easily distinguishable, give rise to closely similar larvæ ("Fish Eggs and Larvæ from the Java Sea"). Both belong to the genus *Chirocentrus*, the 'Parang-Para' of the natives. One of the larvæ is slightly longer than the other and has more myotomes. This interesting find is in accordance with the fact that Bleeker in 1852 distinguished two species, *C. dorab* and *C. hypsalosoma*, whilst other authorities found only one. Dr. J. F. Hardenberg, in another paper in the same number of this journal ("Some remarks on the Genus Chirocentrus (Cuv.)"), fully confirms the separation of the two fishes. Both are long and slender pelagic species, attaining the length of 90 cm. or more. *C. dorab* is the more slender of the two, with more vertebræ than *C. hypsalosoma*, larger scales, and other differences in the proportions of the various parts, the distribution being slightly different, although both species, old and young, and also the eggs, may be found together.

Antarctic Free-living Nematodes.—Dr. N. A. Cobb describes a large number of these worms, which are extremely abundant in the Antarctic marine waters, in a paper entitled "Marine Free-living Nemas" (Australasian Antarctic Expedition, 1911-14, under the leadership of Sir Douglas Mawson: Scientific Reports. Series C—Zoology and Botany. Vol. 6, Part 7, June 1930). They belong to twelve genera, collected from muddy sediment, three fathoms, Commonwealth Bay (Adélie Land), the larger forms from amongst the roots of brown algæ. A formula of measurements and signs is introduced in the systematic work, which conveys a large amount of information compressed into a very small space, and there is a key to the fifteen species involved. These Antarctic nematodes have several features in common. There is one new genus, *Hyptiolaimus*, created for the new species *cephalatus*, which may be related to *Oncholaimus*, and eight new species besides this. It is interesting to learn that one of these, *Monohystera naviculivora*, as its name implies, is a diatom feeder, especially eating *Navicula*. Sometimes the intestine is crowded with the frustules, many of which are as long as the width of the worm and half as wide as its head end; 150 diatoms have been seen in one individual.

The Walnut Tree in England.—Two papers in the *Journal* of the Royal Horticultural Society for September deal with this subject. Mr. H. Spence discusses the qualities of the timber and the cultivation of the walnut in France and California. He also comments upon the quality of the nuts obtained from the various isolated trees grown in Great Britain, so far as recent inquiries enable this to be gauged. Mr. A. W. Witt discusses the vegetative propagation of the tree under English conditions as ascertained by preliminary trial at East Malling. At present, grafting upon seedling stocks of *Juglans nigra*, or the common English walnut, seems to be most practicable, grafting under glass proving most successful. Stocks are also being raised vegetatively, the parent plant being planted in open, sandy ground, layered, and the buds covered with an inch of soil whilst still dormant. The young shoots thus etiolated afterwards root readily.

The Cultivation of *Pyrethrum*.—Of recent years knowledge has been gained as to the conditions necessary to observe if pyrethrum sprays are to be efficacious. Tutin has a paper upon its method of employment in the Annual Report of the Agricultural and Horticultural Research Station, Long Ashton, 1928, and there seems little doubt that this substance may prove a most valuable insecticide; at present it is one of many agents that are being tried out against the tsetse fly in Africa. An article upon its cultivation, in the *Bulletin of the Imperial Institute*, **28**, No. 3, 1930, is therefore very timely. Known for many centuries in Persia, the plant itself, and the powder ground from the flowers, were introduced into Europe early in the nineteenth century. In 1881, the Dalmatian species, *Chrysanthemum cinerariaefolium* Vis., was introduced into Japan, where its cultivation flourished apace, especially around Hokkaido, and 70 per cent of the world's yield is now claimed by Japan. This article, by the British Vice-Consul at Seoul, Japan, shows that the great development of this crop in Japan resulted from War conditions, when cultivation of the plant was almost suspended in Austria. A very good quality of flower is produced in Europe, and subsequent years may see a development of the European product again, especially if the insecticidal use of the product undergoes wide development.

Stratigraphical Position of the Coutchiching Series.—In the neighbourhood of Steep Rock Lake, Ontario, a series of schistose Pre-Cambrian sediments occurs, bordered on the north by Keewatin basic volcanics and on the south by intrusive granite. To the west these schists continue towards Rainy Lake, but to the east they gradually finger out and are lost in the granite. They have been alternatively correlated with the Coutchiching (below the Keewatin) and with the Seine (above the Keewatin). In the *Jour. Geol.*, p. 521, 1930, J. E. Hawley presents evidence to show that although the schists appear to dip beneath the Keewatin, the contact is one of nearly flat shear-faulting, in which case the stratigraphical evidence of relative age becomes ambiguous. From the larger structures it is thought probable that the disputed series is of post-Keewatin age. This does not, of course, imply that genuine Coutchiching schists may not exist in the Rainy Lake area.

Mineral Industry of Alaska.—The mineral industry of Alaska, if it has not been the mainstay of the country, has at least contributed largely to its economic development. Some thirty years of geological survey, fostered by the Federal Government of the United States, has produced results of inestimable value to the prospector, miner, and business executive, and abundant information relative to the origin, character, distribution, and extent of the various ore deposits is available. The total value of the mineral production in 1928 (*Bull.* 813-A, United States Geological Survey) was more than fourteen million dollars, furnished chiefly by gold and copper. There is also some silver, tin, lead, a little platinum, coal, and petroleum, while marble, gypsum, etc., are important. The gold is obtained from lode mines and placers in about equal quantities, the principal lodes occurring in the south-east. The Yukon Basin still figures as the prominent placer territory, though a considerable quantity of the metal comes from placers in the Seward Peninsula. Practically all the copper is derived from two mines in the Copper River region and from Latouche Island. The chief source of silver is the copper lodes, though it is also obtained from the gold lodes and placers. Lead is recovered as a by-product in the course of gold and silver mining. Platinum, together with palladium, osmium, and iridium, has been found sporadically in both lodes and placers. Tin has been mined from veins and mineralised rocks occurring in the Seward Peninsula, and the comparatively small tonnage finds its way to Singapore for reduction. The output of bituminous and anthracitic coals has increased, and in 1928 more than 126,000 tons were produced. Petroleum is mainly confined to the Katalla field. It is refined on the spot, and the products, gasoline and distillate, find a ready sale for the boats of the fishing fleets. This last industry has not apparently justified the optimism originally expressed or the vigorous search for fields in the past. Imports of oil from the United States supply most of the needs of the inhabitants.

Intensity of the Auroral Line.—It is possible, by the use of a special colour filter, to isolate effectively that part of the light from the night sky which extends for about 200 A. round the green oxygen auroral line λ5577 and so to follow variations in its intensity. Lord Rayleigh, in the November number of the *Proceedings of the Royal Society*, has given an account of an attempt to make these relative measurements absolute, which has been accomplished by determining the absolute values of the numbers in his arbitrary scale of intensities, by reproducing them with the illumination from a standard incandescent lamp. Actually the light from the sky which was transmitted by the filter used consisted only in part of the auroral line, this being superposed upon a continuous background, the relative intensity of which is known to vary considerably. Taking the fraction of the light transmitted by the filter and due to λ5577 to be 0·37, the brightness of this line in the sky was found to be approximately 3×10^{-5} candles per square metre. The energy required to maintain this is 6·4 ergs per second per square metre, and the number of atomic transitions required to supply this energy 2×10^{12} per second per square metre. These numbers are known to vary from time to time, and to be quite definitely rather approximate, but should be of much value in testing theories of the light emission from the upper atmosphere.

High Velocity Positive Ions.—Work is now in progress in several laboratories on the production and properties of particles of high speed, the aim of such experiments being to provide electrical sources to replace radio-active sources of α-particles and β-particles. A preliminary report on some work of this nature, which is being performed with positive ions in the Cavendish Laboratory, is given by J. D. Cockroft and E. T. S. Walton in the November number of the *Proceedings of the Royal Society*. The problem can be

divided into two parts, so far as the generation of the high-speed particles is concerned; first, the production of a stream of ions in a form suitable for acceleration, and secondly, the method of acceleration. The source of ions which has been used is a canal ray tube, the cathode of which is pierced with a narrow tube from which emerges a mixed beam of protons and molecular ions, and the acceleration of these has been brought about by a potential of 300 kilovolts produced by rectifying the output of a low-frequency step-up transformer. Many difficulties were, naturally, encountered in the course of the work on account of the high potentials involved. The electron tubes used to rectify the high potential had to be specially built, and were kept continually exhausted by a diffusion pump, the latter containing oil instead of mercury. The bulbs in which the ions were accelerated and the potential rectified were blown from a hard Jena 'molybdenum' glass, and, with their stems, were each approximately a metre in length, to minimise the chance of sparks passing externally through the air between the electrodes. It was found that the ion beam could be focused by suitable choice of the dimensions of the electrodes. Very little space is devoted in this paper to applications of the fast ions, but it is mentioned that a non-homogeneous radiation has been found to be produced when metals are bombarded by the stream of ions, the intensity of the radiation being approximately one ten-thousandth of that produced by a similar electron source at the same voltage.

Radiation Distribution of a Radio Antenna.—To the September number of the *Journal of the Institution of Electrical Engineers*, R. M. Wilmotte, of the National Physical Laboratory, contributes two papers on the radiation distribution which takes place from the antenna of a radio system. In the first paper, he obtains formulæ for this distribution from advanced theoretical considerations, and he shows how they can be applied in practice to the case of the beam antenna. He points out that even in complicated cases where we have an array of antennæ, it is possible to obtain solutions. In the second paper, he discusses experimental results on the radiation distribution in vertical planes from an antenna. The results were obtained by measuring in an aeroplane the strength of the received signals from an excited antenna on the ground. The position of the aeroplane was determined from the ground by means of a theodolite, and the signal strength was recorded on a cinematograph film. The results showed very definite maxima and minima, their positions being determined within a few degrees. But only rough values of the field strength could be obtained, as many experimental difficulties had to be overcome. In the case of low frequency, substantial agreement between theory and experiment was obtained. The radiation was also obtained for one of the beam stations of the Marconi Co. It was found that, owing to the sharpness of the beam, large discrepancies were sometimes observed. The average results obtained were, however, in good agreement with theory. It is concluded that the theory of radiation distribution is correct to a first approximation. The difficulties seem to be connected with the fact that in practice it is impossible to obtain a site which is theoretically perfect.

Hydrates of Hydrogen Fluoride.—In the October number of the *Journal of the American Chemical Society*, Cady and Hildebrand describe measurements of the freezing points of the system water + hydrogen fluoride, which indicate that, in addition to the solid hydrate $HF.H_2O$ previously known, the compounds $H_2O.2HF$ and $H_2O.4HF$ exist. The existence of two compounds with excess of hydrogen fluoride but none with excess of water indicates that hydrogen fluoride tends to assume a more complex polymerisation than water, and the formula $H_2O.4HF$ is in agreement with the existence of H_4F_4 as one polymer of HF. Berliner and Hann had suggested that this polymer exists, and had pointed out that hydrofluorides of amines have the general formula B.4HF. Other compounds such as KF.3HF and $MgF_2.2HF$ may be regarded as derivatives of H_4F_4, and if water behaves in a manner similar to the amines, one compound formed should be $H_2O.4HF$.

Filter-cloth from Nitrocellulose.—In an article in the *Chemiker-Zeitung* for Nov. 8, Dr. Hans Gradl of Munich directs attention to the suitability of nitrocellulose as a material for the manufacture of filter-cloth. The resistance of various textile materials to the corrosive action of acids and alkalis appears to depend upon the amount of nitrogen which they contain, and numerous attempts have been made to increase this resistance by increasing the nitrogen content of the fibre. Thus, cotton cloth has been nitrated after it has been woven, but the best results so far have been obtained by using cloth woven from an artificial silk consisting of nitrocellulose, containing 12 per cent. of nitrogen. This filtering material has given very satisfactory results during the last four years. It can be used to filter a 40 per cent solution of phosphoric acid at 90° C. without deterioration. It must be preserved damp, and the serious technical difficulties at first encountered in weaving it in this condition have been overcome. It can be cut into convenient shapes and sewn with nitrated thread.

New Inverted Metallurgical Microscope. The Beck Inverted Microscope No. 30 is constructed on the same principles as the Beck-Hadfield microscope. By fitting a collimating lens in front of the vertical illuminator, it has been found possible to replace the long optical bench of the original microscope by a short fixed base, which makes the apparatus much more compact and robust. Apart from the camera, which has a variable extension of 10 in., all the major components are fixed. Just sufficient movement is allowed in the position of the source of light and in the illuminator to ensure that critical illumination may be easily obtained under all conditions. The simplicity of the new design, and the omission of the *macro*-photography equipment, have enabled the makers to reduce the price of the complete outfit from about £350 to £220. The whole apparatus has been designed to stand hard wear, and once it is set up it should need little attention. The microscope stage is remarkably rigid, and the coarse adjustment, which moves the stage, can be clamped in any position. The fine adjustment carries the objective only, and acts smoothly. The changing device for the objectives is positive in action, and very satisfactory. The thin glass illuminator can be replaced easily by a prism, though the makers recommend the use of the former type. The apparatus was tested with specimens of fine pearlite, the laminations of which were so close together that they could just be resolved with the $\frac{1}{12}$ inch oil-immersion lens. When the specimen was examined visually, using the thin glass illuminator, the resolution was found to be excellent. The illumination was even, and the image was satisfactorily free from glare. The definition at about 1500 diameters was good and the field reasonably flat. When the prism was substituted for the glass slip, however, the image was, of course, brighter but the illumination decidely less even. The illuminant was a 'pointolite' lamp which has only about one-fifth the intensity of a carbon arc.

Aspects of Carbohydrate Metabolism.

III. SOME RELATIONSHIPS WITH PHOSPHORUS METABOLISM.

IT is now well known that esters of carbohydrate and phosphoric acid play an important part as intermediates in carbohydrate metabolism in both animals and plants. They were first obtained in the alcoholic fermentation of yeast; later they were found to play a part in the metabolism of muscle and other tissues. Phosphorus occurs in animal tissues in several other forms; for example, as ortho- and pyro-phosphate, as a constituent of nucleoproteins, and in combination with creatine in muscle. It is proposed in this review to discuss only certain aspects of the metabolism of phosphoric acid esters; the formation of hexose phosphate as a step in the production of lactic acid from starch by skeletal muscle has already been mentioned in a previous article (Nov. 8, p. 740). P. Eggleton has published a review on the rôle of phosphorus in muscular contraction, in which reference is made to the hexose phosphates (*Physiol. Reviews*, vol. 9, p. 432; 1929).

Resting muscles do not contain hexose diphosphoric acid; they can, however, glycolyse it and, in the presence of sodium fluoride and glycogen, synthesise it. The ester formed appears to be the same as that isolated by Harden and Young from yeast fermentations. W. T. J. Morgan has investigated its chemistry (*Biochem. Jour.*, vol. 21, p. 675; 1927; with R. Robison, *ibid.*, vol. 22, p. 1270; 1928). The first step was the formation of the methylhexoside-diphosphates, which were then separated into the α and β forms. The barium salts were hydrolysed with bone phosphatase (to which further reference will be made below), when the phosphoric acid was split off; further investigation, including estimations of the rotations before and after acid hydrolysis of the hexosides, and determinations of the methoxy group, indicated that the hexose present is fructose, probably γ-fructose. A tetramethyl hexose, having the same rotation as tetramethyl-γ-fructose, was also prepared; the constitution of the original acid is probably γ-fructose 1 : 6 diphosphoric acid.

J. Pryde and E. T. Waters have confirmed the presence of the diphosphate in muscle press juice after carrying out the fermentative re-synthesis; when this step was omitted, only a monophosphate was isolated, from the muscle of the rabbit, donkey, and goat, and this appears to be the ester of normal resting muscle (*Biochem. Jour.*, vol. 23, p. 573; 1929). The amount present in the muscles of the larger animals was less than in those of the rabbit, in which the yield was 0·13 per cent; it is possible that it is connected with the speed of contraction of the muscle. By oxidation of the hexose group with bromine and removal of the phosphoric acid by hydrolysis with weak sulphuric acid, a hexonic acid was obtained which was identified as gluconic acid. Ninety per cent of the hexose is an aldose, 10 per cent a ketose; from the formation of gluconic acid the former is presumably *d*-glucose.

The presence of phosphoric esters in different tissues suggests the presence of enzymes to synthesise and hydrolyse them; in fact, phosphatases are very generally distributed throughout the body, according to H. D. Kay (*Biochem. Jour.*, vol. 20, p. 791; 1926; vol. 22, pp. 855 and 1446; 1928). The enzymes can be extracted with chloroform water from the ground-up tissues, the extract being filtered through cotton-wool before use. They act upon hexose phosphates, glycerophosphates, and nucleotides; for quantitative estimation it is convenient to use sodium glycerophosphate in glycine-sodium hydroxide buffer at pH 8–9: the amount liberating 1 mgm. phosphorus in two hours at 38° may be called one unit. The enzyme is found in highest concentration in the mammal in the kidney and the mucous membrane of the small intestine: there is a close parallelism between its distribution and that of ereptase. Study of the reactions with the different substrates led to the conclusion that the same enzyme is responsible for the hydrolysis of each. In the case of the kidney, the enzyme is chiefly present in the cortex; there is more in the infant soon after birth than in the fœtus, and thereafter its concentration does not change much to adult life. It is capable of acting upon part of the phosphoric ester in the blood plasma. It has been suggested that its function is to hydrolyse this ester, which is then excreted as inorganic phosphate in the urine; but Kay, with R. T. Brain and P. G. Marshall (*ibid.*, vol. 22, p. 628; 1928), found that the excretion of phosphate was controlled by the level of the inorganic phosphate in the plasma, and not by that of the ester phosphorus. The low level of the latter in the plasma cannot be raised by administration of ester by mouth, though a temporary increase can be brought about by intravenous injection. On the other hand, the amount present in the kidney varies with its functional efficiency: thus it is markedly reduced in chronic nephritis in man and in acute uranium nephritis in rabbits (Brain and Kay: *ibid.*, vol. 21, p. 1104; 1927).

Both intestinal and kidney extracts show synthetic activity, provided high concentrations of the alcohol are used; sodium glycerophosphate was successfully isolated from the reaction mixture after allowing duodenal contents to act on sodium phosphate and glycerol for a week.

It may be mentioned that Kay has also found a pyrophosphatase in many mammalian tissues, with a distribution similar to that of the phosphatase described above; it hydrolyses pyrophosphate to orthophosphate. Its optimum pH is 7·2–7·8, in contrast to the range 8·8–9·3 of the orthophosphoric esterase.

The true phosphatase is of considerable interest; it can be conveniently extracted from young bones (rabbits) by soaking the split bone in chloroform water for some days, and filtering and evaporating the extract (M. Martland and R. Robison: *Biochem. Jour.*, vol. 23, p. 238; 1929). It can be purified by precipitation from water with alcohol and ether and extraction of the precipitate with 50 per cent alcohol; it cannot be dialysed or ultra-filtered, and is easily adsorbed. Its optimum pH is about 8·4; the initial rate of hydrolysis of glycerophosphate, however, increases up to pH 9·4, but at the same time inactivation of the enzyme is accelerated. It hydrolyses the phosphoric esters of the plasma. Small amounts of inorganic phosphate but not of glycerol retard the hydrolysis of glycerophosphate; in the presence of high concentrations of the alcohol it is capable of bringing about esterification of phosphate (Martland and Robison: *ibid.*, vol. 20, p. 847; 1926: vol. 21, p. 665; 1927).

H. B. Fell and Robison have investigated the phosphatase activity of embryonic avian femora, cultivated *in vitro* (*ibid.*, vol. 23, p. 767; 1929). They found that the tissue synthesised the enzyme during cultivation; the amount in the bone increased to a maximum and then declined, corresponding to the phases of histological differentiation followed by degeneration. The course of development was similar

to that occurring normally *in vivo*, but the degree of development attained was less. The enzyme is confined to bone and ossifying cartilage; it is absent from small-celled, non-hypertrophied cartilage. It presumably plays some part in calcification: it has been shown that it is capable of causing the deposition of calcium phosphate from calcium glycerophosphate in the complete absence of inorganic phosphate (for example, Robison, *ibid.*, vol. 20, p. 388; 1926).

T. H. Milroy examined the processes of fatigue and recovery in normal and diabetic muscle and found that fatigue was characterised by the entrance of water, the loss of some phosphate, depletion of the glycogen store, and increase in lactic acid, together with loss of the power of esterification of phosphate under the influence of sodium fluoride (*Quart. Jour. Exp. Physiol.*, vol. 17, p. 161; 1927). In recovery the reverse changes were observed; with muscle taken from a depancreatised cat, the recovery processes were much slower, especially the storage of glycogen and the ability to synthesise hexose phosphate.

D. Stiven has recently investigated in detail the part played by phosphoric esters in the formation of lactic acid from glycogen or starch, using a muscle extract: muscle from a cat perfused with Ringer's solution after killing instantaneously was extracted, after mincing, with cold sodium chloride and bicarbonate solution; the extract was obtained by pressing through muslin and concentrated by freezing out water; the pH was adjusted by adding phosphate and bicarbonate (*Biochem. Jour.*, vol. 22, pp. 867, 874, and 882; 1928: vol. 23, p. 583; 1929: vol. 24, pp. 169 and 172; 1930). Under anaerobic conditions, the extract produces lactic acid from glycogen, starch, or glucose, though at somewhat different rates. With glycogen as substrate, the changes in phosphoric esters were followed in detail and found to be of three types: in the first, there is no ester accumulation or change in phosphate until all the glycogen has been used up, when phosphate increases; in the second, no ester accumulates for the first 30–40 min. of incubation, but thereafter accumulation is rapid; in the third, ester accumulates at the commencement and is then broken down. The actual course depends in part on the concentration of glycogen and the extract used. In any event, there is no molar relationship between lactic acid production and phosphoric ester accumulation or breakdown.

Addition of hexose diphosphate under certain conditions inhibits lactic acid formation and increases the formation of phosphoric ester; at the same time the glycogen decreases more rapidly than when the addition is not made. Stiven has also found that a sterile cell-free muscle extract prepared from a cat or wild rabbit will convert glucose to lactic acid without the addition of any activator; the glycolysis occurred in the early stages of incubation and was certainly due to the muscle enzymes and not to any infection.

Although the rate and extent of lactic acid formation from glucose are usually greater than from glycogen, the ester accumulation is much greater in the case of the latter. Again, the rate of lactic acid production and ester accumulation is greater with glycogen than with soluble starch in the earlier stages of the reaction, although finally the lactic acid formation is the same with both. Irradiation of the muscle extract with ultra-violet rays from a quartz mercury vapour lamp for short periods increased the rate of lactic acid production from glycogen; at first ester accumulation increased, but later decreased, coincident with the maximum rate of formation of the acid; longer exposures destroyed the enzyme. These results differ in some respects from those obtained by previous observers, and further work will be necessary before the details of the chemical changes produced by muscle or muscle extracts upon carbohydrates are finally and completely elucidated.

The Psychology of Adolescence.

THE psychology of adolescence has not received from psychologists that attention which its popularity with novelists, poets, and painters would seem to merit. It is, therefore, a matter of interest that, at the Bristol meeting of the British Association, Section J (Psychology) devoted the whole of a morning's session to hearing and discussing four papers on this subject.

In his paper on "The Basis of Social Adjustment", Dr. R. G. Gordon maintained that the problems of adolescence were largely problems of adjustment to society, and that the success of such adjustment depended on the formation of a sentiment of a social self which should in large measure dominate the other sentiments in the personality. The organisation of this sentiment, he said, depended on certain emotional dispositions or instincts: suggestibility, passive sympathy, imitation, and the herd instinct—the last of these being of first importance. These, however, were not enough, for the mentally defective often exhibited them in no small degree and yet was almost totally ineducable: he showed no particular peculiarities in respect of the instinctive bases of social adjustment; he was, for example, no more suggestible than normal people. Nor was the tale completed by the sex instinct. "To describe social intercourse as a manifestation of sexuality", said Dr. Gordon, "is, to my mind, a mistake. What the sex instinct does is to give a tremendous impulse to extraversion: it directs the individual's interest away from himself." He made the interesting suggestion that differences in the strength of the herd instinct were largely responsible for differences between the introvert and the extravert. These emotional dispositions, he said, had to be controlled and organised, and the individual had to learn to discriminate between what met with social approval and what did not. This control, integration, and discrimination depended on the acquisition of knowledge, the organisation of beliefs, and the development of the power of making sound judgments. It was in these respects that the mentally defective was lacking. They were associated with the proper development of the cerebral cortex: so social adjustment had to be regarded as of gradual development and only coming to fruition with a full functional activity of the cortex.

Dr. Gordon made an interesting distinction between the control, integration, and discrimination implied in social adjustment and what is commonly called intelligence, and suggested that some intelligent people never developed the capacity for social adjustment, because they were lacking in the special cortical development necessary for the integration of their instincts and the formation of the social sentiments: they were aments in spite of their intelligence. Such people might compensate either by an intense integration of the ego-centric sentiment, as in the typical epileptic personality, or by failure to adjust to life, as in many psychasthenics and chronic hypochondriacs, who preferred illness to health, finding

that a convenient way of escape from social adaptation.

Prof. Olive Wheeler, in her paper on "Variations in the Emotional Development of Normal Adolescents", gave some account of the results of her own inquiries, in which she used the questionnaire method. The replies to her questions pointed to an increase of emotionality during the period of adolescence, which showed itself in three directions: first, an increased feeling of self, tending towards psychological independence and the finding of a vocation; second, a rise or intensification of sex emotions, tending towards the development of a hetero-sexual attitude and the finding of a mate; and third, the development of social, æsthetic, and religious emotions, tending towards the formulating of a point of view on society and on life in general. There were great variations in the time and rate of this emotional development, and equally great variations in the intensity of the new experiences; in some cases there appeared to be a great accession of energy along each of the three chief channels of experience and adjustment, an observation which supported Burt's hypothesis of a central emotional factor.

As regards emotional differences between the sexes, Prof. Wheeler thought that, apart from the earlier emotional maturity of the girl, the most striking difference between the sexes was to be found in a difference of emphasis on the active and passive groups of emotions: boys tended to be more aggressive; their misdemeanours were aggressive (pugnacity, acquisition), while those of girls were passive (lying, sex offences, and attempted suicides). This difference, it was suggested, might be partly responsible for the fact that highly intelligent girls and women found it more difficult to attain that eminence in professional, business, or cultural life justified by their intellectual ability: in boys there was a harmony between the egoistic and the sex emotions which resulted in activity, while in girls there was a perpetual liability to conflict between them, which tended to a passive resultant.

Concerning environmental influences, Dr. Wheeler expressed the opinion that emotional maturity was much more affected by training and circumstances, particularly by the home, than is any other phase of development. Many parents delayed the psychological weaning of their children, with serious consequences; they tended to keep their sons and daughters in emotional leading-strings and to allow them too little freedom of thought and action. The long preparation period necessary for entrance into the professions made difficult the harmonious development of some adolescents: biological maturity was attained before economic independence was reached. Hence the self-help movement, which largely arose through stress of economic circumstances and was beginning to be a feature of English (as of American and Scottish) university life, was psychologically sound: in their vacations, at any rate, students could get a taste of real work, responsibility, and economic independence. The difficulties were very much greater for the youth who was unemployed and sometimes found a mate before he found a vocation and had been trained by work to accept responsibilities and to consider the rights and needs of others.

The development of the young industrial worker of the continuation school was discussed by Miss M. Phillips in a paper entitled "The Adolescence of the Young Wage-earner". His social development, she said, was hampered by his limited environment. Repetitive work provided an even more restricted environment than did the school-room: it provided him with few opportunities of expressing his initiative. Most of these workers resigned themselves to the world as they saw it, and resorted to fantasy: so... sought opportunities for development in persor... relationships outside of the workshop: a few carri... the unadventurous, spiritless attitude of the worksh... into their personal relationships.

The fourth paper, by Miss A. H. M'Allister, ... "Adolescent Modes of Thinking", gave an account ... her own observations made with a method of studyi... adolescent thought, which seems very promising. Sh... compared some 400 stories written by girls of ... and women of 30 to be told to children, thinking th... the writers would in the selection and treatment ... their material reveal their own attitude of life; a... her expectations were fully realised, for there we... distinct differences between the stories of the youn... women and those of the older, which can only ... explained by their difference of outlook. Fairy stor... were more popular with the adolescents and w... treated somewhat differently: they depicted a beau... ful, busy, but secret world, a place of feasting a... dancing and all sorts of wild impossibilities; it w... an expression of the adolescent's growing interest in t... world, of her hopes, and realisation of her own inde... pendence: those of the older women were more sobe... by comparison. A curious feature of the adolescent... stories, one which raises a problem for the psychoanalyst, was the comparative absence of 'fathers'; 'mothers' were plentiful, but 'father' was seldom introduced, and then usually to explain his absence.

Anthropology and Archæology in the "Encyclopædia Britannica".

AS a survey of natural and applied science the "Encyclopædia Britannica" is a record of stupendous achievement by the human intellect in probing Nature's secrets and in the reduction of material conditions to subservience to man's needs. When we turn to the sciences which deal specifically with man himself and his past, we enter upon a field of discovery in which the results, if less spectacualr, offer no lesser appeal to the imagination, and redound no less to the credit of those to whose genius and patient piecing together of the evidence they have been due.

In those branches of science which deal with the origin and development of man and the growth of civilisation, there is one name which dominates all others, one man whose influence and example, explicit or merely implied, permeate the whole and determine the attitude of the investigator towards his material. That man is Darwin. In his article on the evolution of man, Sir Arthur Keith, in paying a tribute to Sir Edward Tylor, the greatest of the early anthropologists, emphasises the effect of his acceptance of the evolutionary theory of human descent as a working hypothesis. He goes on to demonstrate that Darwin's views on the descent of man have withstood all attack, remaining the only sound guiding principle in interpreting the facts.

An earlier generation, apt to facile generalisation, found in the Darwinian theory a ready key to the solution of all its difficulties. Since then as the facts have accumulated they have been seen to conflict with the crudities of premature theorising, and this has led to a popular misconception that the Darwinian position has been discredited. Far from this being the case, as Sir Arthur Keith shows, for example, in his review of the evidence of embryology on the descent

of man, the facts on a subtler interpretation only serve to confirm it. The tree of human descent still flourishes, but instead of a single stem, it has put forth many branches, each a specialised adaptation to its environment. We may no longer believe that men are descended from monkeys, but rather that in the line of descent the anthropoids are early forms which branched off, and have had to pay the penalty of too early specialisation.

It must not be concluded that there are no gaps in our theories, that no difficulties remain to be solved. There are still divergences of view. For these we refer the reader to Sir Arthur Keith's article, in which he pilots a way through the evidence from the anthropoids, *Pithecanthropus erectus*, Piltdown, Neanderthal, Rhodesian man, and the rest. Unfortunately, Peking man came too late to fit into Sir Arthur Keith's chain of evidence. A mere reference to the articles on "Heredity" and "Eugenics" for the place of Darwin in other fields must suffice as we pass to the study of man in its wider aspects. Dr. Marett in his article on "Anthropology" largely attributes the foundation of anthropology in its modern sense to Darwin's revolution in the study of biology. Man and his customs and institutions, it is true, have been a subject of curiosity from time immemorial. Herodotus is the father of anthropology just as much as of history. The study of archæology goes back at least to the Renaissance, as is pointed out in the article "Archæology" by Dr. Hall. But when Darwin published his "Origin of Species", as Dr. Marett says, "the time was at length ripe for a world-wide, age-long survey of the human record". Hence Dr. Marett has taken human survival as the prime object of anthropological study. It was the Darwinian theory of the struggle for existence and the survival of the fittest which provided method, a unity of aim, and a consequent strictness of procedure in dealing with the enormous range and diversity of the material for such a survey, and it is in the light of their survival value that Dr. Marett deals with the study of race and culture, language, social institutions, religion, and morals. It may be noted that Dr. Marett eschews the practically convenient but theoretically unjustifiable arbitrary divorce between prehistoric man, the modern savage, and civilised man. All are equally subject to the same biological canon.

In accordance with the scheme of arrangement of the "Encyclopædia", Dr. Marett has dealt with general principles only. Subsidiary articles cover the question of racial characters, racial distribution, social institutions, and culture under continents or countries as circumstances dictate. Others deal with special subjects of inquiry such as exogamy, kinship, marriage, totemism, and the like. Dr. Harrison's article on "Material Culture" is of special interest at the moment in its bearing upon the question as to how far development in material culture is to be regarded as due to independent invention or to a diffusion from a given centre—a subject which he developed further in his recent address to the anthropological section of the British Association at Bristol.

Those who are prone to ask what is the practical outcome of research and to demand some ultimate utility from academic studies may refer to Prof. Seligman's "Anthropology, Applied", in which he deals with the bearing of anthropological studies on the problems of the administrator in dealing with primitive races in our dependencies, drawing instances from his experience in the field.

When we turn to the treatment of archæological studies in the "Encyclopædia", it is inevitable that attention should be directed in the first instance to the general article by the late Dr. H. R. Hall, whose untimely death we all deplore. In accordance with the general scheme for strengthening the appeal of the scientific articles to a wider public, Dr. Hall has opened with a brief history and methodology of his subject. Two points are immediately presented to the reader with no little force. First is the astonishingly rapid increase in our knowledge in recent years, particularly since the War; and second, the need now felt for technical training in the practical archæologist and the wide range of knowledge which that training must cover, not merely within the four corners of the subject, but also in a wide variety of subjects which impinge upon work in the museums, and still more in the field, and involve problems ranging from practical chemistry to engineering. Dr. Hall is in accord with the spirit of the "Encyclopædia", though he may, perhaps, have felt a little ill at ease in seeking a practical end for archæological studies which he justifies, were justification needed, as one of the 'things of the spirit'.

The final word on method rests with Mr. O. G. S. Crawford, who from the fund of his practical experience deals with archæological discovery from the aeroplane.

The general survey of the stone ages by Mr. M. C. Burkitt, the bronze age by Mr. H. J. E. Peake, and the iron age by Mr. Reginald Smith are synthetic rather than analytic. Even more than in their detail, their general trend marks the advance in archæological studies of recent years. It is of no little significance that the treatment of the larger problems of archæology tends to expand in range until, in the earlier phases at least, it is little short of world-wide. This would have been even more evident had publication been delayed by a little to include discussion of recent evidence from China, India, and Africa which holds out possibilities of world-wide correlations in prehistoric times based on climatological and meteorological argument. As it is, Prof. Seligman could barely touch on Mr. L. S. B. Leakey's discoveries in East Africa.

It is when reference is made to the departmental articles, mostly under geographical headings, that the increase in the sum of detailed knowledge becomes impressive. In this connexion Mesopotamia with its record of recent excavation must hold first place; but Egypt with Badari and the Faiyum, India with Mohenjo-daro and Harappa, China, and Palestine each contribute no less significantly if less sensationally to the archæological picture of the growth of civilisation in prehistoric times which gradually is being pieced together. By no means less important is the eastern European area, of which the prehistoric archæology is ably surveyed by Prof. Gordon Childe. Less attractive, perhaps, to any but the expert because of its difficulties, of which not the least is the language in which most of the original records of research are published, it assumes its proper perspective in Prof. Childe's hands in linking up the cultures of Central Europe, the Danubian area, and the eastern Mediterranean.

It would be impossible even to glance in passing at the many fascinating problems which now engage the attention of the archæologist and are here recorded—the Hittite empire and its ramifications, which the archæological and philological evidence carries, on one side to India, and, on the other, to the peoples of the Mediterranean; the cultures of the south-western United States, in which an archæological method and framework develop as evidence accumulates; and the great pre-Columbian civilisations of Central and South America. As a whole, archæology in the "Encyclopædia" is a record of great achievement reared upon a sound basis of carefully observed and recorded fact.

Fog and Mortality in the Meuse Valley.

FOR three days last week, Dec. 3-5, a heavy fog occurred in part of the Meuse valley, in the industrial area between Huy and Seraing, south-west of Liège, as a result of which sixty-four persons and a number of cattle are dead. An official medical commission which investigated the circumstances has reported that the deaths were due to fog alone; the victims were persons who, by reason of old age or ill health, were in a low state of health.

The Ministry of Health has been in communication with the health authorities in Belgium and is informed that the recent deaths in the province of Liège are not due to any communicable disease; the occurrence is clearly a matter of local conditions, but it may be some days before the cause is fully and authoritatively ascertained.

The fog formed part of a very extensive area of fog associated with an anticyclone that extended westwards from eastern Europe. Precise information as to the density of the fog in the afflicted area is wanting, but the accounts do not suggest that it was any greater than that of the worst London fogs, in which visibility is occasionally reduced to less than two yards. A number of upper air soundings made in Great Britain and on the Continent at this time showed that above a superficial layer of low temperature there was a rapid rise of temperature with height, the air above a height of 5000 ft. being about as warm as on an average day in August, when the annual maximum occurs at these levels. This state of affairs is, of course, very favourable for maintaining a fog, because of the extreme vertical stability that results. The atmospheric eddies that under ordinary conditions cause a constant interchange of air at different heights cannot be present, for any cold air from near the ground if raised to a higher level would have its deficit of temperature increased by dynamical cooling, and its increasing excess of density would introduce a powerful restoring force.

Fog, however, does not originate because of such conditions; it is generally caused by the cooling of the surface layers under a clear sky in the absence of strong wind. The evidence points to this having been the mode of origin of the fog area in Europe as a whole on this occasion. Apart from the fact that the general level of temperature was much higher than is usual in a December fog and that there was an unusually large 'inversion of temperature', the meteorological conditions appear to have been characteristic of the type of weather. If any poisonous fumes or solid particles are present in the surface layers of the atmosphere, they will remain there for so long as the state of exceptional stability lasts. The presence of some such fumes as the cause of the deaths near Liège seems a more reasonable supposition than the alternative one of suffocation through sheer density of fog, because the ordinary particles of fog, whether these are drops of water or minute particles of solid matter, or, as often happens in industrial areas, a mixture of the two, occupy only a minute proportion, by volume, of the atmosphere, and can scarcely be supposed to prevent a due amount of oxygen from being inhaled even by people with impaired lungs.

If these conclusions are correct, the cause of recent deaths in the Meuse valley will be found only by more thorough investigation into the manner of the victims' death. The possibility must also be taken into account that recent industrial developments may have resulted in the liberation of poisonous products on a scale that will become destructive whenever scavenging of the air by turbulence is reduced by exceptional temperature conditions aloft.

University and Educational Intelligence.

CAMBRIDGE.—The Council of the Senate has appointed the following Committee for the James Clerk Maxwell centenary celebration: The Vice Chancellor; Sir J. J. Thomson; Mr. W. Spens, Master of Corpus Christi College; Sir Joseph Larmor, Sir Ernest Rutherford, Dr. C. D. Broad, Prof. H. F Newall, Sir Arthur Eddington, Prof. C. T. R. Wilson, Prof. F. J. M. Stratton, Dr. J. Chadwick, Dr. J. D Cockcroft, Sir James Jeans.

The Managers of the Balfour Fund, with the approval of the Faculty Board of Biology "A", have made a grant of £30 from the Balfour Fund to Miss P. M. Jenkin, of Newnham College, for research on "The Biology of the Smaller African Lakes".

H. G. Wager, of Emmanuel College, has been appointed to the Frank Smart University Studentship in botany.

SCHOLARSHIPS, each of the annual value of £300 plus an allowance for apparatus and other expenses, are being offered by the Grocers Company, the object being the encouragement of original research in sanitary science. Forms of application and particulars can be had from the Clerk to the Grocers Company, Grocers Hall, E.C.2.

A SERIES of twelve Swiney Lectures entitled "The Life of the Past" will be given by Dr. T. M Finlay in the lecture theatre of the Imperial College of Science (Royal College of Science, Old Building), at 5.30 on Mondays, Wednesdays, and Fridays, on Dec. 8-19 and on Jan. 5-16. Admission is free.

UNIVERSITY entrance tests and initial degrees form the subject of a report recently adopted by the council of the Association of University Teachers and published in the October number of the Association's *Universities Review*. The report surveys the existing arrangements for matriculating students in the various universities and finds them unsatisfactory, in that, on one hand, they fail to exact from every entrant valid evidence of preparedness for university work, and on the other, they exert an unhealthy influence on schools in the direction of premature specialisation. It recommends the prescription of a minimum entrance age of about eighteen years; an efficient test in the use of English; a test, to be passed shortly before entry, in four subjects, not involving such a high degree of specialisation as the higher school certificate examinations; and a certificate by the candidate's school authorities as to his powers and interests and general fitness for university work. As regards the test in English, the report expresses approval of the general principles of recommendations embodied in an article by Miss Maitland Smith which appears in the same number of the *Review* under the title "Entrance Examination in the Understanding and Use of English". Although the suggested improvement of the efficiency of entrance tests might be expected to rehabilitate to some extent the depreciated pass degrees of the new universities, the report urges these bodies to retrieve the mistake they made in reserving 'honours' exclusively for success in highly specialised courses, with the result that every ambitious student, whether he really wishes and is fitted to press on to the frontier of knowledge in one particular direction or not, is driven to do so.

Historic Natural Events.

Dec. 14, 763. Cold Winter in Western Europe.—The winter of 763–4, the first concerning which details are extant, appears to have been very cold in western Europe. Winter began early in October, but the greatest cold continued from Dec. 14 until Mar. 16. It extended over the whole of Europe, from England to the Black Sea. The Bosphorus and neighbouring parts of the Black Sea were frozen; in several countries the snow was 30 ft. deep in places, and in Gaul the olives and figs died, the corn froze in the soil, and in 764 a terrible famine desolated a vast region and cost a multitude of lives. The Danube and other rivers were frozen, as was the sea for a long distance from the land. Holinshed records: "There fell such a marvellous great snow, and therewith so extreme a frost, as the like had not been heard of, continuing from the beginning of the winter almost till the midst of spring, with the rigour whereof trees and fruits withered away, and not only feathered fowls, but also beasts on the land and fishes in the sea died in great numbers." It is not mentioned in the Anglo-Saxon Chronicle, but an entry in 761 records: "This year was the severe winter", and there may be some confusion of dates.

Dec. 16, 1857. Neapolitan Earthquake.—This earthquake is notable as the first in which an attempt was made to estimate the depth of the focus. By numerous measurements of the inclination of fissures in buildings, etc., Mallet found that the depth was about 6½ miles.

Dec. 16, 1877. High Pressure over Siberia.—At Semipalatinsk in Siberia the barometer at 9 P.M. read 84·5 mm., equal to 1046 mb. or 30·886 in. The height of the station is not known exactly, but is estimated as 590 feet, and on this basis the pressure corrected to sea level is 1075 mb. (31·75 in.). This is the highest known pressure at sea level. At 7 A.M. on Dec. 17, a reading of 787·4 mm. (1050 mb. or 31·00 in.) was recorded at Barnaoul, a few degrees east of Semipalatinsk. The height of this station is 480 feet, and the pressure reduced to sea level, 1073 mb. (31·69 in.).

Dec. 16, 1920. Great Chinese Earthquake.—One of the greatest earthquakes known to us occurred in the provinces of Kansu and Shensi in north-west China. The area disturbed must have been more than three million square miles, the largest yet known. The number of persons killed, chiefly residents in caves in the river-banks, was estimated at 180,000.

Dec. 16-21, 1925. Tropical Cyclone in Pacific.—A violent cyclone visited the Union, Samoa, and Cook Islands. A cyclone wave swept over Atafu in the Union Islands, and great damage was done by the wind at Rarotonga (Cook Islands).

Dec. 17, 1664. Comet.—Under this date Pepys wrote: "Mighty talk there is of this Comet that is seen a' nights, and the King and Queene did sit up last night to see it, and did, it seems."

Dec. 18, 1896. Ball Lightning in Devon.—During a thunderstorm at Brixham, Devon, a globe of light appeared in a field, travelling from west to east, tearing up the ground. It reached a small house, broke a hole in the closed door, knocked a hole in the wall, and continued along a rope walk, where it killed one man and gravely injured another.

Dec. 19-22, 1929. Snowstorm in Texas.—Snow is rare in central Texas, but in this storm the depth of snow exceeded two feet in places and traffic was disorganised; at Hillsboro 26 inches fell in less than 48 hours. Two inches of snow fell even on the coast, where such a phenomenon is almost unprecedented. The pressure distribution on Dec. 18 showed a deep depression over the Gulf States, bringing in large quantities of moist air, while a cold wave was advancing from an intense anticyclone over Montana, associated with temperatures below 0° F. The snowstorm accompanied the progress of this cold wave, first southwards and then eastwards to the coast.

Dec. 20, 1564. Severe Winter in Europe.—The winter of 1564–65 was very severe over the whole of Europe. The cold began about Dec. 20, and Holinshed states that on New Year's Eve "people went over and alongst the Thames on the ise, from London Bridge to Westminster. On Jan. 3 at night, it began to thaw, and on the fifth there was no ise to be seene betweene London Bridge and Lambeth, which sudden thaw caused great floods, and high waters, that bare downe bridges and houses, and drowned manie people in England, especially in Yorkshire. Owes Bridge was borne awaie, with others." The Zuider Zee and all the great waters of western Europe were frozen; on the Continent the cold continued until Mar. 24.

Societies and Academies.

LONDON.

Physical Society, Oct. 17.—J. P. Andrews: (1) A simple approximate theory of the pressure between two bodies in contact. The approximation makes use of two principles: (a) The displacement at the centre of the circle of contact is twice that at its edge, and (b) for the purpose of calculating the stresses we may replace the two bodies by a single sphere of which the circle of contact is a diametral section, and write the strain at any point as the ratio of the displacement of that point to the length of the line drawn from the point to the sphere in the direction of displacement. When the elastic modulus by which this is multiplied is taken as that appropriate to a rod with sides fixed, the agreement with accurate theory is close. Principle (a) remains nearly true for elliptical areas of contact.—(2) Experiments on impact. For soft metallic bodies and impact of equal spheres, for small velocity of approach v, duration of contact varies inversely as $v^{1/5}$, while the coefficients of restitution e are unity for all speeds below a value characteristic of each material. Duration of contact has no effect upon the size of the permanent deformations. For variation of duration of contact t with mass of sphere at high speeds of approach, t varies as the square root of the mass, as theory predicts.—(3) Observations on percussion figures. Steel ball on glass blocks. Diameter of innermost circular or part-circular crack remains constant for one specimen of glass, and is independent of the maximum pressure exerted by the ball on the glass; diameter of outermost circular or part-circular crack varies with the maximum pressure in a manner which suggests that the crack tends to keep to the outer edge of the area of contact. No crack is formed until the pressure exceeds a value characteristic of the glass.

Geological Society, Nov. 5.—H. Williams and O. M. B. Bulman: The geology of the Dolwyddelan Syncline (North Wales). The syncline lies east of Snowdon and south of Capel Curig, extending along the Lledr Valley westwards from the village of Dolwyddelan. The rock-sequence is closely comparable with that determined by the senior author on Snowdon, and the pyroclastic rocks of Dolwyddelan are, in effect, the attenuated and ragged margin of the great Snowdonian volcanic mass. The central portion of the northern limb of the syncline has been

overturned, accomplished probably by a kind of 'underdrive', much of which took place prior to and during the impression of cleavage, but the final stages of which seem to have been part of a general post-cleavage movement. Large bodies of fresh augite-dolerite, well developed along the northern limb of the syncline, testify to the post-cleavage intrusion of basic magmas.—**L. R. Wager**: Jointing in the Great Scar Limestone of Craven, and its relation to the tectonics of the area. The Great Scar Limestone of Craven is traversed by two sets of nearly vertical joints, which are usually at right angles one to the other. Some 4 miles north-west of Grassington-in-Wharfedale, the lead-veins run parallel to one set of the joints, and were in fact deposited in widened joints. The joints and mineral veins are constant in direction over a considerable area; but as the North Craven Fault is approached, their direction is modified. These preliminary observations showed that the formation of the joints preceded the mineralisation, which is probably of Pre-Permian age, and suggested that the jointing and the Craven Faults may be related, since the modification in the direction of the joints is localised near the faults. In order to test this hypothesis, the joints have been examined over a wide area.

CAMBRIDGE.

Philosophical Society, Oct. 27.—**Sir A. S. Eddington**: On the masses of the electron, the proton, and the universe. The opposite cyclic behaviour of protons and electrons, expressed by symbols of the type $e^{i\theta}$, $e^{-i\theta}$, would involve reciprocal behaviour in the corresponding real transformations e^{θ}, $e^{-\theta}$. A theory of the masses is proposed, according to which the representation of a microscopic system with 136 cyclic momenta in a microscopic space-time with only 10 cyclic momenta increases the natural mass of the proton in the ratio $136:\sqrt{10}$ and diminishes that of the electron in an equal ratio. The $\sqrt{10}$ is due to the 10 momenta occurring in a quadratic Hamiltonian, whereas the 136 occur in a linear Hamiltonian. This gives $M/m = 1849 \cdot 6$. A certain amount of check is provided by (1) the 'packing fraction', which corresponds to the increase from 136 to 137 cyclic momenta when the charges are in a perfectly rigid nucleus; (2) the 'original' mass of a charge being $\sqrt{Mm}$, the square of the ratio of electrical to gravitational energy ($5 \cdot 2 \times 10^{78}$) comes to be of nearly the same order as the number of particles in the universe ($1 \cdot 4 \times 10^{79}$) determined from the recession of the spiral nebulæ.

PARIS.

Academy of Sciences, Nov. 10.—**Emile Borel**: The extension of the properties of irreducible polynomials to integral functions.—**Georges Perrier**: The section of geodesy of the International Geodetic and Geophysical Union at the general meeting at Stockholm, Aug. 11-23, 1930.—**Georges Claude**: The utilisation of the thermal energy of the sea. Additional results obtained in the experiment at Matanzas.—**B. Berloty**: The localisation of the epicentres of earthquakes. From theoretical considerations, the parallel of articulation and deformation of a flattened ellipsoid such as the earth, is 35° 15′ 52″. Data extracted from nine years of the International Seismological Summary are discussed and the conclusion drawn that the parallel of deformation is only 16″ from that indicated by theory.—**Paul Delens**: Functions with complex variable and geometrical representations.—**Marcel Vasseur**: The deformation of congruences of normals.—**Georges Bouligand**: Applications of the idea of the contingent.—**Georges Durand**: A type of points of the envelopes of spheres.—**Nikola Obrechkoff**: The exponential summation of Borel.—**M. Lavrentieff**: A problem of maximum in conformal representation.—**F. E. Myard**: A generalisation of Cardan's joint.—**R. Mazet**: The stability of certain isolated vortices.—**Lyot**: The solar corona studied apart from eclipses. This work was carried out at the Observatory at the Pic du Midi, on account of the purity of the atmosphere at this elevation. The sun's image was formed on a metallic screen extending 30″ over the sun border. Protected by this screen, observations could be made directly with the eyepiece. The prominences were visible without the assistance of the spectroscope and showed the same pink colour seen during eclipses. The polarisation of the corona was examined under these conditions. The polarisation found was not instrumental or of atmospheric origin: the results are given graphically.—**Ernest Esclangon**: Remarks on the preceding communication. The author considers that this marks a new stage in the study of the solar corona.—**H. Deslandres**: Remarks on M. Lyot's communication.—**Jean Becquerel, W. J. de Haas**, and **H. A. Kramers**: The law of paramagnetic rotation in xenotime and its experimental verification. Comparison of the experimental results obtained at absolute temperatures of 4·22° and 1·38° with those calculated from the modified formula given in an earlier paper.—**J. Cichocki**: The diffusion of the ions of salts in aluminium. The phenomena described by Peczalski for copper and iron are reproduced in the case of aluminium, except that no negative thermionic emission has been observed for the last-named metal.—**M.** and **Mme. Clément Duval**: The isomerism of radicals.—**Raymond Delaby** and **Mlle. Jeanne Hiron**: The generalisation of Skraup's reaction applied to α-alkylglycerols. A description of the preparation and properties of α-ethylquinoline, α-propylquinoline, and α-butylquinoline.—**Maurice Marie Janot**: Sclareol and its derivatives. The formula deduced from the analyses given is $C_{17}H_{30}O_2$. The physical properties and chemical reactions are given.—**Fernand Blanchet**: Some new or little known facts concerning the geology of the southern Briançonnais (Massif d'Escreins Hautes-Alpes).—**A. Mailhe** and **Renaudie**: The transformation of propylene into liquid hydrocarbons. A study of the effect of silica gel at 650° C. on propylene.—**René Truchet**: A method of preparation of substituted acetylene hydrocarbons. The methyl esters of benzenesulphonic acid and of p-toluenesulphonic acid can replace methyl sulphate as a methylating agent in many cases. By the reaction

$$R.C:C.Na + C_6H_5SO_3R' = R.C:C.R' + C_6H_5SO_3Na$$

the author has prepared nonine, decine, and undecine.—**C. P. Nicolesco**: Discovery of the Senonian on the banks of the Seine between Gonfreville-l'Orcher and Bacqueville, to the east of Tancarville.—**André Ike Duninowski**: A new method for the optical estimation of atmospheric ozone. The usual method of measuring atmospheric ozone is based on the absorption in the ultra-violet, but Cabannes and Dufay, working on observations made at the Mount Wilson Observatory, have deduced the proportion of ozone from the atmospheric absorption in the visible region of the spectrum. The author has developed the latter method, using a linear thermoelement placed in a vacuum. The method has proved sufficiently sensitive to give accurate daily means, the accuracy being sufficient to give the thickness of the ozone to 0·2 mm. (at atmospheric pressure).—**Pierre Lesage**: The growth of *Lepidum sativum* cultivated at different latitudes in 1930.—**Robert Lami**: The liberation of iodine from the *ioduques* of *Bonnemaisonia asparagoides* under the action of the ultra-violet rays.—**Joyet-Lavergne**: The ratios between the intracellul

rH and the cytoplasmic sexualisation of the spores of horsetails.—**St. Ionesco**: The presence of tanoids in flowers.—**Raymond-Hamet**: The physiological action of aminomethyl-3 . 4-dioxyphenol carbinol.—**Louis Rapkine**: The chemical processes in the course of cell division.—**Lespes, Regnier, and Rungs**: Contribution to the study of the phases of the locust, *Schistocerca gregaria*.—**Mlle. Simone Mouchet**: The comparative morphology of the deferent canals of *Pagurus*.—**Etienne Rabaud**: The standing of *Argiope bruennichi* on its cobweb.—**L. Lutz**: The soluble ferments secreted by the Hymenomycetes fungi. The quinones and the antoxygen function.—**M. Javillier** and **Mlle. L. Emerique**: Biochemical researches on rubrene. Rubrene exerts no toxic action on rats, and does not replace vitamin A.—**Constantino Gorini**: Acidoproteolytic bacteria in pasteurised milk.—**Maurice Piettre** and **Pierre Villedieu**: The attenuation of the anthrax bacterium as a function of the nutrition.—**E. Brumpt**: The transmission of Marseilles exanthematic fever by the dog tic, *Rhipicephalus sanguineus*.—**J. Verge**: The second intradermomalleination in the glandered horse.

Official Publications Received.

BRITISH.

Imperial Bureau of Plant Genetics Herbage Plants. Bulletin No. 2: Miscellaneous Information relating to Herbage Plants. Pp. 41 (Aberystwyth: Agricultural Buildings.)

Union of South Africa: Department of Agriculture. Sixteenth Report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria. Pp. vi+592. (Pretoria: Government Printing and Stationery Office.) 10s.

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1928–1929 Pp. 247. (London: Ministry of Agriculture and Fisheries.)

Air Ministry: Aeronautical Research Committee Reports and Memoranda. No. 1324 (E. 36): Experiments on the Ignition of Gases by Sudden Compression By R. W. Fenning and F. T. Cotton. (I.C.E. 731 and A.) Pp 43+18 plates (London: H.M. Stationery Office.) 2s. 6d. net.

Notes from the Botanical School of Trinity College, Dublin. Vol. 4, No. 3, November. Pp. 81-144. (Dublin.)

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Seventh Conference held at New College, Oxford, September 19th-22nd, 1930. Pp. 116. (London.)

Report on the Agricultural Department, Grenada, for the Year 1929. Pp. ii+15. (Grenada, B.W.I.: Government Printing Office.) 6d.

Heriot-Watt College, Edinburgh. Calendar for Session 1930–1931. Pp 302. (Edinburgh.)

Indian Journal of Physics, Vol. 5, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 4. Conducted by Sir C. V. Raman Pp. 385-471. (Calcutta.) 1.4 rupees, 1s 8d.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1929. Pp. iv+28. (Trinidad.) 6d.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 26: The Carboniferous Rocks of Hook Head, County Wexford. By Dr. Louis B. Smyth. Pp. 523-566+plates 15-20. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1200 (Ae. 361): On the Problem of Hydro-dynamic Stability. 1: Uniform Shearing Motion in a Viscous Fluid. By R. V. Southwell and Letitia Chitty. (T. 2754.) Pp. 54. 2s. 6d. net. No. 1247 (Ae. 401): Tail Flutter of a particular Aeroplane. By Dr. W. J. Duncan and A. R. Collar. (T. 2959.) Pp. 21. 1s. 3d. net. No. 1310: The Aeroplane as a Source of Sound. By Morris D. Hart. (N. 26.) Pp. 38+5 plates. 1s. 9d. net. No. 1322 (M. 68): Further Experiments on the Behaviour of Single Crystals of Zinc subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. (T. 2826.) Pp. 20+16 plates. 1s. 6d. net. No. 1323 (M. 69): The Behaviour of a Single Crystal of Antimony subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. (T. 2861.) Pp. 18+19 plates. 1s. 6d. net. No. 1333 (Ae. 465): A Simplified Analysis of the Stability of Aeroplanes. By W. L. Cowley and Sylvia W. Skan. (T. 2928.) Pp. 13. 9d. net. (London: H.M. Stationery Office.)

FOREIGN.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 169: First-Order Leveling in Alaska. By Howard S. Rappleye. Pp. 31. (Washington, D.C.: Government Printing Office.) 10 cents.

Field Museum of Natural History. Botany Leaflet No. 16: Fifty Common Plant Galls of the Chicago Area. By Carl F. Gronemann. Pp. 30. (Chicago.) 25 cents.

Bulletin of the Geological Institution of the University of Upsala. Founded by Hj. Sjögren. Vol. 21. Pp. iii+430+9 plates. (Upsala: Almquist and Wiksells Boktryckeri A.-B.)

Forty-fifth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1927–1928, with accompanying Papers: The Salishan Tribes of the Western Plateaus, by James A. Teit, edited by Franz Boas; Tattooing and Face and Body Painting of the Thompson Indians, British Columbia, by James A. Teit, edited by Franz Boas; The Ethnobotany of the Thompson Indians of British Columbia, by Elsie Viault Steedman; The Osage Tribe: Rite of the Wa-xo'-be, by Francis La Flesche. Pp. vii+857+29 plates. (Washington, D.C.: Government Printing Office.) 2.35 dollars.

Sudan Notes and Records. Vol. 13, 1930, Part 1. Pp. 148. (Khartoum.) 30 P.T.; 6s.

Japanese Journal of Botany. Transactions and Abstracts, Vol. 5, No. 2. Pp. iv+133-252+31-53. (Tokyo: National Research Council of Japan.)

Havsforskningsinstitutets Skrift. No 58: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1927. Herausgegeben von Gunnar Granqvist. Pp. 48. 20 Fmk. No. 61: Über den Einfluss der Temperatur auf die p_H-Bestimmung des Meerwassers. Von Kurt Buch. Pp. 23. 20 Fmk. No 62: Vedenkorkeusarvoja 1926 (Vattenståndsuppgifter 1926). Av S. E. Stenij. Referat: Wasserstandsangaben 1926. Pp. 50 20 Fmk. No. 63: Havsforskningsinstitutets verksamhet år 1928. Redogörelse avgiven av Rolf Witting. Pp. 17. 10 Fmk. No 64: Översikt av isarna vintern 1928 29. Av Gunnar Granqvist. Referat: Übersicht der Eisverhältnisse im Winter 1928 29 an den Küsten Finnlands. Pp. 48 20 Fmk No. 65: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres, Januar 1928 Juni 1929. Herausgegeben von Gunnar Granqvist. Pp. 60. 25 Fmk. No. 66: Croisière thalassologique et observations en bateaux routiers en 1928 Rédigé par S. E. Stenij. Pp 36 20 Fmk. No. 67: Vedenkorkeusarvoja 1927 (Vattenståndsuppgifter 1927). Av Henrik Renqvist. Referat: Wasserstandsangaben 1927. Pp. 51. 20 Fmk. No. 68: Bathymetric Chart of the Bothnian Bay and the North Kvark—Echo Soundings in the Years 1927–1929. By Henrik Renqvist. Pp. 28 15 Fmk No. 69: Zur Reduktion von Echolotungen. Von Gustav Elfving. Pp. 11. 10 Fmk. No. 70: Croisière thalassologique et observations en bateaux routiers en 1929. Rédigé par Gunnar Granqvist. Pp. 36. 20 Fmk. No. 71: Översikt av isarna vintern 1929 30 Av Gunnar Granqvist. Referat: Übersicht der Eisverhältnisse im Winter 1929 30 an den Küsten Finnlands. Pp 33. 20 Fmk. No. 72: Havsforskningsinstitutets verksamhet år 1929. Redogörelse avgiven av Rolf Witting. Pp. 15. 10 Fmk. (Helsinki.)

CATALOGUES.

A Rough List of Selected Works on Natural History, including Periodicals and Publications of the Learned Societies. Third Portion. (New Series, No. 23.) Pp. 109-152 (London: Wheldon and Wesley, Ltd.)

A Selection of Valuable Books (Catalogue No. 31.) Pp. 100. (London: William H Robinson Ltd.)

A Catalogue of Books on British and Foreign Birds Pp. 16. (London: Francis Edwards, Ltd.)

Choice Books: XVI-XVII Century, First Editions, Modern Presses. (No. 454.) Pp. 42. A Catalogue of Works on Political Economy. (No. 455.) Pp. 64. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, DECEMBER 12.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department Lecture Room, Imperial College of Science and Technology), at 2.30.—The Purification of Waste Waters from Beet-Sugar Factories:—D. W. Cutler: Microbiological Aspects.—E. H. Richards: Biochemical Aspects.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall) at 3.30.—Major W. Gregson: Waste Heat Recovery from Internal Combustion Engines, with particular reference to Marine Oil Engines.

ILLUMINATING ENGINEERING SOCIETY (in Lecture Theatre of Holophane, Ltd., Elverton Street), at 4.30. Dr. S. English: Glasses for Use with Invisible (Ultra-violet and Infra-red) Rays.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—A. Wigglesworth: India's Commercial Fibres.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: (a) On the Relation of Colour and Spectral Type in the Different Galactic Latitudes; (b) On the Axial Rotation of the Stars; (c) Some further Remarks on the Rotation of the Stars.—Prof. H. N. Russell and R. S. Dugan: Apsidal Motion in Y Cygni and other Stars.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Central London Ophthalmic Hospital), at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY (at Linnean Society), at 6. Dr. B. Prashad: Further Notes on Indian *Ampullariidae*.—L. G. Hertlein: Changes of Nomenclature of some Recent and Fossil *Pectinidae*.—Dr. F. F. Laidlaw: On a suggested New Sub-Family, *Dyakiinae*, and a New Species.—Sir Joseph C. Verco and B. C. Cotton: The Spermatophore of *Sepioteuthis australis* Quoy & Gaimard.—R. Winckworth: Notes on Nomenclature. No. VII. *Helicella*.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—V. E. Pullin: X-Rays in Engineering Practice.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. J. Rees: Refractories for Boiler Furnaces.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—W. D. Oliphant: Laboratory Method as met with in Wireless Technique.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—J. M. Preston: Theories of Lustre.—W. F. A. Ermen: Notes on the Iodine Mercerisation Test.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Royal Institution, Liverpool), at 7.—A. W. C. Harrison: The Incorporation of Dry Pigments into the Medium.

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 7.—A. C. Ansell and others: Discussion on Some Problems in the Design of Roof Truss Members.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry) (at Thomas' Café, Swansea), at 7.30.—Dr. P. M. Davidson: The Structure of Molecules (Lecture).

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Henry George Lyons: Technical Museums and their Value to Engineers (Presidential Address).

INSTITUTE OF FUEL (East Midlands Section) (at Derby Technical College), at 7.30.—T. F. Hurley: Some Factors influencing the Design of a Combustion Chamber for Pulverised Fuel.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.—A. Brier: Electrical Driving of Textile Machinery.

INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University, Sheffield), at 7.30.—R. H. D. Barklie and A. E. Nicol: Studies in the Electrodeposition of Silver. Throwing Power. The Behaviour of Silver Anodes, with special reference to Blackening and its Prevention.

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—E. S. Andrews: A Comparative Study of Retaining Walls.

SATURDAY, DECEMBER 13.

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 2.30.—Prof. Heidbreder: Thinking as an Instinct. —Dr. Stephenson: Application of the Theory of Two Factors to Non-verbal Tests.—Dr. Fortes: Perceptual Tests of 'G'.—Mr. Drake: Demonstration of some new Tests of Musical Ability.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30. W. H. Connell: Some Recent Improvements in Surveying Instruments.—*Papers open for further discussion*:—Machine Mining in Faulted Ground, A. L. Ford; A Record of the Upper Carboniferous Non-Marine Lamellibranchs of Northumberland and Durham, and a Record of their Sequence, Dr. W. Hopkins.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3. Sir E. Denison Ross: Persia and the Persians (2): Art and Literature.

MONDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (jointly with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers), at 6.45.—W. H. Evans: Industrial Psychology.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7. Informal Discussion on Heating in the Home.

INSTITUTE OF FUEL (North-Western Section) (jointly with Institution of Electrical Engineers, Institution of Mechanical Engineers, and Association of Engineers) (at Engineers' Club, Manchester), at 7.—Major E. Ivor David: Private Generation of Electricity *versus* the Grid.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Group-Capt. the Hon. R. A. Cochrane: An Air Reconnaissance of the Hadhramaut.

TUESDAY, DECEMBER 16.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—E. J. Loveridge and others: Informal Discussion on Commutator *versus* Slip-Ring Motors.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—G. Henderson: Modern Developments of the Metal cylinder Mercury-Arc Rectifier.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. V. Chilton: The Efficiency of the Safelights for Darkroom Use.—Dr. S. O. Rawling and Dr. G. B. Harrison: A Simplified Method of Measurement of pH by means of a Triode Valve and Glass Electrode.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (jointly with Coke Oven Managers' Association, Northern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. E. F. Armstrong: Coal as a Raw Material.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Cleveland Scientific and Technical Institution), at 7.30.—J. Lang: Metallography of some Engineering Materials.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Extraordinary General Meeting.—At 8.30.—A. Goodwin: The Stone Age in South Africa.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre).—Dr. J. J. Rudra and Prof. Miles Walker: The Theory and Performance of Phase Advancers.

WEDNESDAY, DECEMBER 17.

SOCIETY OF GLASS TECHNOLOGY (in Chemistry Theatre, University College), at 2.—Discussion on The Flow of Glass in Tank Furnaces:—B. P. Dudding: Preliminary Statement.—E. A. Coad-Pryor, A. L. Marden, and J. B. Murgatroyd: Reports on the Results of Some Experiments made at the Works of United Glass Bottle Manufacturers, Ltd., Osram G.E.C. Glass Works, and Rockware Glass Syndicate, Ltd.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. J. Glasspoole: Heavy Falls of Rain in Short Periods (two hours or less).—W. D. Flower: An Analysis of the Cold Front over Egypt on March 7th, 1929.—M. T. Spence: The Factors Affecting Visibility at Valencia Observatory.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. Harold Jeffreys: The Mechanics of Mountains.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—A. Titley: Cornish Mining: Notes from the Account Books of Richard Trevithick, Senior.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—S. C. Akehurst: Observations on Pond Life, with Special Reference to the possible Causation of Swarming of Phytoplankton.—J. M. Preston: A New Top Light Illuminator.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London Section) (at 296 Vauxhall Bridge Road), at 6.—H. I. Andrews: Possibilities of Condensing on Locomotives.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—H. C. Armitage: Machine Tools from the Manufacturing Users' Point of View.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (in Chemistry Theatre, Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. E. F. Armstrong: Coal as a Raw Material.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.

THURSDAY, DECEMBER 18.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Prof. J. W. Gregory: The Copper Shale (Kupferschiefer) of Mansfeld.—G. Trestrail: (*a*) The Witherite Deposit of the Settlingstone Mines, Northumberland; (*b*) A Device for Controlling Mine Dams.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. J. J. Rudra and Prof. Miles Walker: The Theory and Performance of Phase Advancers.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—S. W. Melsom, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

INSTITUTE OF RUBBER INDUSTRY (at Manchester Ltd., Manchester), at 7.—J. H. Carrington: The Use of Concentrated Latex in the Rubber Industry.

CHEMICAL SOCIETY, at 8.—R. Child and Prof. F. L. Pyman: 1-ω-halogenoalkylisoquinolines and their Derivatives.—E. Hope, Prof. F. L. Pyman, F. G. P. Remfry, and R. Robinson: A Synthesis of Hydrastine. Part I.

FRIDAY, DECEMBER 19.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (in Mining Institute, Newcastle-upon-Tyne), at 7.15.—E. L. Champness and others: Are we justified in using Steel and other Materials of Foreign Manufacture in the British Engineering Industries?

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics and Comparative Medicine Sections), at 8.30.—Major A. A. Pryer, Dr. R. W. A. Salmond, Lieut.-Col. E. Middleton Perry, Dr. J. B. King, and others: Discussion on A Comparison of Radiological Problems in Man and Animals.

PUBLIC LECTURES.

FRIDAY, DECEMBER 12.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene, 28 Portland Place), at 5.30. A. S. Comyns Carr: Education for Management, to be followed by a discussion.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—H. Ll. Bassett: Nitrogen in Nature and Industry.

SATURDAY, DECEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Bird Life in and around London.

MONDAY, DECEMBER 15.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30. W. S. Vernon: Liquid Air.

WEDNESDAY, DECEMBER 17.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. L. Collis: The Prevention of Industrial Diseases.

BELFAST MUSEUM AND ART GALLERY, at 8.—E. J. McKean: Ulster Folk Lore.

FRIDAY, DECEMBER 19.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—J. Pryde: Human Engines.

CONFERENCE.

DECEMBER 19 AND 20.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Bedford College).

Friday, Dec. 19, 10 A.M. to 1.—Dr. M. C. Rayner: Observations on *Armillaria mellea* in Pure Culture with Certain Conifers.
- J. G. Boswell: The Biochemistry of Dry Rot in Wood.
- G. E. Blackman: The Effect of Nitrogen Compounds on the Botanical Composition of Grass.
- Dr. W. H. Pearsall: Changes in the Constitution of *Beta* Leaves during Growth.
- Dr. E. D. Adrian: The Activity of Isolated Nerves and Nerve Cells.
- H. O. Bull: Conditioned Responses and Salmon Smolts.

2.15 to 4.—Dr. C. M. Yonge: The Relationship between Corals and Zooxanthellae.
- Dr. T. A. Stephenson: The Growth of Corals.
- E. Hindle: Thermophilous Organisms.
- W. H. Thorpe: Experiments on the Biology of the Petroleum Fly *Psilopa petrolii*.

5.30 to 6.30.—E. Charles: Metabolic Changes associated with Pituitary Activity.
- E. A. Spaul: Internal Secretions and Metamorphosis.

Saturday, Dec. 20, 10 A.M. to 1.—Symposium on the Permeability of Protoplasmic Membranes.
- Prof. L. T. Hogben: Electrical Conductivity and the Permeability of Animal and Plant Tissues.
- Prof. A. V. Hill: The Steady State across Biological Membranes.
- A. D. Hobson: Changes in the Sea-Urchin Egg following Fertilisation.
- R. J. Pumphrey: Electrical Potentials across the Membranes of the Trout Egg.
- C. F. A. Pantin: Surface Permeability and the Evolution of the Blood Serum.

SATURDAY, DECEMBER 20, 1930.

CONTENTS.

Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Dyestuffs and Applied Organic Chemistry.

THE tourney at Westminster on Dec. 4 was a joyous passage of arms in which the lances of the knights of Cobden dominated in the House of Commons, and champions of dyestuffs were driven from the lists. The ten years' chapter of protection is ended ; those worthy burghers of the textile industry who, with the chains of foreign dye merchants round their necks, knelt before Lord Moulton and prayed for deliverance, have forgotten their cry of 'never again'! Fortunately, an amendment was carried in the House of Lords on Monday to extend the Act for twelve months in order there may be a full and impartial investigation into the state of the dye industry. At the eleventh hour, therefore, it is possible that the subject will be taken from the slough of politics and considered in the light of ascertained knowledge.

It is opportune to inquire from a scientific point of view what the real effect of the Act has been, entirely apart from its financial benefit to the small group of dye-makers, who indeed have in the main devoted their profits to research £700,000 during the operation of the Act in the case of the best-known firm, which is still spending at the rate of £80,000 a year upon it. Above all else, the Act has brought into existence virile schools of organic chemistry which have rendered it possible for our young men to be trained in this subject, to make it their profession, to gain experience in its application to industry, so that they in their turn may originate, invent, and take a leading part in the establishment in Britain of new industries based on organic chemistry.

Twenty-five years ago our organic chemists were few in number and mostly trained abroad ; the excellent facilities provided being made possible by the demand for organic chemists by the foreign dyestuffs industry, then in the heyday of its most active development. The opportunity for their employment in industry at home was scanty and the reward small ; such organic industries as Britain had were only just holding their own.

During the War, when for the first time the country was thrown wholly on its own resources, the need for the organic chemist soon became apparent and extreme. Right well did the few men who were available, and the hastily trained juniors and even seniors, succeed in extemporising to fill the national needs, so that when peace ensued the nation as a whole followed willingly and with some degree of understanding those leaders who in their wisdom declared that Great Britain

must have its own flourishing, vigorous, successful organic industry, and that dyes, fine chemicals, and the like should be protected and cherished.

At once a new, attractive career for our youth had arrived; the universities were not slow to provide facilities, nor did the young men delay to utilise them. The dyestuff industry in particular readily absorbed at first all the talent available; it is common knowledge that there is no better training ground. In course of time many passed out of it again to other branches of applied organic chemistry, so that to-day Great Britain has—let us repeat, as a direct consequence of the Act—a large and growing force of experienced middle-aged organic experts, of young men occupying junior posts in the industry, and of younger men training specially for such. All are capable of understanding the potentialities of their subject, the speed at which it is developing, and are convinced of the need of Britain more than holding its own in this field if we are not to stand aside from the most promising section of future industrial advance.

Should by any chance the dye-making industry be allowed to languish in Britain, it will inevitably involve also the loss by us to the foreigner of such allied consuming industries as those of lakes, pigments, and printing inks. Ultimately, and at no distant date, we may expect to lose also the dyeing industry and the speciality sections of the textile industry itself. The manufacture in Britain, as the outcome of extensive research, of the newer, more expensive colours has resulted invariably in a reduction of price, whereas those colours which are not yet made here are maintained by the importer at relatively high prices. Much has been made by representatives of the textile industry of the alleged fact that the operation of the Dyestuffs Act has denied them access to the novelties, or at least delayed their making use of these, but they overlook how easy it will be in the future for the foreign dye-maker either to withhold his specialities altogether from the British textile customers or only to supply them at an excessive price or under such onerous conditions as, for example, an agreement to buy their whole range of dyes from him. Indeed, it will not be difficult then to build up a dyeing industry abroad, under the wing of the foreign dye-maker, supreme in quality and price, and having first or sole access to the novelties, to which factory British-made goods would have to be sent to be dyed—a step so disastrous that it is easy to foresee that it would be followed by the goods themselves being woven abroad.

Does the textile industry realise that rayon is only the first of the synthetic textile threads—the product of the organic chemist—and that it will inevitably be followed by others having novel properties, bringing with them new problems of handling or of dyeing? Is Manchester prepared to stand aside from all such developments? Why is it that the need for scientific research in modern life and in modern industry is so much more difficult to bring home to politician and people alike in Britain than in any other country? Germany owes the position its industry has attained almost entirely to its appreciation of science; America since the War owes its progress not to mass production, not to financial plethora, but to the same appreciation by president and people alike of the need for invention, new methods, new ideas, the inextricable linking of scientific research with every vital and progressive industry within its boundaries. The great industries in the United States—minerals, canning, oil, automobiles, agriculture—are alike in that in each of them there is that alliance between the chemist and the manufacturer which spells progress. Yet the House of Commons strikes a damaging and disheartening blow at this alliance, and one calculated to cripple an industry which, as a training ground alone, should be preserved, apart from the fact, which even its critics admit, that it has made good in its own field. Too much has perhaps been made of its achievements, for, as those actually engaged in the industry know, there is still much to be done, much that is difficult and costly, yet withal is attractive, as well as promising of new successes.

Britain, a small country in area, densely populated, is sadly deficient in natural resources; we have scarcely any water power, no mineral oil, no cotton, cannot grow wheat or cattle in competition with the prairies, have no oil-bearing seeds. The chemist alone can come to our rescue, and, by effecting syntheses of the materials we need from the materials we have, can assist in restoring prosperity to our manufactures and also provide employment for the population. The whole of human life is but the transmuted rays of the sun—food, clothing, nearly all that we use, are but the transformations of its energy. The organic chemist is learning at an ever-increasing rate how to guide such transformations of carbon compounds into ways which are of immediate advantage to mankind, but meanwhile he must be trained and employed. That nation will be foremost in the future which has the most and best trained chemists, above all, the nation with the clearest, sanest chemical outlook.

Newcomen and Triewald.

'he *Newcomen Society for the Study of the History of Engineering and Technology*. Extra Publication No. 1: *Marten Triewald's Short Description of the Atmospheric Engine*, published at Stockholm 1734. Translated from the Swedish, with Foreword, Introduction and Notes. Pp. xxii + 61. 12*s*. 6*d*. net. Extra Publication No. 2: *R. D'acres's The Art of Water-Drawing*. Published by Henry Brome, at the Gun in Ivie Lane, London, 1659 and 1660. With Introduction and a Diagram by Rhys Jenkins. Pp. xxiii + 43. 7*s*. 6*d*. net. (Cambridge: W. Heffer and Sons, Ltd., 1928 and 1930.)

OF all the features which distinguish the present age from those of the past, none is more strikng than that of the extended application of power o every need of man. The Egyptians, Greeks, and Romans depended on the work of tens of thousands of slaves—we to-day depend on coal and oil. The liscovery of how to produce power from the combustion of fuel must therefore ever rank as one of he great landmarks in the progress of civilisation, and the inventor of the first practical steam engine, omas Newcomen, as one of the world's greatest enefactors. That Newcomen but applied the liscoveries of others; that he invented neither he cylinder, the piston, the beam, nor the pump corporated in his engine, detracts nothing from he merits of his achievement. He it was who lved a problem which had long exercised men's ninds, and by so doing set on foot the great power ndustry of the present age.

Whatever our debt to Newcomen, however, it is unfortunate that we know comparatively little of his life and character. Such material as exists relating to him is of a meagre description, and even n the matter of his engine we are dependent on the writings of others. In these circumstances, it was a happy inspiration of the Newcomen Society to publish as their first "Extra Publication" a translation of Marten Triewald's "Description of the Fire- and Air-machine at the Dannemora Mines", a work which has long been regarded as a classic in Swedish technical literature and was the first book ever written devoted solely to the steam engine. Originally published at Stockholm in 1734, some time after Triewald had returned from his ten years' sojourn in England, it has now been translated by Mr. Are Waerland, and printed with a foreword by Mr. Carl Sahlin and a critical introduction by Mr. Rhys Jenkins, together with a bibliography of Triewald's writings.

Newcomen was born in 1663 and died in 1729; Triewald was born in 1691 and died in 1747. A man of great energy and ability, Triewald also possessed self-confidence and a firm belief in an overruling providence. Coming to England in 1716, he made the acquaintance of the scientific writer and lecturer, Desaguliers, and it was probably from him that he gained his first information on the new atmospheric engine. Among those erecting atmospheric engines at this time was Nicholas Ridley, of Newcastle, and Triewald's chance came when Ridley, "led by the wonderful foresight of God", asked Triewald to assist him. Thus embarked on an engineering career, Triewald afterwards formed a company with young Calley, the son of Newcomen's colleague, for the construction and supervision of fire-engines, and immediately after returning to Sweden in 1726 proposed to the shareholders of the Dannemora mines the erection of the Newcomen engine which is described in his book. Triewald, however, appears to have been more successful as a lecturer and writer on scientific matters than as a constructor, for the Dannemora engine was not a success and the shareholders became involved in a long correspondence and a lawsuit.

The book itself is divided into fifty paragraphs, some devoted to personal details, some to scientific theories, some to engine details, and some to suggestions regarding the uses of the engine. In this connexion it is worth observing that Triewald was probably the first to suggest using steam for pumping out a dock. At Carlscrona was the finest dock in the world, but when it was desired to dock a man-of-war, it required the services of 600 men for three days and nights to get rid of the water. An engine, Triewald says, would empty the dock in 8 or 12 hours. The engine could also be used for grain- and saw-mills, tilt hammers, for draining marshes, and for blast furnaces; but whatever it was put to, "the fire-machine is not only a tool, whereupon a very great force is brought to bear, but also the means by which this force is created, so that it can be said with good reason that all the other artifices compared to the fire-machine are merely simple tools which a craftsman is using".

The Newcomen Society has since published as its second "Extra Publication" a reproduction of R. D'acres's "The Art of Water-Drawing" of 1659, the first book in the English language on the raising of water. Only a few copies of the original work are in existence, and though of great interest, it has hitherto escaped the notice of writers generally.

Though written so early, D'acres, whose identity cannot be traced, had a good idea of the action of the atmosphere, and his work contains descriptions of bucket pumps, lift pumps, force pumps, and also of an apparatus for sucking water from wells by obtaining a vacuum by condensing steam in a somewhat similar manner to that adopted in the modern pulsometer. A conjectural sketch has been made of the apparatus by Mr. Jenkins, who for D'acres's book, as for Triewald's, has written the introduction.

New Physiology.

Human Physiology. By Dr. F. R. Winton and Dr. L. E. Bayliss. With a Chapter on The Physiology of the Sense Organs, by Dr. R. J. Lythgoe. Pp. xiv + 583. (London: J. and A. Churchill, 1930.) 15*s*.

Concerning the Statue of Liberty in New York Harbour, Clemenceau is alleged to have remarked that the French people also had memorials to the illustrious dead. During the past few years there have appeared several revised editions of the standard works on human physiology used by medical students fifteen or twenty years ago. The changes necessitated by the rapid strides which physiology has made during the intervening period are extensive; and the advisability of putting so much new wine into old, if illustriously old, bottles is questionable. In chapter after chapter a short postscript on the discovery of an oxygen is added to a lengthy exposition of a phlogiston hypothesis. In the mind of the student who approaches his studies in this way confusion is inevitable. In the labyrinth of Nature the path of scientific discovery is often tortuous. One expedition after another ends in a cul-de-sac, from which the inquirer must needs retrace his footsteps and make a fresh start. To the philosopher and student of scientific method such reverses are meat and drink. They only bewilder the beginner.

Winton and Bayliss have produced a text-book in which they have set out to expound what is known about physiology to-day. They have not encumbered their exposition with a catalogue of the mistakes of our illustrious predecessors. They have not assumed that the time devoted to elementary zoology is exclusively confined to architectural mnemonics intended to recall the foramina of the dog's skull or the pontifical polysyllables associated with the appendages of the crayfish. From the first to the last page they have confined themselves to the kind of information which a medical student who has surmounted the stile of the first professional examination may reasonably expect from a course of physiology bearing directly on the practice of medicine. The information is presented with lucidity and good humour. The book is a highly creditable performance. The authors are to be warmly congratulated on their task.

Apart from the rapid progress of physiological science during the past few decades, there are several extrinsic reasons which prompt a demand for a new tradition in the teaching of medical physiology in Great Britain. One is the new temper in British zoology. A generation of younger professors, including Dr. D. M. S. Watson, himself a distinguished palaeontologist, are insisting that zoology, as its name implies, is the study of animals rather than corpses. Consequently, it is becoming possible to relegate the experimental anatomy of the organs to an earlier stage in biological instruction. Under the influence of Dr. Charles Singer the history of medicine is rightly asserting its claims to rank as an independent branch of study. There is therefore less need to subordinate the inclusion of vital contemporary issues to the historical presentation of the individual sciences. Winton and Bayliss have wasted no space in 'flogging dead horses'. They have made no attempt to deal with those aspects of physiology which have developed more particularly in connexion with the study of the lower organisms and may now be safely entrusted to the teaching of experimental zoology. They have succeeded in writing a book which is suitable for the medical student, omits nothing which is of vital interest to the present generation, and spares no effort to familiarise the reader with laboratory methods and experimental data on which modern physiological principles rely. Their presentation of the new work on muscle and nerve, reflex action and the special senses, endocrinology and reproduction, shows that there is room for a higher standard in medical instruction so soon as those engaged in teaching physiology are willing to devote less attention to effete themes and superannuated topics.

Throughout the book there is a careful attention to the definition of terms. On page 1 we are reminded that "health and disease are primarily sociological concepts", a truism overlooked by many physiologists and by nearly all psychiatrists and eugenists. The phraseology is felicitous, and the authors consistently encourage those "who have acquired the rare faculty of being able to suspend judgment without undue discomfort to take the opportunity to exercise it". In dealing with the special senses and with the mechanism of behaviour

the writers adhere to a strictly objective nomenclature more rigidly than the authors of earlier works. The remarks upon speech are an exception to their general practice. No one will disagree with the statement that "such relations have not yet been analysed in objective terms" (p. 446). Their statement that "considerable progress has been made in this field by the methods of introspective psychology (*e.g.* psychoanalysis)" is open to the objection that, if any conceivable progress in such matters is due to professional psychologists who still adhere to an introspective terminology, it is because they have actually employed methods analogous to those which the physiologist uses.

American Oil Fields.

Structure of Typical American Oil Fields: a Symposium on the Relation of Oil Accumulation to Structure. Forty Special Papers including a Critical Summary, in part from the Program of the Twelfth Annual Convention of the American Association of Petroleum Geologists at Tulsa, Oklahoma, March 24, 25 and 26, 1927. Vol. 2. 1929. Pp. xxiii + 870 + 4 plates. (Tulsa, Okla.: The American Association of Petroleum Geologists; London: Thomas Murby and Co., 1929.) 27*s.* net.

THE origin, migration, and accumulation of petroleum: three outstanding episodes (in proper sequence) in a natural history even now imperfectly understood. Every text-book on oil geology gives a chapter to each: every author reiterates the same arguments which have held sway since the enlightened days of Redwood, Engler-Hofer, and their contemporaries. 'Origin', as such, has a literature of its own, much of it unconvincing to a degree. Migration of petroleum is a subject still in a state of flux and kept so by the contradictory results of experiment and conflicting tenets of modern philosophy. 'Accumulation' is the oil-pool itself, how and why it came to be formed, what its relationship to reservoir-rock really proves to be, what its disposition anent structure actually signifies. In the last case we are on more solid ground because the unravelling of subsurface conditions of so many oil fields to such a point of accurate detail has provided us with tangible evidence of the *raison d'être* of many a big pool.

Our American friends enjoy nothing better than to take stock of a situation, scientific or otherwise, preferably by means of large-scale conferences. 'Accumulation' in itself furnishes an excellent theme for one of these debates, which, in published form, occupies two large volumes. This is the second, in matter, style, and presentation similar to the first.

If the reader can wade through the mass of detail given in each of these studies of American oil-pools, his knowledge of accumulation will be almost rare. If detail appals, he may emulate without shame that type of novel-reader who weakly scans the end pages to see if it has a likable ending or plot, or whose patience tires before the half-way chapter; only in the present instance, the last paper, by F. G. Clapp, not only reveals the essence of all that has gone before, but also it is by far the best contribution of all, and, if for no other reason, this volume merits attention. Apart from this, the papers making most appeal deal with such famous pools as Long Beach, California; El Dorado, Kansas; Caddo, Louisiana; Cushing, Oklahoma; Yates, Texas, and Salt Creek, Wyoming; perusal of these is worth while if other sources of relevant information have not previously been consulted.

There are probably few types of oil-pool in the world not amply illustrated by the examples quoted in these two books, and one wonders whether, under the heading of 'accumulation', we have very much more to learn and, be it admitted, to what extent symposia really advance our learning.

H. B. M.

'How it was Made' in Antiquity.

The Technical Arts and Sciences of the Ancients. By Albert Neuburger. Translated by Dr. Henry L. Brose. Pp. xxxii + 518. (London: Methuen and Co., Ltd., 1930.) 42*s.* net.

THIS is a disappointing book, and scarcely worth the great labour of an English translation, or the translator's occasional attempts to patch it up; and as the bibliographies of the German original have been omitted, it is impossible to check or follow up many remarkable statements without reference to it. But considering the immense field which it is designed to cover, and the very defective materials available in many parts, it is a remarkable compilation, and justifies the translator's contention that the achievements of the ancient world have been unduly overlooked in matters not only of industrial technique but also of scientific experiment.

Dr. Neuburger complains that often his predecessors have been insufficiently acquainted either with the ancient languages or with modern experience in the same arts and industries. But his book will perpetuate hardy misconceptions,

on both sides: and some which were already cleared up when he began to collect his material. This is part of the price that a very learned nation has to pay for its prodigious output of *thesis* and *programm*, and for the rapidity with which, in historical studies at all events, wild guesses gain and lose acceptance. A man must be something of a specialist in general knowledge to gather only good grain where there is so much chaff.

Take the chapters in the present volume on metallurgy. What evidence is there that the "Germanic races . . . became acquainted with copper long after they had used iron" (p. 13); that the Phœnicians obtained metallic tin from India (p. 15); that Herodotus "makes special mention" of the Cassiterides (p. 14) except to deny knowledge of them; that the Corinthian clay-tablets depict smelting furnaces (p. 11), not pot-kilns; that Spartan boys played with lead soldiers (p. 19); that the iron column at Delhi is dated to the ninth century B.C. (p. 21), or that iron was worked in India in 2500 B.C., or even in 1500 B.C., or cast-iron in 1400 B.C. (p. 22); that Thothmes III. took great booty in iron spears (p. 22)? The Egyptian furnace in Fig. 24 was not a 'bloomery', but for gold working, as the (omitted) inscription shows. Nor does the iron "generally flow out", or it would be cast-iron and useless to ancient smiths (p. 26); nor is chrysocolla identical with malachite (p. 46); nor galena with lead-oxide (p. 48). On p. 119, it is difficult to see how lead sulphate could result from alteration of black-lead. An Athenian *stater* equalled two *drachmæ*, not four.

The chapters on pottery are not much better. The *crux ansata* (p. 131) is not the same as the *swastika*, nor is either ornament found on "all fired clay of the first-period", nor even, if it were, would it prove that the "cradle of the clay industry" was in Asia Minor or in Egypt—which are really quite different countries. The "art of varnishing glaze" (p. 132) looks like a mistranslation, for *Firniss* includes vitreous glaze; "ordinary clay stones" is perhaps another (p. 132). But the descriptions of the Greek potter's wheel (Fig. 204) and of the technique of 'red-figure' painting are nonsensical. On p. 144 and p. 151 distinct and discrepant accounts are given of ancient "black-glaze", and on p. 142 it is stated that the first object in thus glazing pots was to make them waterproof. That certain colours were "always applied under the glaze" (p. 143) is unlikely, as they would have been invisible.

There are some wrong references to ancient authors, and some queer mistranslations. Of Xerxes' Bridge, the popular rendering of Herodotus vii. 36 is repeated, though a 'science-man' should have detected its absurdity. In the account of "Oils and Fats", on p. 113, "reels" should probably be "tackle", "see-saw" should be "lever"; p. 114, "buttress" should be "clamp", and the whole mechanism is misunderstood. On p. 117, "notch" should be "knot" (as in knot-grass); on p. 118, is "combusting" correct? On p. 464, "stretches" should be "stretchers".

In spite of obvious defects, for popular purposes the book brings together a very large mass of information on a side of ancient life which is in many ways curiously like our own. J. L. M.

Our Bookshelf.

Aircraft Instruments. By C. J. Stewart. Pp. xix + 269 + 30 plates. (London: Chapman and Hall, Ltd., 1930.) 21s. net.

ONE'S first feelings upon picking up this book are that here is a volume that deals with the application of a somewhat nebulous physical science to concrete engineering problems, written by an author singularly competent to link up the two subjects. Unfortunately, the subject is not dealt with from that point of view to anything like the extent possible. The author principally confines himself to the description of apparatus and its use, doubtless with an eye upon the size and readability of the book. There are, however, ample references to relevant publications that enable the subject matter to be followed up if desired. The chapter on the measurement of height is a happy exception to this criticism. It is probably the most comprehensive study of this question published to date.

Major Stewart seldom passes opinions upon the instruments described. There is nobody more competent to do so, both by reason of his extensive experience and of the position that he now holds as head of the Instrument and Physics Department of the Royal Aircraft Establishment. For example, in the chapter on compasses, he describes the selenium cell distant reading type. One feels certain that this is an interesting laboratory experiment at present, rather than a practical aircraft instrument.

The book is certainly the most comprehensive description of aircraft instruments that has yet been published. Incidentally, the photographs and diagrams are very well chosen as illustrations to the text, and are not mere padding, as is so often the case. A device in many of the R.A.F. official photographs, of including a portion of a scale, is very helpful in giving an impression of the size of the objects.

The subdivision of the book is logical and easy for reference. The instruments are classified under

their functions, which facilitates their comparative study as types.

The descriptions are not confined to British instruments, all the better-known foreign makes being included. An interesting chapter deals with the methods of measuring actual height above the ground immediately beneath the aircraft. This problem is very much in the minds of aircraft operators, and is by no means successfully solved yet.

The Victorian Tragedy. By Dr. Esmé Wingfield-Stratford. Pp. ix + 296. (London: George Routledge and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

WHY 'tragedy'? One reads Dr. Wingfield-Stratford's new and brilliant book through with growing wonder. He meets so fully all the cheap gibes against the last generation—the ineffectual politicians, the hypocritical moralists, the fainting women, and all the rest of it—and shows the contrary truth of an age of exceptional earnestness, industry, and success—"the heyday of idealism and imaginative genius"; and then sums it up as a "tragedy". What does he mean? Dr. Wingfield-Stratford's answer is that the Victorian middle class was 'tragic' because its members went on their earnest and triumphant way quite unwitting of the catastrophe which was to follow and of the greatest social and industrial problem which remained to be solved. The latter was the humanising of the industrial revolution, the widening of the conquest of Nature which the nineteenth century initiated with scientific machinery into a conquest of human conditions, the addition of an ideal of beauty to that of wealth.

No doubt on this side our Victorian ancestors were defective; but it was they who first proclaimed the need of the change, through Ruskin, Morris, Carlyle, and a host of other prophets and workers. Unhappily, it was a far easier and quicker process to make cotton goods in a factory than happy and intelligent workers in garden cities. The mechanical process outstripped the moral; but it is mere ignorance and ingratitude to overlook the fact that the mechanical conquest of Nature made possible the vast extension of health and well-being of all kinds which the inheritors of the Victorians now enjoy. Dr. Wingfield-Stratford, of course, does not fall into this gross error, and he has given us a book which is delightful to read for its wit, enthusiasm, and good stories, while it constantly raises big questions such as we have discussed above.

F. S. M.

The Fauna of British India: including Ceylon and Burma. Published under the Authority of the Secretary of State for India in Council. Edited by Lieut.-Col. J. Stephenson. *Cestoda.* Vol. 1. By Dr. T. Southwell. Pp. xxxi + 391. (London: Taylor and Francis, 1930.) 22*s.* 6*d.*

THE investigations of the late Sir William Herdman on the pearl fisheries of Ceylon, begun in 1902, suggested infection with larval cestodes as a cause of pearl formation and thus directed attention to the cestode parasites of fishes found in Indian seas. The reports on these by the late Sir Arthur Shipley and Mr. James Hornell were followed by a series of papers by Dr. Southwell, who later turned his attention also to the cestodes of Indian land vertebrates. Since the War a number of other helminthologists have given a good deal of attention to Indian cestodes. Dr. Southwell has now produced the first volume of a monograph which will be found of great value as bringing together the results of all these researches, hitherto scattered in many scientific periodicals.

The volume deals with those families that include most of the fish-infesting species, and contains an introduction giving a useful account of the structure and classification of the group. The illustrations are numerous and excellent. A little more care in the arrangement of the matter would, in some places, have made the book more easy to consult for those who are not specialists. The hasty reader, finding on p. 344, for example, the names *Thysanobothrium uarnakense* and *Parataenia elongatus* standing in black type at the head of paragraphs of description, may waste some time in discovering that these are regarded as synonyms of *Polypocephalus radiatus* described on p. 342. In the preface it is pointed out that "the field is largely unexplored, and it is clear that in the near future additions to our knowledge are likely to be made on a large scale". This desirable result will no doubt be hastened by the publication of Dr. Southwell's volume.

Thomas Aquinas. By Rev. M. C. D'Arcy. (Leaders of Philosophy Series.) Pp. ix + 292. (London: Ernest Benn, Ltd., 1930.) 12*s.* 6*d.* net.

THE extent of the writings of St. Thomas Aquinas and the vastness of his system make it a very difficult task to condense his philosophy within the compass of three hundred pages. Yet Father D'Arcy has succeeded in presenting the fundamental principles of the Angelic doctor's system in a concise and accurate form.

Although St. Thomas shared many of the naïve beliefs of his contemporaries, he was aware of the provisional character of much science and skirted its treacherous sands when he wished to establish a truth definitely. The physical universe as St. Thomas saw it is the one made familiar to us by Aristotle and the Ptolemaic system; nevertheless, he puts in quietly the *caveat* with his cautious "if it be true". So that his scientific beliefs have little bearing on the fundamental aspects of his mental and moral philosophy. Indeed, in revising St. Thomas's teachings, his modern followers have given up with good grace his astronomical beliefs, his theory of the four elements, of the influence of the air and the sun, of motion, of the physical, chemical, and biological conceptions which entered into his philosophy of substance and change. The bibliography at the end of the book shows that much has to be done in Great Britain for the study of St. Thomas, who had, after all, a considerable influence in the Middle Ages. If Father D'Arcy's book awakens the interest of his readers in that direction, his labours will not have been in vain.

T. G.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Molecular Field and Atomic Order in Ferromagnetic Crystals and in Hydrogenised Iron.

THE molecular field postulated by Weiss to explain ferromagnetism is regarded by Becker[1] as mechanical in origin, representing the control exerted by strain within any portion of a crystal upon the direction in which that portion may retain its magnetisation in the absence of externally applied magnetic fields. More recently, Becker and Kirsten[2] have discussed some interesting experiments upon the magnetisation of nickel under tension. They arrive at the conclusion that, at least for applied fields much larger than the coercive force — which becomes as small as one or two gauss under their extreme conditions — the magnetisation may be predicted quantitatively from the maximal magnetostrictive shortening of well annealed metal and the saturation intensity of magnetisation, both of which quantities are sufficiently well known from previous experiments by others. Their account of the effect of internal stresses over the cross-section of a wire specimen upon its magnetisation is also very satisfactory. They point out, in the second footnote to p. 660, that the "extremely irreversible processes" observed in weak applied fields are not correctly represented by Becker's theory, magnetic changes being observed at field values which are less than the theory predicts as necessary for their occurrence.*

Two other recent notes which present apparently contradictory opinions regarding the molecular field are by Frenkel and Dorfman[3] and by Akulov.[4] In the former, the energies of magnetisation and of the quasi-magnetic separation of a crystal into elementary regions magnetised in different directions are used in computing the minimum and average volumes of the magnetically saturated regions postulated by Weiss. In the latter, it is argued that such magnetic saturation of small regions is incompatible with the observed magnetic behaviour of iron macro-crystals, and that therefore the internal energy of partially saturated states must be nearly the same as that of the saturated state.

A fourth position of interest in the present connexion is that taken by Gerlach,[5] who thinks that his own experiments and those of others are consistent only with the complete absence of magnetic hysteresis in perfect crystals of iron. Against this it may be urged that the hysteresis losses in the polycrystalline hydrogenised iron of Cioffi[6] are at least as low as in any mono-crystalline iron yet described.

My recent studies on magneto- and elasto-resistance[7] have led me to suppose that the electrical resistance of a crystal in which the atomic magnets have been rendered parallel by magnetisation or by mechanical strain is sensibly the same whether the magnetic axes of the elementary magnets all point in one direction — corresponding to magnetic saturation — or point indifferently in either direction — corresponding to magnetic neutrality. The two states have been distinguished in a paper before the American Physical Society[8] as, respectively, 'magnetic' and 'mechanical' atomic order. This distinction affords a convenient starting-point for a more precise treatment of ferromagnetism which may lessen the confusion of opinions noted in the papers first referred to herein.

In agreement with Becker, then, we may regard the molecular field of Weiss as wholly mechanical in origin.† Since, however, the strain tensor does not fix the direction of the magnetic vector, we will suppose that a given strain may, in the absence of an applied magnetic field, be associated with any degree of magnetisation, of either sign, in the preferred direction. We must also suppose that the differences in internal energy between the various *magnetic* complexions associated with a given strain are small in comparison with the energy of the strain. This is the more likely because we know that the electrical resistance and the length in the direction of alignment are almost unaffected by changes in magnetisation under these special conditions. This amounts to saying that the reversal of an atomic magnet involves little change in the internal energy of the crystal to which it belongs.

We differ from Akulov in supposing that an atomic magnet can pass from one strain-favoured direction to the other without necessarily dissipating the energy required *per atom* in changing the common direction of all the atomic magnets from the initial direction to an intervening position for which the internal energy is greater. Akulov, for example, sets the minimum hysteresis loss per cycle for reversal of magnetisation along a <100> direction at twice the energy difference for complete magnetisation along <110> and <100> directions. This loss, as Akulov points out, is absurdly too great. We avoid his difficulty by denying that in the reversal of magnetisation along a <100> direction the assembly of atomic magnets ever has any other common direction. We are thus able to go through cycles of magnetisation without working against the molecular field.

We cannot, however, go so far as Gerlach does in denying hysteresis losses altogether. The reversal method of changing magnetisation must still involve some dissipation of energy, because, for one thing, there must be resultant eddy currents in the adjacent metal. This loss will not depend upon the frequency of traversing the cycle if, as seems safe to assume, the reversals are as quick as other atomic energy jumps. We will therefore regard the low values of coercive force which Gerlach and others have attained as closely approaching the limit to which perfect atomic order would permit us to go. The low values of coercive force reached by Becker and Kirsten by stretching nickel are still far higher than this limit, and, indeed, the strains under even their extreme stresses must have been far from homogeneous on an atomic scale. The imperfections of real crystals may prevent our ever quite attaining the ideal case by purifying and annealing.

If these hypotheses are correct, the calculations of Frenkel and Dorfman, which depend for their validity upon magnetic saturation of each elementary region, are no longer valid.

The effect observed by Cioffi is distinctly mo

* It may also be mentioned, though the facts are not pertinent to the present discussion, that the theory of the distorted dipole lattice, as the authors themselves state, predicts a magnetostriction of the wrong sign and amount, and that the similarity in the magnetic behaviour of cold-worked and annealed specimens under great tension is not surprising, in view of the fact that such tension is reported to have stretched the annealed specimen by so much as 10 per cent.

† This opinion has, of course, been held by others than Beck
My first explicit statement of the hypothesis was made in connexion with the magnetostriction of permalloy (*Phys. Rev.* [2], **28**, 158-166; 1926), where I said: "The more or less random stresses in ordinary metals would, in accordance with the views here expressed, do that for which this molecular field [of Weiss] was evoked, for they would in the case of all but favourably oriented atoms tend to maintain the established direction of magnetisation against small disturbances, and thus confer upon magnetisation that stability which the simple interaction of freely turning magnets cannot furnish".

puzzling. It is suggested as possible that hydrogen[8] dispersed throughout the lattice of iron crystals—not at lattice points—may act catalytically in the following way. Some of the iron atoms immediately adjacent to hydrogen atoms are thereby strained in a manner that favours increase in magnetisation by their reversal along the direction of the applied field. We know nothing of the manner in which hydrogen atoms conduct themselves in iron at room temperature, but it is at least possible that a single hydrogen atom may wander about sufficiently to strain in the favourable way a great many iron atoms in succession at each low value of the applied field. If this is the process involved, the hydrogen atoms must repeatedly lose their energy of thermal agitation, and therefore the iron must be cooled during the process and the energy must be supplied from outside by thermal conduction and by the magnetic field. If, as is the case, the reduction of area of the hysteresis loop is by more than 50 per cent, there will be a net cooling during each cycle, the hydrogenised iron being a refrigerating engine worked by cyclic magnetisation. Experiments with alternating magnetic fields should be competent to fix not only the amount of cooling integrated over many cycles, but also the time interval required for the complete promotion of magnetisation at each increment in magnetic field by the necessary random migration of hydrogen atoms.

This explanation would be much more fanciful if we had not recently learned from the experiments of Ellwood[9] that cooling may occur at certain stages in a hysteresis cycle, and that the heat developed in the whole cycle may be less if the cycle is traversed in many steps so that there are periods of ageing under the important applied fields. In Ellwood's case, carbon, not hydrogen, is known to have been present, and carbon is also known to enter the lattice of iron not at lattice points but by crowding into interatomic spaces. Its diffusion rate in iron at room temperature would be expected to be much less than that of hydrogen.

On these views, the possible ways in which magnetisation may change are two: (1) by reversals, without sensible magneto-resistance changes or magnetostriction, and with small but definite hysteresis losses probably closely conditioned by electrical conductivity; and (2) by rotations through less than 180°, with magneto-resistance and magnetostriction, with hysteresis losses of important amount largely controlled by mechanical strains inherent or induced by applied stresses, and possibly subject to catalytic acceleration.

L. W. MCKEEHAN.

Sloane Physics Laboratory,
Yale University, Oct. 15.

[1] R. Becker, *Zeits. f. Physik*, **62**, 253-269; 1930.
[2] R. Becker, M. Kirsten, *Zeits. f. Physik*, **64**, 660-681; 1930.
[3] J. Frenkel, J. Dorfman, NATURE, **126**, 274-275; Aug. 23, 1930.
[4] N. S. Akulov, *Zeits. f. Physik*, **64**, 559-562; 1930.
[5] W. Gerlach, *Zeits. f. Physik*, **64**, 502-506; 1930.
[6] P. P. Cioffi, NATURE, **126**, 200-201; Aug. 9, 1930.
[7] L. W. McKeehan, *Phys. Rev.* [2], **36**, 948-977; 1930.
[8] L. W. McKeehan, O. E. Buckley, *Phys. Rev.* [2], **33**, 636; 1929.
[9] W. B. Ellwood, *Phys. Rev.* [2], **36**, 1066-1082; 1930.

Unit of Atomic Weight.

THE discovery of the complexity of oxygen clearly necessitates a reconsideration of the scale on which we express the weights of atoms. Owing to the occurrence of O^{17} and O^{18}, now generally accepted, it follows that the mean atomic weight of this element, the present chemical standard, is slightly greater than the weight of its main constituent O^{16}. The most recent estimate of the divergence is 1·25 parts per 10,000. This quantity, even apart from its smallness, is not of much significance to chemists, for the experience of the last twelve years has shown that complex elements do not vary appreciably in their isotopic constitution in natural processes or in ordinary chemical operations. Physics, on the other hand, is concerned with the weights of the individual atoms, and by the methods of the mass-spectrograph and the analysis of band spectra it is already possible to compare some of these with an accuracy of 1 in 10,000. Furthermore, the theoretical considerations of the structure of nuclei demand an accuracy of 1 in 100,000, which there is reasonable hope of attaining in the near future. The chemical unit is clearly unsuitable, and it seems highly desirable that a proper unit for expressing these quantities should be decided upon.

The proton, the neutral hydrogen atom, one-quarter of the neutral helium atom, one-sixteenth of the neutral oxygen atom 16, and several other possible units have been suggested. None of these is quite free from objection. It is desirable that this matter should be given attention, so that when a suitable opportunity occurs for a general discussion of the subject, each point of view may be afforded its proper weight in arriving at a conclusion.

F. W. ASTON.

Trinity College,
Cambridge, Dec. 4.

The Geological Importance of the Radioactivity of Potassium.

DR. A. HOLMES and Dr. R. W. Lawson in their paper on "The Radioactivity of Potassium and its Geological Significance" (*Phil. Mag.*, Dec. 1926, p. 1218) have estimated the heating effect of potassium by multiplying the average energy of the emitted β-ray by the number emitted per second. The energy can be obtained from the β ray absorption coefficient, and the number emitted per second from the half value period. From the best data at the time available, they decided that the energy was $7{\cdot}3 \times 10^{-7}$ erg, and the half value period $1{\cdot}5 \times 10^{12}$ years: that is, about 225 β rays are emitted per second per gram of potassium.

The recent work of W. Muhlhoff (*Annalen der Physik*, vol. 7, p. 205; and NATURE, Nov. 22, 1930, p. 823) leads, however, to a very much lower value. By the use of a Geiger and Müller sensitive particle counter he counts directly the number of β-rays emitted per gram of potassium; and obtains a value of 23 β-rays per second: not 225. This means that the heating effect will be reduced to one-tenth of its previously estimated value.

This result is important in connexion with a theory of the surface history of the earth advanced by me. For it increases the estimated period required for the thermal development of a 'revolution'; and in this manner contributes towards agreement with estimates of geological time based on the lead ratios of uranium and thorium as found in the rocks.

J. JOLY.

Trinity College, Dublin,
Nov. 25.

Internal Conversion of Nuclear Energy.

WHEN a nucleus passes from an excited state into a state of lower energy, two different processes may occur: either a γ-quantum is emitted or one of the extra-nuclear electrons thrown out of the atom (with an energy equal to that of the γ-quantum minus the ionisation energy of the electronic level); in this case we speak of internal conversion of nuclear energy.

For a theoretical calculation of the probability of internal conversion, we have to know the interaction between the atomic electron and the excited nucleus. As is well known, the problem is different according as the distance is large or small compared with nuclear dimensions. On large distances the action of the excited nucleus can be described as the field of a Hertzian doublet. The part of the probability of ejection caused by the interaction in this region may be written as the product of the total number of γ-quanta emitted, times a factor K—depending only on the wave-length of the γ-ray—which we will call the coefficient of internal photo-effect.

In order to determine whether this effect, or the effect caused by the interaction in the nuclear region, is the more important for the ejection of atomic electrons, one has to evaluate the coefficient of internal photo-effect and compare it with the experimental data. The first calculations of this kind were carried out by Miss Swirles [1]; as, however, these calculations are based on non-relativistic wave mechanics, the results obtained cannot be expected to hold when the energy is large compared with mc^2, which is the case for most of the γ-rays investigated. It is necessary, therefore, to deduce a relativistic formula. Using Dirac's equation and assuming, for simplicity, that the energy of the γ-quantum is large compared with mc^2 ($5 \cdot 1 \times 10^5$ volt) I arrive at the following expression:

$$K = \frac{1}{Z} \cdot \frac{1}{\rho} \cdot \; \cdot (2\alpha)^{2\sqrt{1-\alpha^2}} \cdot \frac{\left|\Gamma(\sqrt{1-\alpha^2} - i\alpha)\right|^2}{\Gamma(2\sqrt{1-\alpha^2}+1)} \cdot e^{-2\alpha \arccos \alpha}$$

where $\alpha = \frac{Ze^2}{hc}$ and ρ the ratio of the momentum of the ejected electron to mc. Putting $Z = 83$ (RaC) we find:

$$K = 0 \cdot 82 \times 10^{-3} \cdot \frac{1}{\rho}$$

The ratio of the number of ejected electrons to the number of γ-quanta emitted for radium-C has been measured by Ellis and Aston.[2] These values are given in the second column of the accompanying table; the last column gives the theoretical values of internal photo-effect:

Energy of γ-ray in volts $\times 10^{-5}$.	Measured internal conversion $\times 10^4$.	Calculated photo-effect $\times 10^4$.
6·12	61	4·6
7·73	48	3·7
9·41	61	3·3
11·30	62	2·8
12·48	57	2·6
13·90	14	2·4
14·26	10^4 (?)	2·3
17·78	16	1·8
22·19	13	1·6

From this table we see that the number of ejected electrons is much larger than the number we could expect from internal photo-effect. This means that for the hard γ-rays of radium-C the ejection of atomic electrons is mainly due to the interaction in the nuclear region.

An attempt to estimate this effect was recently made by R. H. Fowler,[3] with the assumption of the Coulomb law of interaction between the atomic electron and an α-particle, moving in a potential box. The probability of ejection, calculated in this way, is too small to account for the discrepancy between the experimental values and the theoretical values of internal photo-effect. Fowler, also, uses non-relativistic wave mechanics. It may, however, easily be seen from general considerations that also in the present relativistic theory the effect always will be much smaller than the internal photo-effect. Clearly we are here outside the limits of applicability of relativistic wave mechanics. In these circumstances it is scarcely justified to lay too much stress on the agreement between Fowler's calculations and experiment for the β-ray line $14 \cdot 26 \times 10^5$ volt. The only thing independent of special ideas about the interaction is that one would always expect the effect to be about proportional to the probability density of the ejected electron in the nucleus ($r \to 0$). This is actually confirmed by the experiments about conversion in other than the K-levels. The electrons are ejected by hard γ-rays only from such levels as K_1, L_1, M_1, . . ., where the density at the origin does not vanish. For the ratios of the densities in the nucleus for a $2S$ and a $1S$ state we find (in the relativistic theory) 0·15 in good agreement with the experimental ratios of the coefficients of internal conversion in the L- and K-levels.

H. CASIMIR.

Institute for Theoretical Physics,
Copenhagen, Nov. 16.

[1] *Proc. Roy. Soc.*, A, **116**, p. 491; 1927; **121**, p
[2] *Proc. Roy Soc.*, A, **129**, p. 180, 1930
[3] *Proc. Roy. Soc.*, A, **129**, p. 1; 1930.

Electric Conduction in Metals.

THIS note has reference to the very interesting paper by Mr. R. H. Fowler in the Supplement to NATURE of Oct. 18 last on the conduction of electricity in metals. In this he refers to the difficulty in connexion with Drude's model in that the free electrons in the spaces should behave like a perfect gas, and so affect the specific heat relations. As experience shows that this is not so, the inference is drawn that the dynamics is wrong and we must invent a new one. But another inference would seem more natural: that the conclusion that the electrons behave like a perfect gas is wrong and we must seek the reason why. I think this is not far to seek, and the error lies in supposing that the *same* electrons are continuously in the free space. This may be illustrated by taking the theory of emission as proposed recently by me in the *Philosophical Magazine* (**8**, 108; 1919). Shortly put—the nucleus decides what particular orbits of electrons round it are to fall in, the energy of fall goes to the nucleus, and the nucleus radiates according to the $nh\nu$ law. Conversely, the reverse process also takes place. When radiations fall on the atom it absorbs those of its special periods, and when it has absorbed the quota $h\nu$ it raises an electron to a corresponding outer orbit. This then falls in and its energy is radiated again by the nucleus. Amongst these operations, some will be due to free electrons falling in, and a similar set being set free. Consequently, the free electrons in the interatomic spaces will be continually passing in and out, and they never have time to take up the energy due to the temperature of the space. The time required for this must be considerable, measured in terms of the mean interval between collisions.

The theory explains, further, the remarkable fact that a single atom behaves as a smooth sphere—or, in other words, its internal system appears dynamically isolated. In the early days of the theory of the rigid atom, the hypothesis of a smooth sphere completely explained the difficulty. But an atom consisting of a nucleus and a number of electrons circulating round it carries with it difficulties as to the equal distribution of energies between the large number of degrees of freedom involved. This difficulty disappears on the present theory. An electron entering

the domain of an ionised atom dissipates its energy until it takes up some critical orbit. Then it falls to its normal place of lowest energy in the system. The energy goes to the nucleus and is promptly got rid of by radiation. *Or*, conversely, in a hot region, the temperature radiation of the space falls on the nucleus and those of the critical periods only are absorbed. The energy is then got rid of by the reversed process. In this way the mean internal energy of the atom remains the same always, and it behaves apparently as an isolated dynamical system. The atom itself would appear to have the structure of a perfect machine. W. M. HICKS.

Change in Electron Coupling in the Rare Gases.

HOUSTON (*Phys. Rev.*, **33**, 297; 1929) has worked out an approximate quantum mechanical theory of the relation of the triplet interval ratio to the singlet-triplet interval for two electron configurations in which one of the electrons is in an *s*-state; he has also derived expressions for the *g*-values and for the intensities. Those formulæ show the variation with change of coupling.

Recently Laporte and Inglis (*Phys. Rev.*, **35**, 1337; 1930) have applied Houston's results to configurations like p^5s and d^9s by considering the invariance of the configurations p^5 and d^9 with changing coupling and taking the spin-orbit interaction and coupling factor with negative sign. The only spectrum in which the calculated *g*-values could be compared with experimental values was that of Ne I. In that spectrum Back (*Ann. der Phys.*, **76**, 329; 1925) has measured the *g*-values of the singlet and middle triplet level of the configuration $2p^53s$. The experimental data on the Zeeman effect of the rare gases which I have at my disposal, from my work on this subject in Prof. Zeeman's laboratory, enable me to give experimental *g*-values of the analogous levels of the configuration $3p^54s$ in A I and $4p^55s$ in Kr I. In the spectrum of Xe I only the *g*-value of the middle triplet level of the configuration $5p^56s$ could be measured. The following table gives the comparison of experimental and theoretical values.

g-values.

Paschen.	Russell-Saunders		(*SL*) coupling.	Ne I.	A I.	Kr I.	Xe I.	(*JJ*) coupling.
	$^1P_1$	obs						
		calc.	1·000	1·036			1·281	1·333
	$^3P_1$	obs.		1·464	1·40	$1{\cdot}24^5$	1·18	
		calc	1·500		1·399	1·243	1·219	1·166

The agreement of the observed and calculated *g*-values is very satisfactory in the cases of Ne I, A I, and Kr I. The agreement is not so good in the case of Xe I, due probably to the fact that the first order perturbation calculations do not hold for very large values of the spin-orbit interaction.

A more detailed description of the measurements will be given elsewhere. C. J. BAKKER.

Laboratory "Physica",
University, Amsterdam,
November 1930.

Surface Films.

READERS of Dr. Langmuir's stimulating and detailed review of my book, "The Physics and Chemistry of Surfaces" (NATURE, Nov. 8), may possibly suppose that there is an important difference of opinion on fundamental questions of the structure of surface films, from the criticism which he makes of one remark in the book. This I do not believe is the case; the differences, if there are any, relate to points of detail only. Dr. Langmuir appears to think I am disputing the fact that the heads of the molecules anchor them to the water and so cause spreading from bulk material on the surface; but this fundamental fact, which he himself established, is not doubted by any worker in this field, so far as I know, and has been confirmed *without exception* in many thousands of my own experiments. It is rather important that no impression of disagreement should be given on this matter: the water-soluble or 'polar' group unquestionably anchors the molecules to the surface, and if the attraction of this group is weakened sufficiently, the film either becomes unstable or cannot be formed at all. This anchoring is equally important in all classes of films, condensed, expanded, and gaseous.

My suggestion on page 75, "that the heads tend to hold the molecules together, while the chains try to disrupt the film", may be better for some explanation, since taken out of its context it is liable to be entirely misleading. It applies only to the 'liquid expanded' state of the films, and the disruption considered is a surface 'evaporation', or escape of the molecules laterally from coherent islands of monomolecular film, to form gaseous films, not a disruption by collapse of the film to form aggregates on the surface. The liquid expanded state is intermediate between the most coherent state, the condensed, and the least coherent state, the gaseous, in which there is so little lateral adhesion between the molecules that they move about independently in the surface like a two-dimensional gas. In all these states, the molecules are anchored to the water by their heads; in the condensed, they are held together in coherent islands by the lateral adhesion of both heads and chains; in the gaseous, the lateral adhesion has been practically completely overcome. In the expanded, my suggestion is that the thermal agitation has reached an amount sufficient to overcome the lateral adhesion between the chains, but that there still remains enough adhesion between the heads to prevent separation of the molecules completely. This would mean that the chains are whipping about violently, the restraints on their thermal agitation having broken down more or less completely; the heads of the molecules near the water are, however, exercising a restraining force, keeping the molecules from flying off laterally along the surface.

This suggestion is not more than a speculation, yet I believe it is the best and indeed the only tenable one of the many speculations which have yet been made as to the structure of the liquid expanded films. The principal facts to be explained are these: the films are coherent, with but a small surface vapour pressure; their area is two or three times the minimum area to which the molecules can pack in the surface; they are not formed unless there is a good deal of residual affinity in the heads of the molecules, series of compounds in which the residual affinity in the heads is small passing straight from the condensed to the gaseous (or sometimes 'vapour expanded') films; they are formed from condensed films (provided there is sufficient residual affinity in the heads) by rise of temperature, a higher temperature being required the longer the chain in the molecule, which indicates that all, or some part of, the lateral adhesion between chains has disappeared in the liquid expanded films.

My principal doubt in regard to this explanation is as to the propriety of separating in this clear-cut way between the adhesions due to the chains and those due to the heads. It seems scarcely likely that the adhesions can break down completely throughout

the length of the chains and still remain intact at the heads. Also, there is some difficulty in picturing the mode in which the heads can hold the molecules together when these are separated to two or three times their normal (areal, not lineal) spacing. My suggestion, which was made in 1928, is really the reverse of an earlier suggestion of Dr. Langmuir's, that in these liquid expanded films the heads are trying to be free as in the gaseous films, while the chains are restraining them. This does not fit the experimental facts as now known.

Let me repeat that this doubtful matter does not in the least affect the fundamental points of the theory of surface films, which were so well established by Dr. Langmuir that years of further research have only consolidated his position on all the most important questions.

Dr. Langmuir suggests that too much is made of the 'tilt' of the molecules in the films. I must plead not guilty to much definite theorising in this direction, for we owe nearly all that has been done to Dr. Rideal and his school in Cambridge. But I am sure that if we could find out the tilt of the molecules, we should know much more about the detailed structure of these films than we actually do; and therefore, although I do not believe the recent theory of Lyons and Rideal, that the chains interlock at definite angles of tilt, is correct or even probable, I cannot but applaud them for having taken some cognisance of the possibility of definite angles of tilt determined by the form of the molecules. Dr. Langmuir thinks that the molecules are nearly as free in the films as in liquids, except for their being anchored to the water by their heads. This cannot, I think, be true of all states of the films; it may quite likely be nearly true of the liquid expanded films, but surely in the condensed films, both solid and liquid, there is not room enough for as much free motion of the molecules as occurs in liquids. In one kind of condensed film, where the area is greater than that of closely packed chains, I think that the packing of the heads and perhaps a small length of the chains close to the heads decides the *area* of the film, and the rest of the chains, being flexible, pack in as best they can into the space so determined above the heads; Rideal and Lyons seem to think that the heads determine the *tilt* of the molecules and that this tilt determines the area. These differences of opinion, we may hope, will be decided in course of time. N. K. ADAM.

University College,
Gower Street, London, W.C.1,
Nov. 18.

Embryology and Evolution.

FOUR of Prof. MacBride's statements, in NATURE of Dec. 6, call for comment. "... no one has ever seen 'genes' in a chromosome." Genes cannot generally be seen, because in most organisms they are too small. In *Drosophila* more than 100, probably more than 1000, are contained in a chromosome about 1 μ in length. They are therefore invisible for exactly the same reasons as molecules. But the evidence for their existence is, to many minds, as cogent. Where the chromosomes are larger, as in monocotyledons, competent microscopists—for example, Belling, in NATURE of Jan. 11, 1930—claim to have seen genes. In a case where I (among others) postulated the absence of a gene in certain races of *Matthiola*, my friend Mr. Philp has since detected the absence of a trabant, which is normally present, from a certain chromosome. I shall be glad to show this visible gene to Prof. MacBride.

"... if Prof. Gates were a zoologist instead of being a botanist, he would know that the assumption that 'genes' have anything to do with evolution leads to results ... that can only be described as farcical". I should like to direct Prof. MacBride's attention to the droll fact that in a good many interspecific crosses various characters behave in a Mendelian manner, that is, are due to genes. This is so, for example, with the coat colour of *Cavia rufescens*, which, on crossing with the domestic guinea-pig, behaves as a recessive to the normal coat colour, but a dominant to the black. Hence there has been a change in a gene concerned in its production during the course of evolution. Scores of similar cases could be cited.

"All known chemical actions are inhibited by the accumulation of the products of the reaction. An 'autocatalytic' reaction, in which the products of the reaction accelerated it, must surely be a vitalistic one!" Autocatalytic reactions are common both in ordinary physical chemistry and in that of enzymes. Thus the acid produced by the hydrolysis of an ester may accelerate its further hydrolysis. As an example of an enzyme action, which for quite simple physico-chemical reasons proceeds with increasing velocity up to 75 per cent completion, I would refer Prof. MacBride to Table 7 of Bamann and Schmeller's[1] paper on liver lipase.

In view of such facts, Prof. MacBride's statement that "The term 'autocatalysis' is a piece of bluff invented by the late Prof. Loeb to cover up a hole in the argument in his book" would seem to be a wholly unfounded attack on a great man who can no longer defend himself. If Prof. MacBride would acquaint himself with the facts of chemistry and genetics, he might be somewhat more careful in his criticism of those who attempt to analyse the phenomena of life. He might also cease to ask the question propounded by him in NATURE of Oct. 25, "whether the organs of the adult exist in the egg preformed in miniature and development consists essentially in an unfolding and growing bigger of these rudiments, or whether the egg is at first undifferentiated material which from unknown causes afterwards becomes more and more complicated and development is consequently an 'epigenesis'". The formation of bone in the embryo chick was shown by Fell and Robison[2] to be due to the action of the enzyme phosphatase, which is neither a miniature bone nor an unknown cause. But so long as he does not take cognisance of recent developments in science, Prof. MacBride will no doubt remain a convinced vitalist.

J. B. S. HALDANE.

Biochemical Laboratory,
Cambridge University, Dec. 8.

[1] *Zeit. Physiol. Chem.*, **188**, p. 167.
[2] *Biochem. Jour.*, **23**, p. 766.

Ravens Flying Upside Down.

BIRDS frequently perform strange antics in the air, both during courtship and at other times, and the air acrobatics of the raven have long been known. Thus Morris describes him as "performing various circling evolutions and frolicsome somersets in view of his mate". Yarrell, a better observer, says that in courtship the raven "turns over sideways on his back as he flies, shooting in that position in front of his mate". More recently, in 1917 if my memory serves me, the trick of flying upside down was referred to in a well-informed article on ravens which appeared in the *Times*.

Watching birds has long been a hobby of mine, and I once had the good fortune to see a raven flying on his back. The sight was extraordinary and unforgettable, but at the time I did not realise that I had witnessed

something very unusual in the behaviour of the raven, and unfortunately I made no note. Now, however, after the lapse of many years, it has been suggested to me that the facts are worth recording.

The observation was made in July 1917, when I was staying in Patterdale. One morning, between nine and ten o'clock, I was standing in front of Patterdale Hotel watching a pair of ravens flying across the Dale from Place Fell towards the wooded heights above Patterdale Hall. They passed by me rather low down and within about 200 yards. It was a clear, bright morning, and the sun being behind me the observing conditions were favourable. I was using an excellent pair of field-glasses, magnifying eight times, and with a field of about 5°. The two birds were flying close alongside each other, as is the habit of ravens. As they were passing by, the one nearer to me suddenly, and without any warning action, rolled over sideways and after falling in a confused fashion ended on his back, some five or six feet below his mate. In this position, and without losing horizontal speed, he continued flying; or to describe more precisely what I saw, he remained on his back, flapped his wings, and travelled along in what appeared to be level flight. He kept pace with his mate, who continued stolidly on her way entirely unconcerned by the antics of her partner down below. After flying upside down for a considerable distance, the raven rolled over again and got himself right side up; not without a fluster of wings and loss of height. By this time the birds were a good deal farther off and observation had become more difficult, but before they finally passed out of sight I noticed that they were once more flying side by side, as a pair of self-respecting ravens should do.

It was not easy to estimate the distance the raven flew upside down. Anyone who has had to do with the range-finding of aircraft, as I had to do during the War, will appreciate the difficulty of estimating, even roughly, the distance travelled by a flying bird. However, doing the best I could, I judged the distance the raven flew while he was upside down to be not less than 100 yards and very possibly a good deal more. That, at all events, was the judgment of the observer at the time and on the spot.

Some years later I began to wonder how the wings of a bird would work, if at all, when the bird was on its back; and whether, in the absence of aid from the flapping wings, the kinetic energy acquired in tumbling downwards would have sufficed to carry the raven on a level course over the observed distance. But such speculations as these do not affect what I saw, and the sight has remained vividly present in my mind from that day to this.

SYDNEY EVERSHED.

40 Woodville Gardens, London, W.5,
Nov. 9.

Masking of Spike-disease Symptoms in *Santalum album* (Linn.).

DURING the course of disease transmission studies, it was found that certain stocks for long periods did not exhibit the characteristic symptoms of the disease, and were therefore believed to represent disease-resistant varieties. The leaf tissue from such operated and disease-resistant varieties was found non-infective as shown by transmission experiments conducted with the leaf on susceptible stocks. Two such plants on being accidentally injured—in one case by a borer, and by wind in the other, both involving the removal of much foliage—exhibited the characteristic symptoms during the course of 15 days after the accident, with sprouting of the dormant buds. This suggested the possibility of accelerating the manifestation of disease symptoms by defoliation and by light pruning, which has met with great success. Foliage tends to inhibit the external manifestation of the disease symptoms. In one instance the infected stock remained apparently healthy for 417 days and more than doubled its girth and size during this period; but on light pruning and defoliation the stock exhibited the symptoms during the course of 16 days, with bursting of the dormant buds. A study of the physiological changes in the composition and reaction of the cell sap induced by defoliation should reveal the true cause of this remarkable phenomenon.

In diseased forest areas, therefore, external appearance of sandal is not the true criterion of its freedom from infection, which, if dormant, manifests itself on pruning the plant. This curious masking of symptoms in the case of sandal appears to be influenced by intense sunshine, and temperature. During this masked period the virus appears to be localised in certain tissues (phloem) of the plant, where it multiplies and exists in a highly virulent form.

M. SREENIVASAYA.

Department of Biochemistry,
Indian Institute of Science,
Bangalore, Nov. 4.

The Designation of Women Biologists.

MANY years ago, Dr. Eigenmann, of the University of Indiana, finding certain small fresh-water fishes of South America very perplexing, decided to turn them over to one of his most capable students, Miss Marion Durbin. In due course of time Miss Durbin published a new genus and twelve new species of Tetragonopterid Characins, small fishes of a type which has since become very popular in parlour aquaria. Miss Durbin married Dr. Max Ellis, and papers on South American fishes, with new species, were afterwards written by each. As the species are usually cited, they are credited to Ellis, and the reader may or may not know that if they belong to a certain family they are of Max Ellis, if of another they were described by the former Miss Durbin. The first initial being the same in both cases, it is necessary to cite two initials to indicate which is which. In 1921 some new South American birds were published by G. K. Cherrie and Mrs. E. M. B. Reichenberger. There has just appeared an admirable revision of the birds of Matto Grosso, by Mrs. Naumburg. But Mrs. Naumburg is identical with the former Mrs. Reichenberger.

These examples suggest that, in view of the constantly increasing number of taxonomic papers by women, and the confusion which must result from the customary method of designating them, it would be an advantage to all concerned if, for the purposes of publication and citation, the maiden name were used without any change. It would always be possible to add the married name, as "By Mary Smith (Mrs. Wm. Jones)". Should this reform be supported by councils of societies and editors of journals, it is probable that little or no opposition would be met from the authors themselves. There is at least one well-known case of a woman author of taxonomic papers retaining her maiden name, though married.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Nov. 12.

Transmission of Infantile Kala-azar.

WITH reference to Drs. Adler and Theodor's note entitled "Infection of *Phlebotomus perniciosus* Newstead with *Leishmania infantum*", published in NATURE of Sept. 20, I would like to add that the insect concerned has not as yet been recognised as a distinct species, but only as a variety of *Phlebotomus major*

Ann. Mr. E. Brunetti [1] (1912) remarks in this connexion as follows: *P. major* var. *perniciosus* Newstead, "A form described by Newstead as a distinct species from Malta is, according to Dr. Annandale, only a variety of *P. major*, an opinion in which I am inclined to concur, there being no difference in either the venation or the male genitalia". Sinton [2] (1928) supports the same view.

S. MUKERJI
(Entomologist, Ancillary Inquiry into the Transmission of Kala-azar).

Kala-azar Research Laboratory,
School of Tropical Medicine and Hygiene,
Calcutta, Nov. 5.

[1] Brunetti, E., "The Fauna of British India" (Diptera, Nematocera"), p. 211; 1912.
[2] Sinton, J. A., *Ind. Jour. Med. Res.*, 16, 2, pp. 303-305; 1928.

THE Editor of NATURE has kindly permitted me to see Dr. Mukerji's letter, and I am glad to have the opportunity of replying to it.

Several investigators have recognised that *Phlebotomus major* and *P. perniciosus* are closely related. França and Parrot (1921) named the latter sandfly *P. major* var. *perniciosus*. It is, however, certain in the light of recent investigations that *P. major* and *P. perniciosus* are distinct species. The males can easily be distinguished. They have a similar pattern of external genitalia common to all the males of the *major* group, but they show constant differences in important details.[1] The females can also be distinguished, though not so readily as the males. This problem is discussed in several papers which will be published shortly.

It cannot be emphasised too strongly that it is important to distinguish between closely related species of *Phlebotomus*, for these often show striking differences in their bionomics and distribution, and they may also differ in their capacity for transmitting disease. S. ADLER.

Nov. 29.

[1] Adler, S., and Theodor, O., The Distribution of Sandflies and Leishmaniasis in Palestine, Syria, and Mesopotamia. *Ann. Trop. Med. and Parasitol.*, vol. 23, No. 2, pp. 269-306; 1929.

Leaf-Curl in Cotton.

IN an interesting letter (NATURE, May 3, 1930, p. 672) Mr. Kirkpatrick states that in the Gezira area (Sudan) an undetermined species of Aleurodidæ causes leaf-crinkle. In the Punjab (N.W. India) *Bemisia gossypiperda*, Misra and Lamba (Aleurodidæ), has been under observation during the last two years. This insect is present in enormous numbers but is not known to cause any deformation of the attacked leaves. Even in cages under conditions of a pure infestation of *B. gossypiperda* leaves literally covered on the under side with all the stages of the pest—eggs, nymphs, pupæ, and adults—remain quite flat and normal, and do not show curling, wrinkling, or crinkling. On the other hand, *Empoasca devastans* (Jassidæ) definitely causes leaf-crinkle.

From the sentence quoted by Mr. Kirkpatrick from "Cotton in Africa" (NATURE, Feb. 22, 1930, pp. 291-92), and from his own statement that "leaf-curl of cotton . . . is transmitted mainly, if not entirely, by . . . Aleurodidæ . . .", one is led to think that the disease is due to a causal agent which is carried either by a jassid or a white-fly. Has this been fully established?

In the Punjab we have had under observation several species of white-flies on several different hosts—for example, citrus, castor, sugar-cane, cotton, etc.—but none of these white-flies causes any malformation of the attacked leaves. M. AFZAL HUSAIN.

Entomological Section,
Agricultural Research Institute,
Lyallpur, Punjab.

Living Ostracods in the Rectum of a Frog.

QUITE recently I received a communication from Mr. J. Omer-Cooper in the course of which he said: "When examining the contents of a frog's rectum yesterday in the course of our lab. work I noticed several living Ostracods. The frog had been kept for some time in a small aquarium which contains a good many ostracods. I have pickled up some of the contents of the rectum and also some of the ostracods from the aquarium. . . . The frog was chloroformed, well washed under the tap and dissected in normal salt solution. There is no chance that accidental contamination of the preparation can have taken place."

I examined both lots of ostracods and find that the two agree. Actually there was only one species present and that was *Pionocypris vidua* O. F. Müller, a very common ostracod. The observation is of interest as it gives a means of distribution of this ostracod, and the distribution of freshwater Entomostraca generally is a problem that requires a considerable amount of investigation.

There is, however, another aspect to the problem. The species in question is easily cultivated and reproduces parthenogenetically. Pure cultures can be obtained. If these are capable of passing through the intestines of various animals they may furnish a method of investigating certain changes that are going on there, both pathological and otherwise.

A. G. LOWNDES.

Marlborough College,
Wilts.

Prof. H. B. Dixon.

THE news of the sudden and unexpected passing of Prof. Harold B. Dixon has just reached me, bringing with it the shock of personal loss. As one of the oldest of his Manchester students, space may perhaps be granted me for a few words of personal tribute.

I saw Prof. Dixon last when I was in Manchester in 1925. I called at his house rather late in the evening and found him busily engaged with a tableful of papers, working out calculations in connexion with his latest researches on gaseous combustion. We talked about his work and exchanged news of his old students until I missed the last tram into Manchester.

It was not until quite recently that I wrote to tell him of my doings since that meeting, and by return mail I received a charming letter from him, enclosing a page from his diary, closely packed with a week's engagements, while gently chaffing me on my partial 'retirement' in Bangalore. It was the last example of his method of the *oratio obliqua* so well known to his students. Like all of these, I owe him unmeasured gratitude for shrewd and wise advice, and effective help, at critical junctures. His careful watchfulness over our welfare was not always realised until revealed by later happenings.

Prof. Dixon was a splendid example of the scientific research spirit at its best, combined with an active and broad interest in human affairs. It was a privilege to know him well and to come under the stimulus of his inspiration. GILBERT J. FOWLER.

Central Hotel, Bangalore, South India,
Oct. 27.

The Machinery of the Earth.*

By Prof. J. W. GREGORY, F.R.S.

A DEFINITION of the word "machine" given in "The New English Dictionary" is "a combination of parts moving mechanically, as contrasted with a being having life, consciousness and will". According to that definition, the whole earth may be regarded as a machine, as it consists of various parts with differential movements, and it is moving in mechanical obedience to the forces of the universe and without any impulse or free will of its own. The study of the primary machinery of the earth involves consideration of its construction and of those movements of its parts which control its main function—the preparation and maintenance of its surface as the home of man.

THE STRUCTURE OF THE EARTH.

The geological method—the interpretation of the direct contemporary evidence of the rocks—has the drawback that it can only be applied directly to a thin layer, which is about one five-hundredth of the radius of the earth; and this restriction is the more regrettable as the material of the interior is different from that of the surface crust. The extent of this difference was revealed by Sir Isaac Newton, who calculated that the specific gravity of the earth is between 5 and 6. The figure generally accepted is 5·53.

Ordinary rocks vary in specific gravity between the 1·8 of clay, and 2·2 of sandstone, and 3·0 of basalt. The average cannot be more than about 2·5. For the whole rocky crust or lithosphere, which includes a great thickness of the deeper basic igneous rocks, the average specific gravity is taken by Tyrrell as 2·7. Hence the earth as a whole is composed of material more than twice as heavy as that of the crust. The internal mass is therefore appropriately named the barysphere, and a large amount of it must have a specific gravity four times as high as that of the rocks of the upper crust. It has been suggested that the matter in the interior owes its density to compression; but that view has been abandoned, and the high specific gravity of the interior is attributed to the segregation there of a large proportion of metals.

The high specific gravity of the earth can be accounted for by a metallic core with the specific gravity of about 8 to 10, or, perhaps in part, as much as 12. The material is probably mainly metallic iron alloyed with nickel, and containing smaller proportions of other metals and various silicates.

The composition of the barysphere is revealed by several lines of evidence. We may expect the earth to consist of the same materials as other heavenly bodies; and the most positive information as to the extra-terrestrial material is given by samples which fall upon the earth from outer space. They are known as meteorites and are most familiar to us as shooting stars. Their numbers are enormous. Any quick-sighted observer on a dark cloudless night can see about seven in the hour. Hence from 10 to 20 millions enter the earth's atmosphere every day. The meteorites are shattered into fragments, which fall in lumps or dust upon the surface. They are divided into two main classes. The iron meteorites or siderites consist of metallic iron with from 3 to 41 per cent and usually from 7 to 15 per cent of nickel and small proportions of other metals and some silicates. The second class are the aerolites or stony meteorites, which consist mainly of silicates and of mineral species, especially olivine and enstatite, common in the basic rocks of the earth's crust. A small intermediate group, the stony-iron meteorites or siderolites, consists of nickel-iron and silicates.

The proportion of the iron to the stony meteorites according to Sir Lazarus Fletcher's list of the meteorites in the British Museum in 1904 was 13·7 to 1. Dr. Prior's British Museum Catalogue of Meteorites (1923) includes all those known up to 1922 and has rendered practicable a more complete estimate. According to the records in that catalogue nickel-iron is twenty-one times more abundant in meteorites than stony material. Hence, if the earth represents a fair average of the material of the universe as revealed by meteorites, its metallic barysphere would have twenty-one times the bulk of the stony crust, which would be about 140 miles thick.

The relative thinness of the stony crust is confirmed by radioactivity. The earth's radioactive power is surprisingly weak. As determined by Lord Rayleigh, it can be accounted for if all the radioactive constituents are confined to a depth of about 45 miles. The material below that shell is practically non-radioactive. The iron meteorites are also non-radioactive. This evidence indicates that the earth's core is composed of nickel-iron.

This conclusion was originally advanced by J. Milne from the study of earthquakes. He found that earthquake waves which in their course go deeper than 30 miles undergo marked acceleration, owing to their entry into a highly elastic material which Milne called 'geïte', as it is the rock that forms the bulk of the earth; and he concluded that it consists mainly of nickel-iron. Subsequent research has confirmed this conclusion. The earth consists of an outer stony shell—the earth's crust or lithosphere—which is separated by a fairly sharp surface from the underlying barysphere. This inner mass, being denser, more elastic, and non-radioactive, is probably a mass of nickel-iron, like the iron meteorites. That the core of this mass is different in constitution from the rest was shown, also from earthquake evidence, by R. D. Oldham. He found that earthquake waves of distortion do not pass through the central region of the earth. Within the elastic barysphere is a centrosphere, which transmits waves of compression but not waves of distortion. It is therefore either a liquid or a gas.

An earthquake sends out waves of three kinds from its centre of origin. Two of the sets of waves are small vibrations or tremors that go through the

* From the seventeenth Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered on Nov. 7.

earth; the third set are large waves that travel along the surface and may cause widespread devastation. All three kinds of wave are recorded on seismographs at a suitable distance.

The simple earthquake seismogram includes records of the three kinds of waves; it begins with small jerks made by the first tremors, which are waves of compression. They are known as the *P*-waves, *P* standing for primary, as they arrive first; but the late Prof. Turner suggested the name of push-waves as they are pressure waves. The second set are the *S*-waves or secondary waves, which are due to vibrations at right-angles to the path of the earthquake. They are waves of distortion. Prof. Turner called them the shake-waves. They are followed by the large waves or *L*-waves.

The first push- and shake-waves travel at the speed with which such waves travel through granite; hence they must have passed through a layer of the earth's crust composed of a rock like granite.

Farther from the centre the seismogram is more complex, as two sets of push-waves and two of shake-waves may arrive before the large waves. Still farther away there may be three sets of push-waves and three of shake-waves. The P_{g} or shallow push-waves have a velocity of 3¼ miles per second, which is that of such waves through granite. The second set of push-waves (*PP* or P_{x} waves) have a velocity of 4 miles per second, which is that of such waves in diorite; the third set of push-waves (P_{n}) have the velocity of 4¾ miles per second, which is that in such a highly basic rock as dunite.

Accordingly it appears that below the surface is a layer of rock like granite; beneath it occurs diorite, as suggested by Prof. Holmes; and lower still is a more basic rock, which transmits the push-waves at 4¾ miles per second.

Farther from the origin of the earthquake four out of these six sets of waves are not recognised and only the P_{n} and S_{n} waves and the main waves leave their record on the seismogram.

The P_{n} and S_{n} waves both traverse the geïte until they reach the depth of 1800 miles. A wave going to that depth, emerges at the surface at a distance of 103° from its origin; between that distance and 144°, the push- and shake-waves are not recorded. So an earthquake under the north pole would be felt by its push- and shake-waves so far as 13° S. of the equator, in say southern Peru; farther south there would be no record of them before reaching the latitude of Cape Horn; but farther south again the push-waves would disturb the surface so far as the south pole. The shake-waves, however, would not be felt anywhere south of Peru.

This suppression of the shake-waves around the antipodes to the place of origin of an earthquake was first recognised and explained by R. D. Oldham. He pointed out that as only the waves of compression reach the antipodes, the earth's central core must consist of material which transmits waves of compression but not waves of distortion. It must therefore be liquid or gaseous. That it is liquid is shown by the yielding of the earth to tidal strain, which indicates a less rigid earth than earthquake observations; and Dr. H. Jeffreys has shown that the contradiction between this evidence disappears if a liquid centrosphere occupies half the diameter of the earth.

According to Oldham and Knott, the liquid core is a fifth of the radius or $\frac{1}{125}$th of the mass of the earth; but according to Dr. H. Jeffreys' estimate it is half the radius, or an eighth of the mass of the earth. This huge centrosphere is doubtless a liquid mass of nickel-iron, which, owing to compression, has a specific gravity of 12.

Such, then, is the general structure of the earth-machine; it has a fluid centre, a thick metallic shell, the barysphere, and an outer rocky crust, the lithosphere.

As the earth is approximately spherical, we may regard it as a huge projectile, travelling at an enormous velocity through space, and consisting of an iron shell which, like those of modern artillery, is hardened with an alloy of nickel.

ORIGIN AND HISTORY OF THE EARTH.

The separation of the barysphere and lithosphere is the natural result of their difference in specific gravity. The lithosphere consists of light silicates and earthy materials which floated to the surface out of the heavy metallic mass, as the earthy impurities in iron-ore float to the top as slag when the ore is smelted in a furnace. The rocky crust may therefore be regarded as a slag which has exuded from the metallic mass below.

Laplace's long accepted nebular theory of the origin of the solar system is now generally discredited; and the earth is regarded as either a mass torn out of the sun by the attraction of a passing star, or as due to the aggregation of a swarm of meteorites, and mainly of those which, having a planetary orbit, are regarded as infinitesimally small planets and are known as planetismals.

The meteoritic theory of Lockyer and the planetismal theory of Chamberlin and Moulton are both out of favour in Great Britain; but they have to the geologist the advantage that they do not start the earth as a fragment of a body with, according to C. E. St. John, the temperature of 29,000,000° C. For the oldest and most deep-seated of the known rocks in the earth's crust show no evidence of transcendent temperatures.

Either the earth never experienced the supreme temperatures of the sun or hotter stars, measured by millions of degrees, or it had cooled down to about 5000° F. before the formation of the oldest known part of the crust.

The earth clearly passed through a stage in which it was so hot that it was plastic and behaved as a fluid body. One relic of this early stage is the high temperature of the earth's interior, as known from the uncomfortable heat of deep mines and the boiling water of deep-seated springs. The standard rise of temperature underground in Europe is 1° F. for every 53 or 58 feet of descent.

If that rate continued, the temperature 5 miles deep would be above 500° F. and at the earth's centre, 3950 miles deep, would be nearly 400,000° F. There is no geological evidence for such a tem-

perature within the earth. None of its minerals imply temperatures higher than the 2500° F. of sillimanite, or the 3100° F. of cristobalite, or the 3450° F. of some species of olivine. There is no geological evidence that the central hot mass or thermosphere has a temperature higher than a few thousand degrees. The internal heat was not too high to prevent the formation of a solid non-conducting crust, which soon became so thick as to prevent the thermosphere having any material influence on climate. The oldest interpretable fossils indicate that at the beginning of geological time the climate of the earth was about as warm as in modern times. Evidence of this surprising fact is given by the existence at about the time of the oldest fossiliferous rocks of glaciers in the Yangtze-kiang Valley, and of glaciers that nearly reached the tropics in South Australia. Those glaciers do not imply that all the earth had then a colder climate; but they do prove that the conditions were not tropical over the whole of the earth. Judging from the marine organisms nearest in date to these early glacial deposits, the mean climate of the earth was similar to that of to-day.

Climate has undergone marked local variations. Sometimes it was more uniform over the earth and at others the extremes were greater, after mountain uplifts had increased the local differences.

Even allowing for such changes and for those due to different distributions of land and sea, the meteorological agents have been remarkably uniform. In rocks of all ages the imprints of the raindrops are of about the same size. The sand grains spread over the deserts or heaped in sand dunes, and the ripples on 'the sands of time' have been always approximately equal; and the particles of volcanic dust and tuff also show that the ejecta of ancient and modern volcanoes have been scattered by volcanic explosions and winds of similar power.

This climatic uniformity since the Cambrian period indicates that the earth's crust had by then acquired approximately its present thickness and strength. Before that date it must have been thinner and weaker, as is proved by the universally tilted condition of the primeval (Pampalozoic) rocks. The sedimentary rocks of the crust were deposited in horizontal layers; most of them have been tilted. The younger rocks generally have a slight dip except near fold-mountain chains, which are due to the crust having been squeezed into a smaller space, and having accommodated itself to this compression by folding. In modern rocks violent lateral compression is limited to relatively narrow belts along the younger fold-mountain chains.

As the older rocks of the crust are steeply tilted in all parts of the earth, the pressure that disturbed them was then universal. The crust was undergoing contraction to an extent which threw all that is known of it into folds, for as the crust sank over the diminishing internal mass the whole of it was packed into a narrower space and was thereby thickened and strengthened.

The change from the thin, universally crumpled crust of the older primeval time to the thicker, stronger crust which yields to compression by package along narrow bands has led to a fundamental difference in geographical conditions. Land and water were re-distributed and this change had a great effect on local climates.

When the crust was weak, its buckling would have produced many shallow basins and domes, so that water was distributed in land-locked seas, scattered widely over the surface. The total sea surface was apparently much less than at present, for the commonest rocks of the latter part of the primeval era are reddish sandstones and layers of red shale, with wind-rolled sand grains and pebbles polished and faceted by wind-blown dust.

The powerful effects of the wind and the prevalent desert conditions may have been due in part to the absence of turf, which binds the sand and prevents its grains being constantly rolled forward by the wind. The lack of land vegetation suggests that the environment was unfavourable for it. The extensive limestones in the primeval seas indicate that seaweeds were luxuriant. The failure of plants to grow well on land suggests that the conditions did not suit them. The absence of land vegetation until Silurian and Devonian times may have been due to climate. The prevalence of deserts in the upper Pampalozoic is evidence of a dry atmosphere, which would have been the natural result of a greater proportion of land to sea than in later geological epochs.

The growth of the seas involves an increase in the amount of water on the earth's surface. The possibility of this increase was discredited when the authoritative estimates of the age of the earth varied between ten million and a hundred million years. Annual additions to the surface water that would be negligible in a few million years become important when they accumulate for thousands of millions of years.

At one time it was held that all the water on the earth's surface is meteoric and has fallen as rain. But the evidence is convincing that much of the water of hot springs and deep mines and that given off by igneous rocks and volcanoes is of deep-seated origin. It is plutonic water which has worked its way to the surface. The amount discharged was probably greatest in early times when the crust was thinner and more often fractured. The transfer of deep-seated water from the interior to the surface during geological time must have added largely to the volume of the seas. According to Prof. Schuchert the earth's surface water may have increased by 25 per cent since the beginning of the Cambrian period. Though data for a quantitative determination are inadequate, the evidence is in favour of the seas of the earlier days having been shallower and less extensive.

Hence, although the earth's crust had early become sufficiently thick to cut off the surface from any material contribution from the internal heat, yet the shrinkage of the interior so frequently fractured the crust that plutonic water rising through the fissures has continually widened the seas and thus helped in the better nourishment of the land.

THE EARTH IN MOTION.

The earth is not only a complex structure built up of several distinct parts, but also it is in motion at a terrific speed. It is charging through space, with the rest of the solar system, at the rate of 750 miles a minute; it travels along its orbit around the sun at more than 1000 miles a minute; and its rotation around its axis gives any place on the equator an additional movement of more than 1000 miles an hour. The fact that the earth holds together in spite of such movements shows that it is strongly constructed: but it is sufficiently plastic, owing to its hot interior, to be automatically moulded into a spheroid, or more correctly, into a geoid. It is approximately an oblate spheroid owing to the moulding force of its rotation.

The rotation has not been uniform. Owing to tidal friction it is slowly losing speed and the day lengthening. According to Sir George Darwin and Dr. H. Jeffreys, the earth's day was at one time only five hours long. Changes in the shape have also affected its rate. For example, the polar regions have been raised and lowered to an extent that would have affected the earth's ellipticity as shown by the widespread occurrence of raised beaches in both the polar regions. These beaches are so regular and horizontal that they have been attributed to the so-called 'eustatic' movements or world-wide variations of sea-level. But that view is improbable, as the raised beaches, which are conspicuous in Scotland, occur at a lower level or are absent from most of England.

A change in the earth's rate of rotation would produce circumpolar beaches, for its slackening would lower the sea in the tropics and raise it in the polar regions. The distribution of the raised beaches is, however, probably due to the alternate subsidence and upheaval of the polar areas; and if both of them had sagged simultaneously the earth's ellipticity would have been increased and therefore also its rate of rotation.

The earth revolves like a badly made and badly mounted fly-wheel, and its wobbling causes some shifting in the position of the poles, as proved by the variation of latitude. The movement of the poles that has been actually observed is small, and has been attributed to meteorological factors, which Dr. Jeffreys has shown to be insufficient. The deformation of the earth by crustal changes is the more probable cause. Any extensive migration of the poles has been declared impossible, since a body with so heavy a load on its circumference as the earth's equatorial bulge could undergo but minor oscillation of its axis. That the wandering of the poles has been within narrow limits is consistent with the geological evidence; for the distribution of animal life has been along zones that were in general parallel to the present climatic zones.

The changes in shape of the earth have, however, had an important influence in other respects. The earth cannot be deformed beyond a limited amount or it would become unstable and ultimately fly to pieces. But with the wonderful automatic adjustments of the earth, as soon as deformation renders the crust unstable, stability is restored by movements by which the approximately spheroidal form is recovered. The convulsions during this process lead to changes in the crust that are indispensable for its primary service as the home of man. The lot of man is dependent on the earth's movements in space and on its power of self-adjustment to changing conditions, both internal and external. The combined rotation and revolution determine the weather and weather-changes in all parts of the earth, and thus control the habitability of the earth. The movements within the crust, which depend on its adjustment to the shrinking interior, provide for our many and fastidious needs.

The earth's atmosphere is apparently fickle and liable to great changes in composition, but the limits of its variation must be narrow. Its maintenance at the special composition breathed by animals, and that protects the earth from undue changes of temperature, is one of the beneficent functions of the sea. The efficiency of the atmosphere depends on its content of carbon dioxide, which is affected by many agencies. The sea acts as the great regulator of the atmosphere, and counteracts the disturbing factors; if too much carbon dioxide is taken from the air the bicarbonates in the water are dissociated and the sea breathes it forth until the standard proportion is restored. If volcanic activity or forest fires add an injurious amount to the air, the sea absorbs the excess and retains it as bicarbonates. The atmosphere is thus maintained at the special composition necessary for human respiration.

Man requires dry land that has been drained and left available for his occupation, and it would be of no use unless most of its surface were sloping. The land is constantly being lowered by wind and rain, and would in time be planed so level that the rain water would lie upon it and be removed only by the slow, chilling process of evaporation. But, thanks to the interaction of the crust and the shrinking interior, the surface is being lowered in some places and upheaved in others. The instability of the crust, which we deplore when an earthquake devastates a province or slays a hundred thousand people, renews the slopes on which the habitability of the earth ultimately depends.

The crustal movements by tilting the surface produce slopes which are essential for the flow of water and the formation of the grassy steppes where have evolved many of the animals most helpful to man, including those that supply wool and hair for clothing, meat and milk, and serve as beasts of burden.

Man also requires a soil that will produce the foods necessary for his nourishment; and soil is a delicate instrument that is easily exhausted and rendered infertile. The flow of water, though indispensable, charges the soil heavily for its service. Water is the most active of general solvents and removes in solution enormous quantities of the constituents essential to plant growth.

This process would in time leave only insoluble materials, and the soils would be barren and useless.

The earth is saved from this fate by the re-fertilisation of the soils from the primary rocks of the interior, which are rich in lime, alkalis, and phosphorus. Movements within the earth upraise igneous rocks to form highlands and mountains, and their constituents are washed down the slopes and renew the fertility of the lowland plains.

The tilting of the rocks on the surface in consequence of the internal shrinkage makes another essential contribution to the economy of Nature. Many of the most useful minerals lie in the old rocks, and if they were still horizontal the minerals would be so deeply buried that their discovery and economic working would be impracticable. But as the rocks have been tilted and folded the mineral seams are exposed on the surface, where they are easily found and can be profitably mined.

Hence the interaction of the different parts of the earth machine has rendered possible the evolution of man and still controls his destiny; for it keeps the earth's surface drained and habitable, it distributes the seas so that the land is supplied with rain and fresh water; it maintains the constituents of the air at the balance required in the breath of life, and it raises from the interior the minerals that renew the fertility of the soil and provide the mechanical engineer with the materials that have rendered possible the development of modern civilisation.

The Adequacy of Human Dietaries.

THE importance of the food supply in the preservation of normal health and well-being is generally recognised among scientific observers, but the necessity for a scientific selection of the food, in addition to that due to the dictates of appetite, is not always realised by many classes of the population. Dietary surveys, carefully performed, will indicate the adequacy, both quantitative and qualitative, of popular diets, in terms of accepted standards: when estimates of the cost of the diets are also made, data are available as to the minimum cost of an adequate food supply under different conditions. At the same time, encouragement may be given to education on the planning of adequate diets at minimum expense, especially if the surveys indicate that many dietaries are not only inadequate but also expensive.

J. B. Orr and M. L. Clark (*Lancet*, vol. 2, p. 594; 1930) have recently completed a survey of 607 families in seven cities and towns in Scotland. The information was collected from the housewives and is considered to be fairly reliable. For the calculation of the composition and energy value of the diets, Sherman's and Plimmer's tables were used. These tables allow for inedible material in the food purchased, but not for waste, for which 10 per cent should probably be deducted from the figures given for food consumption. Allowance must also be made for the fact that the food requirements of women and children differ from those of men; it is customary to express their requirements as a fraction of that of an adult man, taken as equal to 1, so that the 'man-value' of the diet of each family was calculated, using Cathcart's table. No account, however, was taken of the occupation of the adults. The mean man-value for each family was 4·86; the calorie consumption per man per day was 3609 cal., composed of 108 gm. protein, 574 gm. carbohydrate, and 86 gm. fat. The consumption in individual households varied widely from the mean, as shown by coefficients of variation of 20-30 per cent. Cases of insufficient caloric consumption were, however, relatively few; a larger number showed an intake of 4000 cal. per man per day or more, indicating either an unnecessarily high consumption or excessive waste. The average is slightly higher than that found in previous studies in Great Britain, but lower than in those carried out in other countries. Protein accounted for 12·3 per cent, carbohydrate for 65·5 per cent, and fat for 22·2 per cent of the calories.

A less satisfactory state of affairs was disclosed when the protein, calcium, phosphorus, and iron intakes were determined. The protein consumption was below the standard in about two-fifths of the families. The average figures found for the minerals were: calcium 0·86 gm., phosphorus 1·70 gm., and iron 0·0143 gm. per man per day. The figures for calcium and phosphorus are slightly above Sherman's estimates of an adequate intake, that for iron slightly below. About one-quarter of the families were receiving too little calcium and phosphorus, and nearly two-thirds too little iron.

Cathcart's figures for man-value are based on maintenance requirements; when a more stringent standard (Hawley's) was employed, which makes allowance for the fact that growing children require relatively more of certain constituents than adults, a larger number of families showed deficiencies in their intake of protein or minerals. In fact, most of the diets appeared incapable of supporting the optimum rate of growth.

The results of the survey probably explain, at any rate in part, the results obained by G. Leighton and M. L. Clark when extra milk was added to the diet of school children (*B.M.J.*, vol. 1, p. 23; 1929). It was found then that the addition of about a pint of extra milk daily to the diet was followed by an increase in the growth rate, indicated by increased weight and height as compared with the controls. Separated was as good as whole milk, but biscuits had no such effect; separated milk is a good source of protein and minerals, and to these a part at any rate of the good effect can be ascribed. Orr and Clark conclude that the dietaries of urban households can be considerably improved by the addition of milk to supply protein, calcium, and phosphorus, and of green vegetables to supply calcium and iron; both would also supply any vitamins deficient in a carbohydrate-rich diet.

F. M. Williams and J. E. Lockwood have carried out a similar survey among farm and village

families in Central New York, with the addition that the costs of the diets were also worked out (*Bulletin* 502, April 1930, Cornell University Agricultural Experiment Station, Ithaca, N.Y., U.S.A.). The survey in each family covered a period of four weeks and both bought and home-grown food was included, the cost of the latter being credited at current average wholesale prices. The standards used were similar to those employed by Orr and Clark, though the table for calculating the 'man-value' of a family with respect to energy requirements was not quite the same. In addition, an 'adequate food cost unit' was employed; this was obtained by taking the annual retail value of a diet supplying 3400 calories daily, a 'man's' requirements, as equal to unity, and expressing the cost of other diets as a fraction thereof. The adequate food cost scale was found to diverge slightly from the energy scale, especially in the case of children and when diets of low energy value were employed, since, for calories consumed, the cost of these is relatively high.

The analysis showed that 42 per cent of the village families and 64 per cent of the farm families were adequately fed. In many cases home-produced food made a substantial contribution to ensuring the adequacy of the diet and accounted for a considerable part of the retail value of the food consumed. In the inadequately fed families, it appeared that poor food selection rather than poverty was the cause of the poorness of the diet: the deficiency was most marked in the minerals, less so in the protein and calorie consumption. As in Orr and Clark's study, over-consumption was observed in a number of families.

The result of the study indicates the importance of proper selection of the food, and the addition to income represented by a supply of home-grown produce.

News and Views.

WHEN the Expiring Laws (Continuance) Bill came before the House of Lords on Dec. 15, Viscount Hailsham's amendment, which provided for the continuance of the Dyestuffs (Import Regulation) Act, 1920, until Dec. 31, 1931, was carried by 87 votes to 14. Viscount Hailsham sketched once again the circumstances attending the birth, decline, and revival of the industry in Great Britain. During the past ten years the progress made has been so remarkable that success appears to be the main argument used against the continuance of a protective measure. Although the Council of the Colour Users' Association expressed a majority opinion in favour of the lapse of the Act, the president of that Association holds the contrary view; any risk of undue exploitation in the matter of price is removed by the undertaking which the dye-makers have given. Lord Parmoor (Lord President of the Council) repeated the Government's view of the matter as involving conflict between dye-makers and dye-users. The dye-makers have been put into a position in which they can compete with imported dyes; they have built up a great industry, for which everyone is grateful, but the time has now come to make the change in the interests of the dye-user. The Earl of Crawford said that so far as research is concerned, this industry has been a triumph. Some of the most remarkable discoveries in organic science have been made by men working on dyestuffs. The industry is emphatically a key industry, is of great importance in defence, and is becoming the focus from which pharmaceutical progress radiates. The Marquess of Reading said that the matter is not one of free trade or protection; Lord Cowley claimed that the continuance of the Act would be a burden on the textile industry, a view which was challenged by Lord Newton, who showed how small is the cost of the dye contained in a suit of clothes. Lord Arnold, Paymaster-General, contended that the dye industry would not be injured. Hence the present situation, besides being of political interest, may lead to a comprehensive scientific examination of a scientific and industrial problem.

THE Slaughter of Animals Bill, which passed its second reading in the House of Commons on Dec. 12, would make compulsory in England the modern methods of slaughter already in vogue in Scotland, Holland, and elsewhere. This measure has been vigorously resisted for many years by the meat traders, but their opposition has now been withdrawn except as regards the inclusion of pigs. The questions at issue were mainly questions of fact which could be, and nearly all have been, settled by experiments and observation in a scientific way. In 1925 the meat inspectors of the City of London Corporation conducted trials on an extensive scale, and since then other trials of a scientific character have been carried out, notably that by Dryerre and Cameron of Edinburgh. It is to be regretted, therefore, that some members of Parliament attempted to deal with these matters of fact by means of disingenuous rhetoric. One member, for example, dramatically produced two skulls, as evidence of the relative merits of the poll-axe and the humane-killer; whereas the City of London meat inspectors had tested this point by observations on no fewer than 1745 animals. Again, Messrs. Marsh and Baxter circulated to every member a manifesto in which they alleged that the humane-killer causes 'blood-splash' in pigs, and quoted in support of this view veterinary opinions all dated 1923 or earlier; whereas in 1925 the City of London meat inspectors examined more than 700 shot pigs, and found that "in not one of them was splashing in the slightest degree observed". Humanitarians may learn a lesson from the rapid progress that has been made by the humane-slaughter movement in recent years. Most of its advocates have worked by patient insistence on verifiable facts, and its success has been far greater than that achieved by some other good causes in the promotion of which there has been recourse to exaggeration and rhetoric.

THE Pilgrim Trust, founded by Mr. Edward S. Harkness of New York, has made one of its first gifts to the Royal Institution. The Trustees have allocated

the sum of £16,000 to meet the deficiency on the fund, for reconstruction of the building in Albemarle Street. In informing the Institution of this grant, the Trustees state that in making it they had regard to the distinguished scientific services rendered to the whole community for more than a century by the Royal Institution, and to the approaching Faraday celebrations. They were also not unmindful that the founder of the Royal Institution, Count Rumford, was of American origin. The provision of funds to meet the cost of the extensive programme of reconstruction which was forced upon the Managers has been a matter of the greatest concern to them and to every friend of the Institution. It will be recalled that, following a series of alarming explosions in Albemarle Street more than two years ago, the condition of the historic lecture theatre from the point of view of fire risks was shown to be such that reconstruction could no longer be deferred. Plans conforming to modern standards of fire protection, including the provision of suitable exits from the theatre, proved to involve the rebuilding, not of the theatre itself alone, but also of a large part of the structure surrounding it. After the fullest consideration, the work was put in hand at an estimated cost of not less than £80,000; now, as it is rapidly approaching completion, the actual cost is found to be upwards of £90,000.

THE aim has been to raise the sum required for reconstruction without drawing upon the existing funds of the Royal Institution and thereby crippling the already inadequate provision for research. In this the Managers have been successful, and by special measures, and with the generous assistance of private individuals, and of industries which have benefited, indeed in certain cases have their origin in the scientific work at the Royal Institution, they have raised a large fund. This, with the addition of the £16,000 from the Pilgrim Trust, is now sufficient to meet practically the whole cost of the rebuilding. The Institution is thus enabled to enter upon the year of the forthcoming Faraday celebrations and to look forward to a continuance of its work free from immediate financial embarrassment. With the cost of the rebuilding provided for, the Managers are free to turn their attention to another pressing object, the endowment of research. Some progress has already been made towards the establishment of a fund for this purpose. In the coming year it is hoped to add considerably to this fund, and thereby to place the scientific work of the Royal Institution and the Davy Faraday Laboratory on a financial footing which accords with the requirements of modern research.

FOUNDED in 1881, the Society of Chemical Industry will next year celebrate its jubilee, chiefly by means of proceedings of a domestic character associated with the annual meeting, which will begin on July 13 and extend over the succeeding seven days. It is intended to confer the rare distinction of honorary membership of the Society on a small number of eminent foreign technologists. It is also intended to present inscribed plaques to the original members of the Society and to the prime wardens or masters of such livery companies of the City of London as have specially fostered the education or progress of applied science. In addition to the social engagements appropriate to such an occasion, there will be arranged exhibitions of apparatus and plant and visits to works typical of the manufactures of London. Two special publications are being prepared in honour of the jubilee. Dr. Stephen Miall, editor of *Chemistry and Industry*, is writing a comprehensive history of the chemical industry, whilst a special number of the Society's *Journal* will include reprints of the outstanding papers which have appeared during the fifty years of its existence. The progress of chemical industry and that of the Society itself will be outlined, and use will be made of the opportunity for biography. These publications will be available to the general public, for whose information and interest there are also being arranged a series of broadcast addresses and the distribution of authoritative articles dealing with the relation of chemistry to life and industry.

THE International Conference on Silicosis held at Johannesburg on Aug. 13–27 last has an interest quite apart from the valuable conclusions reached in its study of the medical aspects of this dangerous industrial disease. The Conference, which was summoned by the International Labour Office with the assistance of the Transvaal Chamber of Mines and the Government of the Union of South Africa, was the first held outside Europe under the auspices of the League of Nations, and was also the first experiment in co-operation between the International Labour Office and the scientific world. Delegates from Germany, Australia, Canada, Great Britain, Italy, Holland, the Union of South Africa, and the United States of America participated in the work of the Conference, which, in addition to the opportunity of exchanging views and comparing practice, enabled the delegates to obtain personal acquaintance with the achievements of the Miners' Phthisis Bureau of South Africa. An average of £1,000,000 per annum is spent by the mining industry of the Rand in medical care and compensation for silicosis, and Mr. Sampson, the Minister of Posts and Telegraphs, in opening the proceedings, stressed the value of international co-operation in combating this disease.

THE recommendations of the International Conference on Silicosis were adopted as a result of discussion upon reports presented upon three groups of problems: prevention, medical aspects, and compensation—the greater part of the sessions being devoted to the discussions in these groups. Among the recommendations of chief interest to scientific workers are those which urge the absolute necessity of scientific research, and particularly research designed to secure uniformity of terminology and of radiological technique. The collection of further information concerning the incidence and development of the disease and the study of methods of rehabilitation was urged, and the Conference requested the International Labour Office to publish periodically a bibliography on silicosis. The Conference sets a

precedent that might well be followed more widely in the co-ordination of scientific research on social and industrial subjects.

IN connexion with the International Conference for Phytopathology and Economic Entomology held in Holland in 1923, prizes were offered in 1928 for the best two memoirs concerning (1) investigations on rust diseases (Uredineæ) of cereals, and (2) investigations on the rôle played by insects or other invertebrates in the transmission or initiation of virus diseases in plants, the prizes being of the value of 1000 Swedish crowns (about £55) each. It is now announced that the prize for the most meritorious investigations on Rusts has been awarded to Mr. J. H. Craigie, Senior Plant Pathologist in Charge, Dominion Rust Research Laboratory, Winnipeg, Manitoba, Canada. Mycologists will recollect that it was Mr. Craigie who recently discovered the hitherto unknown and important function of the spermogonia of the rust fungi. The adjudicators have made no award in connexion with the subject of the second prize.

ONE of the most interesting developments in high voltage engineering is the use of a method by means of which cables are kept constantly impregnated with oil. As the temperature of the cables is continually altering owing to variations in the load, it is necessary to provide means so that when the cable is hot it is relieved of the excess oil caused by expansion due to temperature and when cold the oil is returned to it. For this purpose feeding tanks have to be supplied when the level of the cable is high and pressure tanks when the level is low. These cables seem to be opening up a new era in power transmission and they are being very closely studied. In the *G.E.C. Journal* (England) for November is published the second of a series of articles by E. H. Horley on the manufacture and testing of the accessories used in oil-filled cables. He points out that the length of the cable which can be supplied from one feeding tank is limited by the viscosity of the oil and the resistance the central channel in the cable offers to the flow of oil along it. The length of this section can be increased considerably by using a pressure tank to assist the feeding tank by taking in oil during the first period of the heating of the cable and sending it out during the first period of the cooling. This is done by constructing cylinders containing flexible walled cells made of corrugated nickel plates. The number of these cells corresponds to the amount of oil required to operate the section of the cable. To test a cell, it is subjected to 10,000 cycles of rarefaction and compression. The test is done automatically for a few days and nights, and is equivalent to several years of actual working. Every length of cable dispatched from the factory has a tank filled with oil under pressure connected with it.

As Italy has practically no coal resources, it has to import nearly all its own coal. Since the War, the price of coal in Italy has fluctuated between wide limits. At the present time it is about thirty shillings per ton. One of the objects of electrifying the railways in Italy was to utilise the water power available in the mountainous regions and thus reduce the importation of coal. Last year the saving effected in amount of imported coal required was about 20 per cent, and the average water power developed exceeded two million kilowatts. During the thirty years since electric traction first began to be used, much experience has been gained on the electric systems in use. G. Bianchi read a paper on this subject to the Institution of Electrical Engineers on Nov. 20. Up to 1916, 230 miles of the railways had been electrified on the three-phase system at 16 cycles. A drawback to this system was that it required exclusive generating stations fairly close together and so further electrifications after 1916 were carried out on the three-phase system at the standard industrial frequency of 45 cycles. The energy was converted into direct current of 3000 volts before reaching the motors of the locomotives, as this has the advantages of simplicity of the overhead contact line and great ease in speed regulation. It was originally intended to confine the 3000 volt d.c. system to the lines of southern Italy, but it has now been decided to carry out the electrification of the Florence-Rome and of the Milan-Bologna lines on this system. When this is done, there will extend from Milan to Naples an electric line which, traversing the peninsula from north to south, will carry the greatest part of the longitudinal traffic of the Italian railways. In order to meet the eventuality of a substation break-down which cannot be repaired in a short time, travelling sub-stations have been constructed. These travelling sub-stations have proved so useful, both from the technical and economic points of view, that it seems probable that they will come into continuous use.

IN two addresses to members of the Eugenics Society in association with the Psychology and Education Sections of the British Association at the Bristol meeting, Prof. R. J. A. Berry, Director of Medical Services in the Stoke Park Colony, Bristol, discussed the physical basis of mind and the diagnosis of mental deficiency. His addresses are summarised in the October number of the *Eugenics Review*. He points out that probably 80-90 per cent of primary mental deficiency is due to bad heredity. In mental defectives it is the pyramidal cells of the controlling supragranular cortex of the brain which are chiefly lacking, while those controlling the animal instincts of self-preservation and sex are often well developed. Mental defectives are usually more or less markedly microcephalic owing to the small development of the brain. Several striking cases were described, illustrating the various types of arrested mentality—the idiot, the imbecile, and the feeble-minded. The various physical and mental tests applied in determining the mental condition are also described. A feeble-minded woman thirty-two years of age may have the brain of a girl of six years and the mental capacity of one of eleven years, combined with bodily growth at the fourteen-year level and the sexual passion of an adult. Lack of control of the natural reactions is the inevitable result. Prof. Berry states that in Great Britain we are spending some £93 per head per annum on mental defectives, who frequently are allowed to reproduce their kind,

while we spend only £12 per head on the normal child. Thus does civilisation bring about its own downfall.

REFERRING to the correspondence under the heading of "Highest Recorded Shade Temperature", on p. 723 of NATURE for Nov. 8, Prof. A. J. Henry gives some further interesting particulars of the conditions under which a temperature of 134° F. was recorded at Greenland Ranch, Death Valley, California, on July 10, 1913. On the day in question there was a slow drift of air from the north, that is, from the high plateau of Nevada, which reaches a general elevation of 6000-8000 ft. On this bare continental plateau the temperature probably approached 100° F., in spite of the elevation. Death Valley itself lies below sea-level, and in its steep descent of several thousand feet from the Amargosa and Funeral Mountains the air was warmed dynamically to a most abnormal temperature. The extreme conditions occurred only in Death Valley, which is a long, narrow trough running north and south, while in other parts of California the day was not especially hot; but these considerations justify the acceptance of the record. Unfortunately, there is not sufficient information available in Great Britain to examine the Azizia record in similar detail, and Prof. Henry is still sceptical as to its reality.

INQUIRIES are often made by amateur naturalists as to how, without starting upon some intricate investigation, they may add new facts to the sum of knowledge. To such and to their advisers we commend an article in the November issue of *British Birds* on "Our Present Knowledge of the Breeding Biology of Birds", by the Rev. F. C. R. Jourdain. The author emphasises the lack of information which at present exists about the length of the incubation period in many common birds, and about that interesting and variable detail, the parts taken by the cock or hen or both in sitting upon the eggs and later in tending the young. The information given is of real value as a guide to the potential investigator, for not only does the article contain a list of the birds concerning which further observations are required, but also it states the form which the observations ought to take. Readers familiar with the immense amount of literature which has been devoted to the birds of the British Isles will be amazed at the number of blanks which occur in the records of incubation and fledgling periods of common birds.

IT is highly probable that in the future tidal power will be used extensively. In most industrial countries, however, the low cost of coal and the progress made in the technique of coal burning imposes a severe restriction on its development, except in a few very special cases. The main problem that has to be overcome is to find an economic way of getting a continuous supply of energy from a variable source. An experimental attempt is being made at the Avonmouth docks (NATURE, Oct. 4, p. 541), where the tidal range is about 30 feet; of this, about 10 feet cannot be used by the turbines and recourse is had to a steam accumulator which has been 'charged' by the tidal turbines. In *World Power* for November, two tidal projects in the Argentine are described, one at the mouth of the Descado River, and the other at the Gulf of San José. The Argentine has a difference between high and low tide levels sufficient to justify the consideration of a tidal scheme and a Government commission has reported favourably on it. In the Gulf of San José, the sea rises 15 feet in neap tides and about 26 feet in spring tides. By a special arrangement the turbines can be made to run in the same direction whether the tide is going out or coming in. It would be possible to have five hours' continuous operation out of every six.

A NEW high-tension power line, costing more than one million pounds sterling, between Toronto and the Paugan Falls electric generating station, a distance of 230 miles, has just been brought into operation by the Ontario Hydro-Electric Power Commission. The voltage of the transmission line is 220,000, which is the highest yet adopted in Canada. In transmitting 150,000 horse-power, the line is also believed to carry the greatest volume of electric energy. It is used to supplement supplies received from Niagara Falls, the station generators at which are now working in perfect synchronisation with those at Paugan Falls. The new line is carried on steel towers, 73 ft. in height, placed at distances apart of about one-fifth of a mile. It is the second of two service lines from Paugan Falls to Toronto. Both are of aluminium with a steel core, the external diameter being $1\frac{1}{8}$ inches. It is interesting to note that the route was planned with the aid of aerial photography. Located in the first instance from the best available maps, the route was photographed with oblique exposures, after which a definite line was selected. This was then re-flown and vertical photographs taken, from which a mosaic map was made for detailed study and the selection of tower sites. It has been, in fact, an important application of the aerial survey method, and it resulted in a considerable saving of time.

MR. SIDNEY SMITH, Assistant Keeper in the Department of Egyptian and Assyrian Antiquities at the British Museum, has been appointed Keeper of the Department in succession to Dr. H. R. Hall, who died on Oct. 13 last.

WE much regret to record the following deaths: Mr. A. B. Basset, F.R.S., a vice-president in 1892–94 of the London Mathematical Society, on Dec. 5, aged seventy-six years; Sir Otto Beit, Bart., K.C.M.G., F.R.S., well known for his generous benefactions for medical and other scientific research, on Dec. 7, aged sixty-five years; and Sir Francis Ogilvie, C.B., formerly Director of the Science Museum, South Kensington, on Dec. 14, aged seventy-two years.

THE Christmas Lectures at the Royal Institution will be delivered this year in the reconstructed lecture theatre of the Institution by Prof. A. M. Tyndall, H. O. Wills professor of physics in the University of Bristol, on the electric spark. The first lecture will be given on Dec. 30, at three o'clock, on "Some Properties of Electrified Bodies". The remaining five lectures will deal with the spark as a

current of electricity, air as a conductor, and the mechanism and properties of sparks and arcs.

As already announced, the twenty-first Annual Exhibition of the Physical and Optical Societies is to be held on Jan. 6-8 at the Imperial College of Science, Imperial Institute Road, South Kensington; it will be open in the afternoon from 3 P.M. to 6 P.M., and in the evening from 7 P.M. to 10 P.M. To mark the coming-of-age of the Exhibition, it will be opened formally by Sir Arthur Eddington, on Jan. 6 at 2.30 P.M. Two discourses, with experiments, will be given at 8 P.M. on Jan. 7 and 8: Mr. E. Lancaster-Jones, "Searching for Minerals with Scientific Instruments", and Sir Gilbert Walker, "Physics of Sport". Members of learned societies can obtain tickets of admission from their secretaries; others may obtain tickets on application to the Secretary, the Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S. W.7. No tickets are required for Jan. 8.

DR. T. A. STEPHENSON, senior lecturer in the Department of Zoology at University College, London, has been appointed professor of zoology in the University of Cape Town in succession to Prof. L. T. Hogben. Prof. Stephenson received his education in zoology and allied subjects at the University College of Wales, Aberystwyth, where he was afterwards demonstrator in zoology for about three years. His earlier research work was on the morphology and ecology of the sea anemones, and more recently he has studied the ecology of corals and coral-reefs; in 1923 he made an investigation of the Guernsey *Haliotis* fishery. In 1928–29 he was in charge of the shore-work of the Great Barrier Reef Expedition. Prof. Stephenson is the author of various publications dealing, among other subjects, with the Actiniaria of the world and British orchids, but his principal item is Vol. 1 of a monograph on the British sea anemones, which is one of the Ray Society publications.

THE annual meeting of the American Association for the Advancement of Science will be held at Cleveland on Dec. 29–Jan. 3. This will be the fourth occasion on which the Association has met at Cleveland. The address of the retiring president, Dr. Robert A. Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology, will be delivered on Dec. 29. Dr. Edwin B. Wilson, professor of vital statistics in the School of Public Health, Harvard University, will deliver the Gibbs lecture (under the auspices of the Association and the American Mathematical Society) on the afternoon of Dec. 30; and Dr. C. E. K. Mees, of the Eastman Kodak Company, will give the Sigma Xi lecture on the same evening. General lectures have been arranged for every afternoon and evening of the meeting, and a science exhibition will also be open. It is also announced in *Science* that the first of the new series of summer meetings of the American Association for the Advancement of Science will be held at Pasadena, California, on June 16-20, 1931, at the California Institute of Technology, the Huntington Library and Art Gallery, and the Mount Wilson Observatory.

ON Nov. 10, the University of Colorado celebrated the twenty-fifth anniversary of the theory of relativity; it was on Sept. 26, 1905, that Einstein's first paper on relativity, entitled "Zur Elektrodynamik Bewegter Körper", appeared in the *Annalen der Physik*. A banquet was given in the Memorial Union Building, after which addresses were given by various members of the faculty. Dean O. C. Lester, of the Graduate School, spoke on "The Changed Outlook on Physical Theories"; Dr. V. P. Lubovich, assistant professor of physics, spoke on "Does the Inertia of a Body depend upon its Energy Content?"; Dr. Walter B. Veazie, of the Department of Philosophy, discussed "Relativity and Philosophy"; and Dr. Frank E. E. Germann, professor of chemistry, spoke on "Chemistry and Relativity". A painting of Dr. Einstein by Miss Virginia True, of the Art Department, was also unveiled.

THE Augustus and Alice Waller Memorial Research Fund is held in trust by the Council of the London (R.F.H.) School of Medicine for Women, but is not restricted to members of that institution. A permanent income of about £100 a year is provided for the primary purpose of making grants, usually of small sums, for the purchase of research apparatus. Twenty-nine grants representing a total sum of £540 have been made, varying in amount from £3 to £48, the average grant being £18. The grants have been given for research work in physiology, physics, chemistry, anatomy, pharmacology, and pathology. It is felt that the Fund is fulfilling its purpose as a memorial to Dr. and Mrs. Waller, who themselves devoted their lives to research. The sum of £105, with accrued interest, subscribed for a memorial at St. Mary's Hospital, will be used to help equip one of the physiological laboratories in the new school to be known as the "Waller Memorial Laboratory". It is expected that the laboratories will be completed in about eighteen months' time.

THE report of the Irish Radium Committee for 1929 has been published by the Royal Dublin Society (*Sci. Proc. Roy. Dub. Soc.*, vol. 19, [separate issue] No. 42). The large quantity of 14,730 millicuries of radon was issued during the year. Reports from several surgeons are included, and some surprisingly good results are recorded in some cases of cancer of the breast, lip, and skin, and in one of pelvic sarcoma, though it has to be admitted that there are numerous failures. In some of the latter, nevertheless, the patient's condition for the time being is often much benefited.

THE first number of a new periodical, *Bulletin Météorologique de l'Observatoire Météorologique de Beograd*, dated 1928, has recently been received. Its contents, however, consist of the daily observations of the various meteorological elements at 3 hours on each day at numerous stations in Serbia during the half year July–December 1905. The *Bulletin* is a sequel to two former publications, one—the monthly bulletin

of the Belgrade Observatory which was published for the period 1902–June 1905, and the other a separate publication giving data from 1904–June 1905. The Observatory archives contain data, for the most part not reduced, for the whole period 1888–1914. It is hoped to publish these and later data in further issues of the *Bulletin*, so that in twelve to fourteen years the whole material will be made available. Meteorologists in other countries will join in wishing that this modest hope may be fulfilled.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master for mathematics and physics in the Smith Junior Nautical School, Cardiff—The Director of Education, City Hall, Cardiff (Dec. 27). An assistant science teacher at the Central Municipal Technical School, Liverpool—The Director of Education, 14 St. Thomas Street, Liverpool (Dec. 31). A male assistant under the Department of Scientific and Industrial Research for work in connexion with research on fruit—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Dec. 31). A professor of pathology in the University of Glasgow—The Secretary, The University Court, University, Glasgow, W.2 (Jan. 7). A graduate woman teacher for arithmetic and geometry at the Bloomsbury Trade School, Queen Square, W.C.1—The Education Officer (T.1), County Hall, S.E.1 (Jan. 9). A research assistant in plant breeding at University College, Dublin—The Secretary, University College, Dublin (Jan. 15). A mechanic and laboratory assistant in the physics laboratory and workshop of the University of Cape Town—The Registrar, The University of Cape Town, P.O. Box 594, Cape Town, South Africa (Jan. 20). A professor in mathematics in the University of Dacca, East Bengal—The Registrar, University of Dacca, East Bengal, India (Feb. 7). A professor of economics and political science at the University College of Wales, Aberystwyth—The Financial Secretary, University College of Wales, Aberystwyth (Feb. 14). A principal of the Dundee School of Economics and Commerce—The Town Clerk, Dundee.

Our Astronomical Column.

A Solar Eruption on Nov. 25.—At the meeting of the Royal Astronomical Society on Dec. 12, observations were described of a solar eruption that was seen near the centre of the sun's disc on Nov. 25 with the spectrohelioscope at Greenwich. Eruptive prominences possessing velocities of 100 km./sec. or greater have been often observed in hydrogen light at the sun's limbs with the spectroscope by recording their linear displacements with time. Similarly they are recorded in spectroheliograms in hydrogen or calcium light. The spectrohelioscope in addition enables the observer to follow the changes of the prominences as they are carried by the sun's rotation across the disc as absorption markings. A simple device for progressively changing the wave-length of the light entering the eye enables the observer to locate and measure the line of sight component of the radial velocity outwards or inwards from the sun with which the absorption marking may be moving.

The phenomena observed on Nov. 25 evidently represented the end-on view of an eruptive prominence blown out of the sun's chromosphere with a maximum observed velocity of 450 km./sec. Forty-five minutes before the eruption, an apparently stable dark marking was visible; at $10^h\ 34^m$ G.M.T. the velocity rose within a few minutes from 40 km./sec. to about 400 km./sec. At 11^h cloud stopped the observations, but the eruption was then declining, and part of the gaseous structure was descending at about 100 km./sec. Contemporary with the appearance of those rapidly moving masses of hydrogen gas, brilliant patches of hydrogen with little or no radial velocity made their appearance. It may be added that the phenomena described could have been photographed with a spectroheliograph had the second or selecting slit been set at appropriate distances from the $H\alpha$, or H or K lines of the solar spectrum so as to allow for the Doppler displacements equivalent to the velocities observed.

Autumn Fireballs.—Mr. W. F. Denning, 44 Egerton Road, Bristol, writes as follows: "Several large fireballs or meteors have been observed during the last two months, and further observations of the following would be welcomed:

Oct. 24, 8.24: Brilliant meteor, fell perpendicularly down in southern sky, seen at Bristol.

Nov. 16, 9.46 P.M.: Estimated four times as bright as Jupiter; path, 165° + 55° to 135° + 35°; duration 5 sec.; seen from Nuneaton, Warwick.

Nov. 16, 2.30 A.M.: Splendid meteor, gave a brilliant flash and left a fiery streak for several minutes; appeared in the eastern sky and moved from north to east; fell at angle of 45°; Campbeltown, Scotland.

Oct. 30, 10.5 P.M.: A fireball passed along parallel to the horizon eastwards; altitude low, first seen when slightly east of the moon and endured 8 to 10 seconds; disappeared in the south-south-east; observed by several people from Edinburgh and described in the *Scotsman*.

Nov. 27, 11.6 P.M.: Reported by observers in Cornwall and Devonshire; it lit up the whole countryside. As seen at Lostwithiel, it moved from north-west to south-east and ended near Orion; as viewed from St. Agnes, it shot almost perpendicularly down the southern sky and traversed the region of Perseus or border of Aries and Taurus and vanished near Orion."

Stellar Absorption Band near λ4200.—Recent work by Dr. A. V. Douglas, described in the *Monthly Notices* of the Royal Astronomical Society for October 1930, throws some light on the discussion concerning the origin of this band. Previous work by Elvey and Zug showed that in the case of the Yerkes spectrograms its presence in stellar spectra could be accounted for by absorption in the optical system. Shapley, also, has withdrawn his earlier identification of cyanogen as the origin in early type stars. Miss Douglas, by means of experiments similar to Elvey's, has been unable to trace any selective absorption in the optical train of the Ottawa 15-inch refractor; whereas, in the case of three cepheid variables examined by her, the absorption band is not only strong but also exhibits periodic variations in intensity in phase with similar variations of enhanced lines. The stellar origin (most probably cyanogen) is thus strongly supported. No mention is made of early type spectra, and the origin in such cases is still not definitely settled.

Research Items.

Megalithic Structures in Ceylon.—In the course of his archæological summary in the *Ceylon Journal of Science*, vol. 2, pt. 1, Mr. A. M. Hocart reports the existence of a dolmen at Padiyagampola, near Rambukkana, the only one of its class that has so far been discovered in Ceylon. It was brought to the notice of the Archæological Department by Mr. F. Lewis, of Kandy, and is situated on the foothills of the central mountain range of the island. It is constructed of three upright slabs with a covering stone placed horizontally on them. The two long upright slabs measure roughly 12 ft. by 5½ ft. each; the upright stone at the north end measures 3¼ ft. by 5½ ft. The covering stone, irregular in shape and measuring 17 ft. by 15 ft., is in a somewhat 'slanting' position and has cracked. The thickness of the slabs is about 15 inches. The room measures internally 11 ft. by 6½ ft., and the height from the present ground level to the covering stone is 6 ft. The southern side is open and there is a passage on the north side also. The stones bear no marks of chiselling, except on the western side, but this is probably not an original feature. Trilithons still survive in Ceylon, where they are called *gonatu*. A Sinhalese statement says that "when pregnant women die, they are reborn as *bodiri* birds. *Gonatu* are made to liberate them from this. Wayfarers place on top the loads that they carry either on their heads or shoulders, and sit by and rest. By that grace the women who are born as *bodiri* birds are liberated from that, and are born in a better world." It is interesting to compare with this the fact that the great trilithon of Tongatabu is known in Tongan as the "Burden of Maui".

Pueblo Ruins in Colorado.—The excavation in 1928 of early Pueblo ruins belonging to the period known as Pueblo I, in the Piedra River district of southwestern Colorado, is described by Mr. Frank H. H. Roberts, jun., in *Bull.* 96 of the Bureau of American Ethnology. The Piedra River is one of two cultural sub-centres in the San Juan Basin—one of the more important minor districts of Pueblo culture—the other being Aztec. The latter, however, towards its final period came under the domination of the Mesa Verde peoples. The Piedra River district was virtually unknown to archæologists before 1921. Early excavations up to 1923 and surveys in later years did little more than show the great importance of the district as an archæological site. Ruins and sites extend along both banks of the river for a distance of more than 15 miles. Three types of houses were found, but while the first is thought to show a late Basket-Maker influence, the two later illustrate definite pueblo forms of the early period. The outstanding constructional development of the period was that of the rectangular, perpendicular-walled building which made possible the joining of single-roomed houses into a communal dwelling of many contiguous rooms, one of the typical features of the true pueblo complex. Ruins of only two of the ceremonial kivas were uncovered—an unusually small number of specialised ceremonial rooms for so large a number of house-group units. This is taken to suggest that this feature of pueblo culture was still in a developmental stage. The pottery also shows that that industry was in a transition stage. Among the most significant new features are the banding on the necks of the vessels, the shift from banded to coil ware, the use of a slip, and the elaboration of painted decoration. Bone and stone implements were not abundant, and consist of a few general forms. Burials were in the contracted position and accompanied by mortuary offerings of pottery.

Insect Control by Aeroplane.—*Circular* 123 (issued August 1930) of the United States Department of Agriculture describes the relative values of dusting the blueberry crop, when infested by larvæ of the fly *Rhagoletis pomonella*, by aeroplane and by ground machines. The authors, Messrs. F. H. Lathrop and C. B. Nickels, state that trials carried out in the State of Maine indicate that calcium arsenate is effective as a dust in controlling this insect. Under favourable conditions, when this material is discharged from an aeroplane flying at a height of about 25 feet, at a speed of 60 miles per hour, the results are as effective as when it is delivered on the crop by ground machines. In the case of this particular insect pest, however, the balance was rather in favour of the latter method. The general topography and the usual atmospheric conditions were against the use of the aeroplane. Heavy fogs during early morning, at the time when the aeroplane could be most favourably used, reduced the length of period available, and it was doubtful whether enhanced speed compensated for the shortness of the time when the aeroplane could be employed.

Parasites of the Pine-shoot Moth.—In the *Bulletin of Entomological Research*, vol. 21, October 1930, pp. 387-412, Dr. W. H. Thorpe describes the results of a preliminary study of the parasites of the pine-shoot moth (*Rhyacionia buoliana*). The investigation was undertaken at the request of the Dominion Entomologist of Canada, where the experiment of attempting to control that insect by biological methods is being undertaken. Although the moth is by no means kept under complete control by parasites in Europe, it was considered possible that the introduction of certain of the more important of these enemies, free from their natural hyperparasites, might result in checking the spread of that pest in Canada. The investigations were carried out at the Farnham House Laboratory of the Imperial Institute of Entomology on material obtained from Norfolk, Suffolk, and the New Forest. It appears that twenty-eight species of primary and secondary parasites affect the insect in question, of which the dominant or 'key' forms appear to be the Braconid *Orgilus obscurator* and the two Ophionines, *Cremastus interruptor* and *Omorgus mutabilis*. Consignments of these species have been transmitted to Canada, where the first two mentioned have become established and have been able to pass the severe winter successfully. A brief account is given of the salient features in the biology of each species, and the chief diagnostic characters of the adults are described, along with those of the mature larvæ. The practical outcome of the experiment will be watched with interest, but some years must elapse before any definite results are forthcoming.

Trematodes of the Dry Tortugas.—Mr. O. R. McCoy has continued his investigations into the life-histories of marine trematodes (Year Book No. 28, Carnegie Institution of Washington, p. 290). Special attention was given to the behaviour of certain cercariæ and some interesting experiments were carried out. Three new monostome cercariæ with large, more or less highly pigmented tails and pigmented eye-spots, all infesting the gastropod *Cerithium litteratum*, were studied. The full-grown active larvæ of each species are strongly photo-positive, and in one species the cercariæ aggregated in masses, the individuals of which moved together as a unit. The posterior half of the tail tapers suddenly to form a sticky ribbon and the tails become tangled together, the head ends of the animals projecting outwards. It is suggested that

such aggregations occur naturally in the branchial chamber of the mollusk. On p. 295, Mr. H. M. Miller and Mr. O. R. McCoy describe their experiments on the behaviour of *Cercaria floridensis* in relation to its intermediate hosts. This larva is also photo-positive, and swims towards the light if any shadow fall upon it, the habit apparently influencing considerably any experiments. Several species of small fishes known as 'grunts' (*Hoemulon* spp.) were successfully infected, the trematodes encysting under the scales and in the fins.

Paryphantidae of New Zealand.—The larger New Zealand land snails belonging to the genera *Paryphanta*, *Wainuia* (n. gen.), and *Rhytida* have now been recorded and described in full detail by A. W. B. Powell (*Rec. Auckland Inst. and Mus.*, vol. 1). How the distribution of the species is governed by present physical features and what their hypothetical ancestry and development may have been are also discussed. *Rhytida* and its close allies have a far wider range than *Paryphanta* and consequently a probably greater antiquity and more ancient dispersal. *Paryphanta* doubtless originated from *Rhytida*-like stock within the New Zealand faunal area and achieved its greatest distribution during the great land extensions of the Lower Cretaceous, reaching Tasmania and Victoria, Australia. The single new species described, *Paryphanta superba*, is the largest of the genus and indeed of the group under discussion; so, that it has hitherto escaped discovery is somewhat remarkable.

The Crab Genus *Actæa*. Mr. Lee Boone makes some interesting remarks on these crabs, belonging to the Pilumnidæ, in a paper entitled "Notes on the West Indian Crabs of the Genus Actæa" (*Bulletin of the American Museum of Natural History*, vol. 61, Pt. 3: 1930). He believes that *Actæa bifrons* Rathbun is merely the young of *Actæa setigera*, but Miss Rathbun, in her recent work on "The Cancroid Crabs of America", amongst the material examined records an ovigerous female of *A. bifrons*, this seems somewhat doubtful. The species of *Actæa* are all very hairy and live in cavities of corals and sponges. Always sluggish in their movements, they are easily overlooked. For the first time, detailed colour notes are given of a specimen of *Actæa acantha* and of the West Indian representative of *A. rufopunctata nodosa*.

Respiratory Products and Plant Regeneration.—K. Kakesita in the *Japanese Journal of Botany*, vol. 5, No. 2, 1930, advances the view that the regenerative activity of the leaf of *Bryophyllum calycinum* may be stimulated by the accumulation of the products of intramolecular respiration within the leaf tissues. This view is suggested as the result of experiments, in which the leaf, still attached to the plant, was caused to produce buds and roots by placing the whole plant in a warm bath, or in an atmosphere of hydrogen. Injection of substances regarded as likely products of such intramolecular respiration, especially ethyl alcohol, is also said to have produced regenerative activities. Evidence is supplied that acetaldehyde and alcohol accumulate in the plant as the result of the warm bath treatment or as the result of surrounding the plant with hydrogen. More acetaldehyde and alcohol were also found in isolated than in attached leaves, so it is suggested that regeneration, as the result of isolation, is also the result of intramolecular respiration in the leaf tissues.

Root Stock Influence.—In the case of British fruit trees, every orchard is filled with worked trees, in which a desirable scion is grafted upon a root system, derived either from another seedling or a vegetatively propagated 'clone' which roots relatively readily. Of recent years the East Malling Experiment Station has emphasised the possibility that propagating a scion 'clone' upon a suitable root stock 'clone' might go far to standardise growth and yields in orchard practice. An examination of stock scion relationships, therefore, by the Director of the East Malling Experiment Station, Mr. R. G. Hatton, in the Masters Memorial Lectures, published in the *Journal* of the Royal Horticultural Society for September, may be expected to summarise the results of experimental work in this interesting field, and the reader will not be disappointed. Some American workers are more inclined to stress the influence of the common scion in impressing uniformity upon the variable seedling material used as source of roots in American practice, and Mr. Hatton points out that this may be the result of the different method of working in the two countries. Much American material is 'bench-grafted' upon root pieces, whilst English unions are made by budding or grafting upon the stem of the stock above ground-level. Mr. Hatton supplies evidence of root stock influence upon scion yield, vigour, and habit of growth under the English method of working. He also examines the possibility that this influence may be in part due to the stem piece of the stock left above its root system, and finds some evidence, in double worked trees, that the intermediate piece of stem may influence the character of the scion above. This argument, if capable of extension, would seem likely to give away the case. If, as is argued, five or six feet of the stem of a vegetatively propagated intermediate can largely produce uniformity, even when the intermediate is worked on seedling stocks, then the conclusion would seem to be that the same uniformity might be expected if the stem piece belonged to the scion. A very useful bibliography is appended.

Bathymetry of the Oceans.—In the *Hydrographic Review* for November, Lieut.-Com. H. Beneker has a paper on the bathymetry of the oceans, in which he discusses the material available for detailed charts. The most valuable part of the paper, however, lies in the appendices. The first of these is a chronological list of the important vessels from 1800 onwards which have contributed to deep-sea knowledge. The dates of foundation of various oceanographic and other institutes are also noted. Following this list is a catalogue of ocean deeps as known up to the present. These are listed under oceans, with the latitude and longitude of the greatest depth. Each is given the generally accepted name. There is also a list of important shoals of all oceans unconnected with continental land masses or islands. These lists are not complete in all details but are published in the hope that any inaccuracies or omissions will be noted and a communication sent to the International Hydrographic Bureau at Monaco.

Earthquakes at Ito (Japan).—The remarkable series of slight earthquakes, 3684 in number from Feb. 13 to April 11, at Ito, on the west coast of Sagami Bay, are described in a previous note (NATURE, Aug. 30, p. 326). While the earthquakes were occurring almost incessantly, a new series of precise levellings was carried across the district. Comparing the measurements with those made in 1924, it appears that, close to Ito, a tract of coast 12 miles long has risen, by so much as 3 ft. 2 in. at a point two miles south of Ito, while at either end of the tract there has been a slight subsidence, of 4 in. to the north and 10 in. to the south (*Earthq. Res. Inst. Bull.*, vol. 8, pp. 375-376; 1930).

Non-metallic Ore Deposits of Russia.—An important work on this subject has been published—under the editorship of I. I. Ginsburg, S. V. Konstantinoff, I. D. Kourbatoff, V. A. Unkovsky, A. E. Fersmann, and D. I. Shcherbakoff—by the Academy of Science of U.S.S.R. (Leningrad, 1926–29: 4 volumes, in Russian). Altogether there are seventy-five original articles, each dealing with compounds of an element or a group of elements, written by a specialist in a given subject. Each article contains the following features: a general description of the mineral and the ore, together with its chemical and physical properties, occurrence in U.S.S.R. and elsewhere, mining and working of the material, technical applications, world markets and prices, and also a special part devoted to a detailed description of Russian occurrences. A comprehensive list of the literature, both Russian and foreign, is included with each article. Indexes and table of contents are included in every volume. This important publication can be recommended as an authoritative source of information to all interested in Russian mineral wealth and industry.

The Michelson-Morley Experiment.—A repetition of the experiment of Michelson and Morley on ether-drift has been carried out by G. Joos at Jena, and is described in a recent paper (p. 385) in the current volume of the *Annalen der Physik*. Several novel features have been introduced in the mechanical and optical arrangements. The frame for the support of the mirrors was built of quartz slabs (made by Schott), the light path being 21 metres. Transmission of vibrations was avoided, not, as has often been done previously, by floating in mercury, but by hanging the interferometer on a great number of springs, oscillations of the suspended system being damped by hairs. The fringes were recorded by photography and measured up in a microphotometer, the final result being that any effect due to an ether-wind was less than 1/1000 of a fringe, or that the ether-wind is less than 1·5 kilometre per second.

Measuring an A.C. Voltage by balancing against a D.C. Voltage.—In the *Journal of Scientific Instruments* for December, S. Whitehead and D. Barham give an account of very interesting experiments showing how an a.c. voltage may be measured by means of a quadrant electrometer and a d.c. potentiometer. The method used is a null method and was originally described by J. Swinburne many years ago. Theory shows that the result found is independent of frequency and wave form. The experiments show that this is true at ordinary frequencies, the maximum inaccuracy being of the order of 1 in 5000. The authors point out minor defects of the method, mainly due to the contact difference of potential and the time taken for the preliminary adjustment. The range of the voltage that can be measured is also limited. Probably, however, if the electrometer were specially designed, these disadvantages could be got rid of, and the sensitivity of the instrument greatly increased.

Lightning.—The lecture which Dr. G. C. Simpson gave to the Junior Scientific Club of Oxford University on "Thunder and Lightning" (Oxford: Vincent Printing Works) is a very helpful contribution to our knowledge of a phenomenon which has been closely studied from the earliest ages. Naturally, there have been a very large number of theories advanced to explain the effects produced, but only two, namely, Wilson's, based on electrical induction, and Simpson's, based on the breaking up of raindrops, are mentioned. When the electric stress breaks down the air at any point, the rent made is at first very local; but once made, it rapidly extends in the form of a narrow channel. The most important characteristic of the rent is that it can only extend in the direction away from the seat of the positive electricity. As the channel extends, it tends to branch, and each branch becomes a new rent. Thus when we see a lightning discharge, we can tell from the branching which way it has extended and where the positive electricity is situated. The rate at which the lightning channel grows is usually very great. Laboratory experiments seem to indicate that it could be as fast as a tenth of the velocity of light. On the other hand, we know that in certain circumstances the channel can grow relatively slowly. The light associated with a lightning flash is due to the recombination of electrons and ions within the ionised channel. The first discharge which opens the channel leaves the air within it very highly ionised and an electrical current can pass along it. Hence it remains ionised for an appreciable time after the visible discharge has ceased. Dr. Simpson showed very interesting photographs of various abnormal types of lightning-flash. He also described two recent occurrences of ball lightning which illustrate its chief features. He confesses, however, that he does not yet see even the beginning of an explanation of it.

Condensation of Electrons on Metals.—The amount of heat liberated when an electron of zero kinetic energy is absorbed by a metal from the gas phase, a quantity of importance in connexion with the theory of electric discharges through gases, was determined several years ago by Prof. K. T. Compton and C. C. van Voorhis from an ingenious combination of microcalorimetry with Langmuir's method for using exploring electrodes. More complete results from similar measurements, which are given in the first November number of the *Physical Review*, now establish definitely that the ionised gas from which the electrons are drawn has a specific effect on the properties of the metal surface. For platinum, for example, the heat of condensation of an electron is equivalent to 5·21 volts in the presence of nitrogen and to 4·39 volts in the presence of helium, and, moreover, contact potential differences between the exploring electrode and another of presumably constant properties change in general with time after the exploring electrode has been cleaned electrically *in situ*. It is suggested that the effect of at least the inert gases is due to their positive ions; these possess the same number of electrons as halogens, and might thus be expected to be chemically active. The permanence of any compounds formed on the metal surface is nevertheless small, since in the discharges studied it would only be necessary for each incoming positive ion to remain on the surface for one-thousandth of a second to keep ten per cent of its surface covered. This research provides a good illustration of the accuracy which can now be attained in problems connected with the electric discharge in gases, the error in the heats of condensation being believed to be well within one per cent.

Nickel as a Hydrogenation Catalyst.—Although a very large amount of work has been done on the use of nickel as a catalyst for the hydrogenation of organic compounds, systematic investigations begun by Adkins and Cramer, the first instalment of which appears in the November number of the *Journal of the American Chemical Society*, will provide much more detailed and useful information in many cases than is now available. The paper describes in a tabular form the results of experiments made with forty-five organic compounds with which satisfactory reductions were obtained. The apparatus permits of the study of the selective reduction of one of two reducible substances through the control of the temperature or time interval of reduction.

Transport of Nitrogen in the Plant.

THE general question of translocation in plants demands attention, not only because of its ractical importance in horticulture, but perhaps ven more so because of its intensely controversial ature. Recent work on the translocation of carbohydrates in the cotton plant, by T. G. Mason and . J. Maskell, has already been reviewed in NATURE 123, pp. 133-135; 1929). Maskell and Mason have xtended their work to the translocation of nitrogen. 'his work, which appears as *Memoir* 2, Series B (1930), rom the Cotton Research Station, Trinidad, is as aluable a contribution to the literature of nitrogen netabolism as to that of translocation.

The experimental technique is very similar to that dopted in the work on carbohydrates; indeed, in nany cases, the nitrogen analyses were made on amples which had already yielded some of the data n the earlier papers. As before, the procedure nvolves various ingenious combinations of ringing, artial ringing, defoliation, etc., and a rather extensive tatistical analysis of analytical data obtained for the arious nitrogenous fractions. It is interesting to eflect that Malpighi ringed stems in the late seventeenth century, and at least so early as 1731 such practices as ringing, partial ringing, defoliation, etc., vere the staple procedures in the attempt to elucidate he "circulation or non-circulation of the sap". Stephen Hales in his "Vegetable Staticks" describes xperiments in which the experimental detail seems tartlingly modern. However, in his preface he found t necessary to enlighten at length those of his readers "who complain that they do not understand the ignification of those short signs or characters (; · ; ·; =) which are here made use of in many of he calculations, and which are usual in Algebra". Whilst two hundred years cannot be said to have produced very outstanding modifications in experimental technique, beyond the adoption of modern nalytical methods instead of fragmentary observations n growth, leaf fall, colour, etc., one can see a vast hange in the method of interpreting results. Maskell nd Mason make very full use of statistical methods, nd apparently place a greater confidence in their eaders' mathematical comprehension.

Part I of the paper now before us, containing observations on the downward movement of nitrogen n the stem, consists of experiments designed to test he idea that the leaf is the principal seat of protein synthesis, and its greater claim than other organs for norganic nitrogen rests on its 'transpiration pull'. Chibnall's contention that there are diurnal changes in nitrogen (total) content of the leaf is confirmed by Maskell and Mason for the cotton plant. They find the nitrogen content higher by day than by night. Though evidence for similar changes in the bark is not so conclusive, the tentative suggestion is made that the leaf changes lead to similar concentration changes in the bark which lag somewhat behind those of the leaf. The effects of ringing on nitrogen movements are interesting relative to Curtis's suggestion that nitrogen (organic and inorganic) moves not in the xylem but in the phloem. Maskell and Mason complete their experiment 24 hours after ringing. They find that the nitrogen content of the leaf samples (3 leaves from near the apex of each of 10 plants) from ringed and normal unringed groups show normal diurnal changes and are practically identical. It is concluded that ringing has not interrupted nitrate movement, which is therefore in the wood.

This view, however, assumes that a redistribution of nitrogen between the leaves above the ring may be neglected. It is worthy of note that the sampled region is that most vigorously growing, and the possibility remains that it has drawn nitrogen, via the bark, from the lower leaves above the ring. This would be more possible in a short time experiment like the one described. Sampling of the entire leaf and stem above the ring clearly offers (in the cotton plant) considerable mechanical difficulties. The wood and bark of the ringed plants above the ring (seven inches sampled) show a significant increase in total nitrogen content, and similar samples below show a decrease. This is in harmony with the view that ringing prevents downward movement in the stem, though not that from leaf to bark. It does not necessarily indicate that there has been an upward movement of inorganic nitrogen in the wood past the ring. Curtis previously claimed (*Amer. Jour. Bot.*, 1923) that leaves of ringed twigs of lilac, privet, etc., increased in nitrogen content much less than corresponding ones of unringed plants. Maskell and Mason reinterpret one of Curtis's experiments to support the view that leaves above a ring import nitrate via the wood and export organic nitrogen via the bark. However, in the absence of data that an actual increase of total nitrogen had occurred above the ring, such an interpretation is inconclusive. Since it is known that transfer of nitrogen from one lateral branch to another does not readily take place (Auchter Agric. Expt. Stat., Univ. of Maryland, *Bull.* 257, 1923), it is improbable that the twigs in question imported organic nitrogen from the rest of the plant.

The possibility remains, therefore, that the nitrogen entering the defoliated region of stem above a ring came from the young, active leaves above it (4 pairs), whilst that entering a similar region below a ring came only from the basal leaves on that same twig (probably not more than 4 or 5 pairs), which were older, less active in protein synthesis (August), and in competition with younger leaves on other shoots for the nitrate application to the soil. Hence the seeming inconsistency referred to by Maskell and Mason, that four pairs of leaves above a ring supply to a defoliated region of stem 70 per cent as much nitrogen as the rest of the plant to a similar region below a ring, may be more apparent than real. In view of their repetition of the criticism that Curtis's results were due to transpiration effects caused by blocking of the xylem, one is reminded of the claim (*Ann. Bot.*, 1925) that complete cutting of the xylem, leaving the phloem intact, has a smaller effect on upward translocation than the reverse procedure. In another connexion Mason and Maskell have suggested, whilst admitting the significance of some of these results, the contradictory view that the superiority of the cut xylem group may be due to a few xylem elements regenerated in six days on the inner bark, whilst the inferiority of the cut phloem group may be due to plugging of the xylem. Surely if a few regenerated xylem elements are adequate, the xylem of the cut phloem group would have to be plugged to an inconceivable degree.

All this indicates the difficulty of interpreting the apparently simple ringing experiments. Many will regard the upward path of inorganic nutrients as still open to question. If Maskell and Mason are right in their contention that inorganic nitrogen moves with the transpiration stream, one is left with the curious situation that one simple solute (cane sugar) moves upward and downward in the phloem and another (inorganic nitrate) moves apparently with the water. Experiments on downward movement of nitrogen in the bark with a restricted channel of transport show that the rate per unit area increases as the available

area decreases. As suggested in the case of sugars, this is suggestive of a movement analogous to diffusion.

Part 2 of Messrs. Maskell and Mason's paper consists of observations on concentration gradients in relation to nitrogen movement. The previous work on sugar movement in the bark by the same authors showed that it was always from a region of high to one of low concentration. No such relation could be found for downward movement of nitrogen in the bark, which proceeds against a well-defined negative gradient of total and crystalloid nitrogen. All attempts to distinguish between mobile and storage forms by fractionation of the total nitrogen fail to reveal a well-defined positive gradient of any nitrogen fraction in the direction of movement, unless this be the rather elusive residual or unfractionated nitrogen. Subdivision of the bark into inner and outer zones disproved the possibility that positive and negative gradients in the different regions mask each other.

Part 3 of the paper under notice consists of an attack on the problem of movement in relation to concentration gradients by determining the change in existing nitrogen gradients caused by stoppage and reversal of nitrogen movement. The desired conditions were obtained by suitable combinations of ringing and defoliation. Unlike the situation in the case of the sugars, zero nitrogen movement is associated not with zero gradient but with a well-defined negative gradient of protein and crystalloid nitrogen. When downward movement of nitrogen is still proceeding, the negative gradient of total and crystalloid nitrogen is smaller than when movement has ceased: that is, the change from zero movement to downward movement is associated with the production of a positive gradient superimposed upon the existing negative gradient. This superimposed gradient is termed the dynamic gradient. An algebraical method of estimating the dynamic gradient, assuming a relatively constant storage gradient, is described. It is estimated that the degree of acceleration over diffusion previously found for sugars would suffice to account for the actual nitrogen movement with the observed concentration gradients (dynamic) of total nitrogen, protein nitrogen, and amino acid nitrogen. The localisation of the dynamic gradient largely in the inner bark suggests its association with the sieve tubes. It appears that the accelerating mechanism presumably associated with the sieve tubes acts impartially on sugar and nitrogen compounds.

F. C. S.

Influence of Steam on the Combustion of Carbonic Oxide.

PROF. W. A. BONE, who delivered the third Liversidge Lecture before the Chemical Society on Dec. 11, chose for his subject "Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930)". Commencing with the late Prof. H. B. Dixon's abandonment of classics for science in 1876, Prof. Bone referred to his repetition of Bunsen's work and his observation (communicated to the British Association at Swansea in 1880) that a mixture of carbon monoxide and oxygen, if dried at the ordinary pressure over phosphorus pentoxide, becomes non-explosive when sparked in the usual way. Examination of the effect of various third substances led him to adopt the view that the action of moisture is chemical and due to the hydrogen contained in it, the pure, dry reactants being mutually inert. Moreover, the speed of flame propagation had a minimum value in the dried mixture and a maximum value in the presence of nearly 6 per cent of moisture.

The investigation was extended in 1884 by Prof. H. B. Baker, who showed that, in dry oxygen, carbon burns essentially to carbon monoxide. Prof. Bone explained the precautions necessary in such experiments, and mentioned Morley's work in 1887 and 1904; long contact of a gas with phosphorus pentoxide is unnecessary, but there is considerable difficulty in drying the surface of the containing vessel. Continuing, he referred to Traube's observations (1885) that the flame of dry carbon monoxide is extinguished by plunging it into dry air, and that when the carbon monoxide flame is directed on to ice, hydrogen peroxide may be detected; hence the scheme

$$CO + O.O + OH_2 = CO_2 + H_2O_2$$

was proposed. Mendeléeff, however, preferred the series:

$$CO + H_2O \qquad\qquad H_2O_2;$$
$$H_2O_2 + CO = CO_2 + H_2O;$$

and Prof. H. E. Armstrong regarded the case as one of 'reversed electrolysis'. Lothar Meyer in 1886 showed that dry, 'non-explosive' carbon monoxide and oxygen could be caused to combine non-explosively by means of a powerful discharge, indicating that direct oxidation requires a higher temperature than indirect. Beketoff postulated the necessity for the presence of oxygen atoms, which were provided by steam more readily than by oxygen molecules themselves.

Dixon's experiments in 1886 showed that in the combustion of dry cyanogen with excess of oxygen, carbon dioxide is always formed to completion, the monoxide being produced intermediately. Smithells and Dent, using the flame separator, found that the outer cone of the dry cyanogen flame will burn in air dried by sulphuric acid only if the cones are not widely separated, showing that the length of life of the carbon monoxide is a determining factor. It was confirmed in 1896 by Dixon, Strange, and Graham that the carbon monoxide, freshly formed in a dry cyanogen explosion, will combine directly with excess of oxygen in the rear of the flame front.

Dixon discounted the conclusions of Mendeléeff and of Beketoff by showing that a dry mixture of carbon monoxide and nitrous oxide does not explode when sparked, and that dry mixtures of carbon monoxide and oxygen, whether exposed to X-rays or mixed with ozone or chlorine dioxide, are equally insensitive. In 1903 Girvan demonstrated that for a given sparking device a certain degree of desiccation is necessary to prevent explosion; while in 1914 Prof. W. M. Thornton found that for given sparking conditions the igniting current for a given medium has a minimum value.

Bone and Weston (1925) studied the minimum discharge necessary to ignite a mixture of two volumes of carbon monoxide and one volume of oxygen under different conditions of water content, and obtained a hyperbolic curve. Moreover, such a mixture, completely dried in 250 days, would withstand moderate, but not heavy, discharges. The influence of hydrogen on the carbon monoxide flame had also been examined. When much is added the characteristic appearance of the flame vanishes. In the ordinary flame of carbon monoxide in oxygen direct and indirect oxidation proceed simultaneously; so-called 'steam lines' in the spectrum may be eliminated by increasing the pressure as well as by drying. A dry carbon monoxide–oxygen mixture which failed to remain in combustion was reignited while a tension of 80,000 volts was maintained between two ring electrodes 30 cm. apart in the tube. The flame slowly reached the electrodes, suddenly accelerated, and became like that of an undried mixture.

The Tercentenary of Cinchona in Medicine.

AS a nation we are much less inclined than some of our Continental neighbours to celebrate historical events. It is therefore somewhat surprising to find that the tercentenary of the introduction of cinchona bark into European medicine (see NATURE, Nov. 29, p. 850) is being commemorated in London. Dr. H. S. Wellcome, whose interest in everything that pertains to the history or the progress of medicine is well known, has arranged at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1, an extremely interesting exhibition of materials, manuscripts, and literature relating to this drug. The Museum itself is rich in specimens of cinchona bark of historic interest, and possesses many rare documents and books on the subject, as well as pictures of personalities who have achieved fame as explorers of the Peruvian cinchona forests, of whom Dr. Wellcome is himself an example. To this nucleus has been added for this occasion gifts and loans from governments, learned societies, and institutions in various parts of the world, with the result that never before has such a collection of material for the study of cinchona been gathered together. The exhibition will continue open for several weeks.

Among the items of general interest may be mentioned three of the original packages of cinchona bark brought from Peru by Ruiz and Pavon on their return from the expedition sent there by Carlos III. in 1777. These are shown by H.M. the King of Spain. The Secretary of State for India has contributed five 'ne-books and the volume of original correspondence manuscript (1859–70) relating to Sir Clements Markham's expedition to Peru in connexion with the introduction of cinchona into India. No less interesting are some of the Museum's own treasures: for example, the original specimens of quinine and cinchonine isolated by Pelletier and Caventou in 1827, autograph letters of La Condamine and De Vrij, and the original permit ' issued by the Peruvian Minister of Foreign Affairs to Sir Clements Markham to enable him to carry out work in the cinchona forests. For the more technical visitor there are the extensive collections of botanical material lent by the Royal Botanical Gardens, Kew; Messrs. Howard and Sons, Ltd.; the Imperial Institute, and the Pharmaceutical Society of London. Not least important is the malaria section ' the Wellcome Medical Museum at Endsleigh Court, hich has been transferred *en bloc* to the exhibition. task of the visitor has been made easy by the llent arrangement of the exhibits, the clear bering of the specimens, and the beautifully luced catalogue.

Not content with having produced this tribute to pioneers who discovered and brought cinchona medical use, Dr. Wellcome arranged a series receptions at which addresses were given by thorities on the history and uses of the drug. At he first of these, on Monday, Dec. 8, which also served an opening ceremony, the chair was appropriately ken by Cardinal Bourne and addresses were delivered by the Ambassadors for Spain and France, whilst the Minister for Peru gave a short but interesting critical survey of the usually accepted history of cinchona. At the evening reception on the same day diplomacy and the Roman Catholic Church were still predominant, the chair being taken by the Ambassador for Holland, whilst the address was given by Cardinal B ene's able djutor, Archbishop Goodier, who co nued and xtended the criticism of the history o chona as sually written. Both critics combine demolish of the romantic story which ha een woven around the name of the Countess of Chinchon, and both declined to accept von Humboldt's statement that the natives of Peru were unaware of the virtues of cinchona.

At the receptions on Wednesday, Dec. 10, the addresses on the more technical aspects of cinchona began. In the afternoon Dr. Wellcome took the chair, whilst Sir David Prain gave the distinguished audience the fruits of his unique experience with cinchona, both as a botanist and in the capacity of a former Director of the Indian Government Cinchona Plantations, as a planter, and a quinine manufacturer. It was particularly interesting to hear this eminent authority account for the abandonment of cinchona planting in Ceylon, not by lack of enterprise or skill on the part of the British planters, but by unalterable natural causes, the chief being unsuitable soil. Sir David is also of opinion that it is unwise to devote so much attention to quinine, to the exclusion of the other cinchona alkaloids. This point was also emphasised by Prof. H. E. Armstrong, who paid a tribute to Dr. Wellcome's long continued and generous support of chemical research, and hoped that part of the energies of the various Wellcome research institutions would shortly be devoted to solving some of the many problems which the proper and economical use of cinchona still presents for solution by chemists, pharmacologists, and clinicians.

At the evening reception the principal address was given by Sir Humphry Rolleston, who provided many interesting medical sidelights on the history of cinchona and finished with an admirable summary of the therapeutics of the drug. During the present week further receptions are being given, at which the speakers will include General Sir Charles MacWatt, formerly Director-General of the Indian Medical Service; Dr. Manson-Bahr, Dr. H. H. Dale, Dr. C. M. Wenyon, and others.

University and Educational Intelligence.

BIRMINGHAM.—The increase in number of students in the Department of Oil Engineering has necessitated the erection of additional buildings adjoining the existing Oil Block. The new buildings, which are nearly complete, include a laboratory for ordinary students, a 'large-scale' laboratory, and stores. An extension of space for research will thus become available and the congested conditions under which research work is at present being carried on will be relieved. The Department of Civil Engineering has also been extended by the erection of a large Cement Laboratory.

The Council of the University has agreed to make a contribution to the funds of the Port Erin Biological Station.

LONDON.—Applications are invited for two Keddey Fletcher-Warr studentships for the promotion of post-graduate research. Each studentship will be of the annual value of not less than £250 and tenable for three years. Application forms and further particulars may be had from the Academic Registrar, University of London, South Kensington, S.W.7, to whom completed forms must be returned by Feb. 20.

A VACATION course in photogrammetry is announced to take place in the Technical-Physical Institute of the University of Jena on Mar. 16-28 next, when lectures will be given on the elements of photogrammetry, the historical development of photogrammetry, terrestrial photogrammetry, and aero-photogrammetry. Applications for the course will be received until Mar. 1 by Mr. A. Kramer, Schützenstrasse 72, Jena, Germany.

APPLICATIONS are invited for the Theresa Seessel research fellowship of Yale University, the object of which is the promotion of original research in biological studies, and the value about £300. The holder of the fellowship must reside in New Haven during the college year, October to June. Applications should be made to the Dean of the Graduate School, New Haven, Connecticut, U.S.A., before Mar. 1.

THE thirty-first annual meeting of the Science Masters' Association will be held at Birmingham, in the University buildings, on Jan. 6–9, under the presidency of Sir Charles Grant Robertson, who will deliver his presidential address on the evening of the first day of the meeting. The programme includes lectures on the lunar landscape (Mr. J. Young), complex molecular structures (Prof. W. N. Haworth), the physicist and chemist in the petroleum industry (Prof. A. W. Nash), science education of boys up to eighteen years of age (Prof. F. W. Burstall), and zoological experiments for school work (Prof. H. Munro Fox), while the Bishop of Birmingham is to give a lecture entitled "A Finite Universe?" Mr. F. Fairbrother will open a discussion on general science, and a meeting will be held with representatives of the Commission on Educational and Cultural Films. Demonstrations will be given in the University departments of science and technology, and visits to industrial works in the locality are being arranged. There will also be a trade exhibition of books and apparatus during the meeting.

Historic Natural Events.

Dec. 21, 1581. Drought.—1581 was described as the droughtiest year that any man had known. On Dec. 21 the river Trent dried up at Alrewas, Staffordshire, on account of the lack of rain.

Dec. 22, 987. Beginning of Long Frost in Western Europe.—On this date a frost began which was said to have lasted 120 days in England. In France the autumn sowings were destroyed by the cold of winter and the drought of spring.

Dec. 22, 1664. Severe Winter and Comet.—Under this date John Evelyn records that "this year I planted the lower grove next the pond at Sayes Court. It was now exceeding cold, and a hard long frosty season, and the Comet was very visible."

Dec. 22, 1894. Gale over England.—A violent westerly gale of short duration prevailed over the whole of England, Ireland, and southern Scotland during the morning, the average velocity at Fleetwood from 8.30 to 9.30 A.M. being 79 miles per hour. The storm caused much damage on land and loss of life at sea, and sea salt was carried inland as far as Birmingham (55 miles) and Masham in Yorkshire (65 miles inland).

Dec. 25, 1739. Severe Winter in England.—The winter of 1739–40 was very rigorous, though somewhat less so than 1607–8 or 1708–9. After a cold spell on Nov. 24–30, there was a warmer interval in December, but the frost commenced on Christmas Day and continued until Feb. 17. There was a second period of cold on Feb. 23–26. At the beginning of January a high wind caused great damage to the shipping in the Thames, several ships laden with corn and coal being sunk by the sheets of drifting ice; many lives were lost. Above London Bridge the Thames was completely frozen over and a 'frost fair' was held, with sports, shops, and a printing press. An ox was roasted whole on the ice, in imitation of the ceremony in 1640. A printing press was also set up on the Ouse at York. The frost was very severe on the Continent; the Zuider Zee was completely frozen, and also the sea off Ostend. A curiosity was the palace built entirely of ice on the banks of the Neva, with six cannon made entirely of ice, one of which was actually fired without being injured. The wind over western Europe was north-easterly throughout, and there was little snow.

Dec. 25, 1923. Hail.—Intense thunderstorms occurred over the Transvaal at Pretoria and to the south-eastward. Two storms struck Pretoria, the first at 6.25 P.M. and the second at 7.30 P.M. The first storm was accompanied by hailstones, some of which weighed more than five ounces. Tiled roofs were almost totally destroyed and even galvanised iron roofs were pierced; the damage to property amounted to £80,000.

Dec. 25, 1927. Snowstorm in England.—The Christmas snowstorm of 1927 is described in *British Rainfall* as "one of the worst experienced in living memory". On Dec. 25 there was snow in the Midlands but continuous rain in the south of England. In the evening the rain changed to snow, which fell heavily over south-east England during the night and throughout Dec. 26 and the following night. It was accompanied by a strong north-easterly wind, which formed heavy drifts, some of them 20 ft. deep; many main roads were completely blocked for days and some secondary roads for weeks. Motor-cars had to be abandoned, and some were completely buried in snow. Many villages were practically cut off from the world, and a few had to be provisioned by parcels dropped from aeroplanes. On Jan. 21, 1928, six or seven feet of snow still lay in some of the Hampshire roads. The storm was most severe and the snow deepest on Dartmoor, in the Alton-Basingstoke district, and along the North Downs.

Dec. 26-30, 1906. Snowstorms in British Isles.—Snow fell heavily over the greater part of the British Isles during these five days. The depth was greatest in the south of Scotland, where numerous trains were snowed up; Aberdeen was isolated for three days, and near Arbroath a railway collision cost many lives. In Ireland the snowfall was probably the greatest on record for depth and intensity. During the same week heavy snow fell also in eastern Europe, accompanied by a high wind which caused it to accumulate in deep drifts.

Dec. 27, 1813. London Fog.—It is recorded in the *Annals of Philosophy* that between Dec. 27, 1813, and Jan. 2, 1814, "a most extraordinary fog prevailed in London, and seems to have extended a great many miles round in every direction. It was frequently so thick that it was impossible to see across the street, candles were burnt in most of the shops and counting houses all day long. This fog condensed upon the grass, the trees, and every wooden or iron railings. The grass was covered with a coating of snow (condensed fog) at least half an inch thick. Below the trees in St. James's Park there lay a bed of snow an inch thick at least, which had fallen from them. In London the thickness of the fog was still further increased by the smoke of the city; so much so, that it produced a very sensible effect on the eyes, and the coal tar varnish might be distinctly perceived by the smell. But at a distance from town, though there was no smoke, the fog was very thick, not a breath of wind was perceptible during the whole week."

ERRATUM.

Dec. 9-11, 1672. Glazed Frost in Somerset.—The record of this phenomenon in the abridged edition of the *Philosophical Transactions*, vol. 2, p. 37, implies that the year was 1671, but Mr. C. E. Britton, of the Meteorological Office, New Ranges, Shoeburyness, from a study of the unabridged edition, states that the correct date should be 1672.

Societies and Academies.

LONDON.

Physical Society, Nov. 7.—W. N. Bond: Turbulent flow through tubes. The experimental methods included (*a*) an aural method; (*b*) photography of the motion of a deflected vane; and (*c*) injection of colour-streams about half-way along the tube. Intermittent turbulence was investigated at speeds near the critical speed, and measurements of the critical speed were made. The velocity parallel to the tube-axis is sometimes almost uniform momentarily over the transverse section. No trace was found of a simple frequency, but evidence was obtained of a predominant wave-length in the turbulent motion at the critical speed. Both these observations seem to agree with the approximate theory given by Heisenberg for flow between a pair of parallel planes.

Geological Society, Nov. 19. A. Brammall: The Dartmoor granites: their genetic relationships (with 80 analyses by Dr. H. F. Harwood and assistants). This complex of differentiated types comprises an 'early' granite suite (sodi-potassic) and a 'late' suite (potassic). They enclose relics of an older differentiated suite (sodic) ranging from granodiorites to granites (with porphyries) and including terms which approximate to Rosenbusch's 'average alkali-granite'. These cognate inclusions are distinguished from hornfelsed xenoliths (shales and diabases). Biotites and orthoclase-phenocrysts 'vary' in the same sense as the granites themselves. The variation-curves for the whole complex show no feature that is inconsistent with a basaltic parentage. Contrary to expectations based on phase-equilibrium, the phenocrysts of the older main granites contain in solid solution a norm-plagioclase which is more albitic than the average for the containing granites. This anomaly (with some others) and the further fact that these coarse granites are the richest in accessory species suggest the effectiveness of crystal-accumulation, as postulated by Bowen. Contamination is general; hybrids are described.

Linnean Society, Nov. 20. R. Gopala Aiyer: An account of the development and breeding habits of a brackish-water polychaet worm of the genus *Marphysa*. A species of *Marphysa* lives in the mouth of the Adyar River (Madras) and the neighbouring backwater. The mouth of the Adyar is usually closed, and the water brackish. The spawn of the worm is found mainly from February to September as jelly-like masses in which the tiny black eggs are embedded. The development of the eggs was observed in the laboratory over a period of eight months. There is no free-swimming stage. The larvæ sink to the bottom and begin a creeping existence. The creeping life is given up as new segments are added, and the tiny worms construct small tubes formed mainly of organic debris cemented together by mucus. Development takes nearly six months.

Society of Public Analysts, Dec. 3.—G. Middleton: A storage and delivery apparatus for antimony chloride solution and other corrosive reagents. Antimony chloride solution is forced upwards by means of a compression rubber bulb into a tube fitted inside the reagent bottle, whence it passes into an external measuring tube, delivering 2 c.c. into the tintometer cell. The ground-glass joints are constructed in such a manner that the reagent does not come in contact with them.—**G. Middleton and F. C. Hymas**: Tests for impurities in ether (2 and 3). The tests recommended for official adoption are: For acetaldehyde, modified Schiff's reagent, made by the addition of 0·1 per cent pyrogallol; and for acetone, the vanillin test of the Dutch Pharmacopœia.—**Norman Evers**: The determination of small quantities of calcium in magnesium salts. Dissolve the required weight of the magnesium salt in 25 c.c. of 20 per cent sulphuric acid, and add 50 c.c. of 95 per cent (by vol.) alcohol. Mix thoroughly and leave overnight. Filter on a Gooch crucible and wash with 200 c.c. of a mixture of 2 volumes of 95 per cent alcohol and 1 volume of 20 per cent sulphuric acid. Ignite and weigh as $CaSO_4$. The results obtained have a tendency to be slightly low. The method may also be applied to solutions containing phosphates, iron, etc. **P. K. Bose**: A new method for the detection of nitro-groups in organic compounds. The method, which is applicable to all poly-nitro organic compounds, is based on the hydrolytic dissociation of the compound by means of potassium hydroxide, and the identification of the resulting nitrous acid by means of the Griess-Ilosvay reagent.

PARIS.

Academy of Sciences, Nov. 17.—A. Lacroix: New observations on the tectites of Indo-China. Tectites have been found in large numbers over a distance of 1300 kilometres in Indo-China. Their chemical composition is constant. The possible origin of these tectites is discussed: volcanic origin, genesis in the place found, are both impossible, and a cosmic origin appears probable.—**André Blondel**: The practical magnetic units.—**Georges Claude**: Concerning a communication of M. Raveau. **R. Nasini**: The discovery of boric acid in the glaze of Arezzo vases. The presence of borax in these Roman glazes of the first century has been suggested, but not proved. By the analyses of authenticated specimens it is now established that this red glaze contains boric acid, not as occasional traces but as a true constituent. Charles Porcher was elected *Correspondant* for the Section of Rural Economy in succession to the late Ulysse Gayon.—**E. Halphen**: The extension of Chasles's theorem to space.—**N. Achieser**: The asymptotic properties of some polynomials. **A Kolmogoroff**: The law of large numbers. **Mlle. Marie Charpentier**: The existence of Peano points of a differential equation of the first order.—**Rolf Nevanlinna**: A class of transcendental functions. **J. Delsarte**: The determination of the Taylor coefficients of a probability function the moments of which are known.—**Jos. Kaucký**: Remarks on the note of M. V. Romanovsky. The discrete chains of Markoff.—**Julius Wolff**: The angular derivative.—**Couffignal**: A new calculating machine.—**D'Ocagne**: Remarks on the preceding note.—**J. Ph. Lagrula**: The position error of the centre of dependences at the interior of a triangle of reference, when the homology is assimilated to linear homography. **James Basset**: An apparatus for experimenting on gases at ultra-pressures of 6000 kgm. per square centimetre. Description with a photograph and two diagrams of the apparatus.—**E. Brylinski**: A system of mechanical, electrical, and magnetic units.—**Panc-Tcheng Kao**: The relaxation oscillations produced by an oscillator with piezo-electric quartz.—**R. Weil**: New observations on quartz.—**A. Dauvillier**: The X-ray spectra of gases. The *K* series of krypton and xenon.—**P. Lebeau and A. Damiens**: The action of fluorine upon wood charcoal. The boiling point and melting point of carbon tetrafluoride. The gas obtained by the action of fluorine upon wood charcoal, after freeing from oxygen and moisture, is liquefied by cooling to $-190°$ C. By fractional distillation of this liquid, pure carbon tetrafluoride has been prepared, with a boiling point of $-126°$ C. and melting point $-191°$ C. From the heavier fractions two other gases have been isolated, hexafluor ethane, C_2F_6, and octafluor propane, C_3F_8, and these are being further studied.—**M. Paić**:

The X-ray study of the products obtained by the action of the halogen acids on the mercuric sulphates. Fusion diagram of the system HgI_2-$HgSO_4$. - **Sou Phou Ti**: The action of ethylmagnesium bromide on *N*-diethylmonochloracetamide. This reaction took an unexpected course, the main product being an amino-alcohol, probably $Et_2N \cdot CEt_2 \cdot CH_2OH$. A trace of diethylacetaldehyde was also isolated.—**J. Décombe**: The *N*-alkylation of the β-amino-ethers.—**Mlle. S. Grateau**: A new method of preparing the δ-ketonic esters. The Friedel and Crafts reaction applied to the chloride ester of adipic acid gives an excellent yield of ethyl δ-benzoylvalerate, and the reduction of this ester leads to phenylcaproic acid. The method appears to be capable of general application.—**Frèrejacque**: A catalyst for the autoxidation of uric acid. In presence of activated carbon, uric acid is completely oxidised in alkaline solution by oxygen, giving a mixture of allantoin and oxonamide.—**A. Travers** and **Franquin**: The extraction of the bases from the condensation liquors of primary tar. **Maurice Blumenthal**: The structure of the penibetic chain between Antequera and Loja (Andalusia). - **Jacques Bourcart**: An attempt at the co-ordination of the observations on the stratigraphy of the Atlantic slope of the Djebalas peninsula (Northern Morocco).— **Mlle. Eliane Basse**: Geological observations on the fossil-bearing secondary formation outcropping between Onilahy and Fiherenana (South-West Madagascar).—**Albert Nodon**: The humming of aerial lines and atmospheric disturbances. The methodical study of the humming of conducting wires, assisted by an amplifying arrangement, can give information valuable for weather forecasts.—**J. Bosler**: The relations between magnetic storms and the earth currents.— **J. Magrou** and **Mme. M. Magrou**: Actions exerted at a distance on the fertilised egg, the sperm, and the virgin egg of the sea-urchin, *Paracentrotus lividus*.— **H. Bordier** and **C. Boisson**: A new application of d'Arsonvalisation: hydrodiathermotherapy. **F. Rosenbusch**: A disease of Paraguay cattle, similar to paralytic rabies.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 16, 1930.—**S. Bernstein**: Some remarks on the polynoms of the minimum deviation with whole coefficients.— **V. Kistiakovskij**: The problem of metastable flotation.— **N. Willams**: The action of the nitric acid on the primary tetrahydro-α-furfurilamine. - **I. Kurbatov**: Conditions of growth of crystals of slightly soluble substances. **B. Licharev**: Two new representatives of the family Productidæ from the Lower Permian of North Caucasus. Descriptions of *Loczyella* (?) *parvula*, sp. n., and *Pectenoproductus proprius*, gen. and sp. n.

Comptes rendus, No. 17, 1930.—**P. Lazarev**: Action of certain substances on the nervous centres. General theoretical considerations.—**P. Lazarev** and **A. Dubinskaja-Voskresenskaja**: Objective studies of nervous centres in persons suffering from *paralysis progressiva*, after the application of salvarsan and of X-rays. Determinations of the increase in the sensibility of eyes supply a method for observing objectively the action of X-rays and of salvarsan. - **P. Lazarev** and **L. Kuper**: Action of acoustic excitations on the sensibility of the eye. The peripheral sensibility decreases under the influence of sounds. —**N. Demjanov**: Action of nitric anhydride on the ethylenic hydrocarbons.— **I. Kurbatov**: The proportions of some active elements in the dispersion rocks of Tuia-Mouiun. - **V. Gromova**: The type of *Bison priscus* Bojanus. A specimen from Siberia in the collection of the Zoological Museum of the Academy is redescribed as the type. **N. Jakovlev**: The discovery of the anal proboscis in the genus *Cupressocrinus*.—**A. Vinogradov**: Vanadium in marine organisms. The concentration of vanadium in the ascidian *Phallusia obliqua* may be up to 0·0302 per cent of the live weight.—**P. Schmidt** and **G. Lindberg**: A new Japanese fish, *Paracanthochaetodon modestus*, gen. and sp. n.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (second class, Natural Sciences and Medicine), Oct. 17. —**J. Wolf**: The origin of fibrillar collagenic sols. Fibrillar sols of the synovia.—**L. Borovanský**: A contribution to the study of growth of organs during the fœtal period.—**V. Hovorka**: Reaction of iodic acid with phosphorous and hypophosphorous acid. In acidic medium, hypophosphorous acid is easily oxidised to phosphorous acid; in alkaline solution iodates are reduced only by hypophosphites. In presence of argentous and mercuric salts the reactions are complicated.—**V. Kořinek**: Quadratic bodies of quaternion orbits. —**J. Koutský**: A study of asymptotic transformations of undevelopable surfaces in projective S_3. - **R. Lukeš**: The action of Grignard's agent on *N*-methyl-pyrrolidon. Grignard's agent of methyl-, ethyl-, *n*-propyl-, and phenyl-bromides acting on *N*-methyl-pyrrolidon yielded 1-methyl-2 alkyl-Δ_2-pyrrolines, which were isolated as perchlorates, and the corresponding 1-methyl-2·2 di-alkyl-pyrrolidines. The aromatic agent gave 1-methyl-2-phenyl-Δ_2-pyrroline. - **V. Prelog**: The sapogenin of beetroot. The oxidation of sapogenin ($C_{31}H_{50}O_3$) by chromic acid yielded a ketonic acid, $C_{31}H_{48}O_3$, giving a methylester, a semicarbazone, and a keto-hydroxy lactone, $C_{31}H_{46}O_4$. The carboxyl is bound to a tertiary carbon atom and the substance contains inert double-linkages. - **K. Šimek**: The graphical solution of reactions and axial forces for special plain systems of poles. - **J. Petrbok**: Pleistocene molluscs of the Danube terrace near Russe in Bulgaria.—**V. Posejpal**: A third contribution to the study of universal ether. From his conception of particles of ether, the radius, r, of which should be identical with that of an electron, the author deduces the diffusion coefficient σ/ρ of hydrogen for very hard γ-rays as $\frac{\sigma}{\rho}$ [illegible] m_H [illegible], where m_H is the absolute mass of a hydrogen atom. The radius of the ether particle thus calculated agrees well with the value derived for the radius of the electron from the electro-magnetic theory of mass. **J. M. Jaeger**: Molecular configuration and optical activity. Methods, results, and problems of precise modern measurements of high temperatures. Constitution and structure of ultramarine.—**C. Purkyně**: The waterfall of river Zambezi.

Nov. 14.- **E. Votoček**: Osazonogenic groups. From original experiments and literature the osazonogenic grouping is shown to be more general, extending to groups like $-CO.CH_2Cl$, $-CO.CHCl_2$, $C-CHCl-CO-$, and many others.—**F. Valentin**: A new form of the two rhamnite antipodes. The two optical isomerides, rhamnite trihydrates, $C_6H_{14}O_5.3H_2O$, are enantiomorphous, according to Pasteur's rule. **J. Babička**: The determination of proteins by means of electrolysis with the dropping mercury cathode. In the presence of ammonium salts solutions containing soluble proteins (ovo-albumin, serum-albumin, hæmoglobin, phyto-albumin) the electrolytic current-voltage curves, registered polarographically, show an electro-reduction at $-1·5$, $-1·7$ volt. The increase of current at this cathodic potential is proportional to the amount of soluble protein. Qualitative and quantitative estimation of albumins is thereby possible.—**R. Nováček**: Linnéit from the mine Prago at Kladno.— **V. Tůma**: On the process of closing umbilical blood vessels during human birth.—**J. Matiegka** and **J. Malý**: The bodily remains of Karel Havlíček Borovský.

Official Publications Received.

BRITISH.

Mathematical Notes: a Review of Elementary Mathematics and Science. Edited by William Arthur. No. 26, October. Pp. xxii. (Edinburgh: Edinburgh Mathematical Society.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), Nos. 40-47. 40: The Nitration of Substituted Diaryl Ethers:—Phenyl-p-Tolyl Ether, by Joseph Reilly, P. J. Drumm and T. Gray; 41: Study of the Polysaccharides, Part 3: Acetamide as a Polysaccharide Solvent, by J. Reilly, Dr. Reinhold Wolter and P. P. Donovan; 42: Report of the Irish Radium Committee for the Year 1929, including Reports by Oliver Chance, Andrew Charles, Oswald J. Murphy, Dr. Walter C. Stevenson, C. M. Taylor, Josephine Walsh; 43: The Raised Beaches of the East Coast of Ireland, by C. P. Martin; 44: *Paradomyces hibernicum*—New Species, by C. V. E. Kennelly and M. Grimes; 45: Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 3: Certain Spruce, Larch, Oak and Holm Oak Woods, by Dr. W. R. G. Atkins and Florence A. Stanbury; 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Factors, by Dr. W. R. G. Atkins and E. Wyllie Fenton; 47: A Study of Fungi found in Butter, by M. Grimes and V. C. E. Kennelly and H. A. Cummins. Pp. 461-569+plates 19-23. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 8s.

Proceedings of the Royal Society. Series A, Vol. 129, No. A811, November 3. Pp. 411-698+xxxviii. (London: Harrison and Sons, Ltd.) 15s.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 3, November. Pp. 83-155+plates 9-17. (London: Dulau and Co., Ltd.) 10s. net.

Transactions of the Edinburgh Geological Society. Vol. 12, Part 3. Pp. 289-304. (Edinburgh.) 1s.

Report on the Administration of the Museum and Public Gardens during 1104 M.E. Pp. 15. (Trivandrum.)

Conference of Directors of Far Eastern Weather Services, Hong Kong, 1930. Report of Proceedings, with Appendices and List of Delegates. Pp. ii+69. (Hong Kong: Royal Observatory.)

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series No. 2: Investigations on Panama Disease in Malaya. By F. S. Ward. Pp. iii+26+4 plates. 1 dollar. Scientific Notes No. 3: An Historical Note on *Pirathalia rubicena* Walk. (The Greater Coconut Spike Moth) and its three Parasites in Malaya, by G. H. Corbett; Preliminary Observations on *Sogata* spp. Pests of Padi, by N. C. E. Miller and H. T. Pagden. Pp. 14. 50 cents. (Kuala Lumpur.)

Report of the Botanical Survey of India for 1928-29. Pp. 9. (Calcutta.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1328 (E. 38): Performance of a Compression Ignition Unit with Reduced Intake and Exhaust Pressures. By P. H. Stokes. (I.C.E. 44 A. and B.) Pp. 20+21 plates. 1s. 6d. net. No. 1332 (Ae. 461): Comparative Handling Tests of three Bristol Fighter Aircraft with different Types of Slots. By Flight-Lieut. C. E. Maitland and Flight-Lieut. J. H. C. Wake. (S. and C. 331.) Pp. 8+9 plates. 9d. net. No. 1335 (Ae. 466): Photographic Records of Flow in the Boundary Layer. By L. F. G. Simmons and N. S. Dewey. (T. 2958.) Pp. 9+6 plates. 1s. net. No. 1336 (E. 40): The Application of Dimensional Relationships to Air Compressors, with Special Reference to the Variation of Performance with Inlet Conditions. By R. S. Capon and G. V. Brooke. (I.C.E. 762.) Pp. 22+9 plates. 1s. 3d. net. (London: H.M. Stationery Office.)

University of Cambridge: Solar Physics Observatory. Eighteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1929 August 1-1930 July 31. Pp. 5. (Cambridge.)

The Association of Engineering and Shipbuilding Draughtsmen Diary 1931. Pp. 110+Diary. (London: The Draughtsman Publishing Co., Ltd.)

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum, Vol. 4, No. 2. Pp. 145-273. (Adelaide.) 10s. 6d.

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 3, No. 21: The Climate during the Pleistocene Period. By Dr. G. C. Simpson. Pp. 262-296. 3s. Vol. 50, Part 3, No. 22: The Metabolism of the Frog's Isolated Heart. By Prof. A. J. Clark, Dr. C. P. Stewart and R. Gaddie. Pp. 297-303. 9d. Vol. 50, Part 3, No. 23: On some Persymmetric Determinants. By J. Geronimus. Pp. 304-309. 9d. Vol. 50, Part 3, No. 24: The General Form of the Orthogonal Polynomials for Simple Series, with Proofs of their Simple Properties. By F. E. Allan. Pp. 310-320. 1s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The British Institute of Radiology, incorporated with the Röntgen Society. Year Book 1930. Pp. 72. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 407, November. Pp. 1369-1539+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Journal of the Royal Society of Western Australia. Vol. 15, 1928-1929. Pp. xlv+131. (Perth.) 35s.

Ministry of Transport and Ministry of Agriculture and Fisheries: Joint Committee on Damage to Fisheries. Detailed Biological and Chemical Reports on Tars used for Road-Surfacing. Pp. 171. (London: H.M. Stationery Office.) 2s. 6d. net.

New Zealand: Department of Lands and Survey. Scenery-Preservation: Report for the Year ended 31st March 1930, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 30+8 plates. (Wellington, N.Z.: W. A. G. Skinner.)

New Zealand. Tongariro National Park: Annual Report of the Board. Pp. 7. (Wellington, N.Z.: W. A. G. Skinner.) 6d.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 9. Pp. 81-192. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.)

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-fourth Session adopted at the Annual Meeting of Governors held on the 21st October 1930. Pp. 79. (Glasgow.)

Canada. Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1928. (No. 712.) Pp. ii+71+2 plates. (Ottawa: F. A. Acland.)

Tide Tables for the Eastern Coasts of Canada for the Year 1931: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. Thirty-fifth Year of Issue. Pp. 92. (Ottawa: F. A. Acland.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1303 (E. 39): Torsional Vibration of Crankshafts Beardmore 'Tornado' Airship Engine Investigations. By B. C. Carter and N. S. Muir. (T.V.C. 44 and 50.) Pp. 56+10 plates. (London: H.M. Stationery Office.) 3s. net.

Memoirs of the Geological Survey of India. Vol. 56: The Jharia Coal Field. By Dr. C. S. Fox. Pp. vi+255+vii+21 plates. (Calcutta: Government of India Central Publication Branch.) 8.12 rupees; 14s.

Records of the Geological Survey of India. Vol. 63, Part 3. Pp. 281-377. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 15, Parts 1 and 2, 15 November. Pp. 192. (London: Cambridge University Press.) 15s.

Tide Tables for the Pacific Coast of Canada for the Year 1931: including Fuca Strait, the Strait of Georgia and the Northern Coast, with Data for Slack Water in the Navigable Passes and Narrows and Information on Currents, also Tide Tables for the U.S. Ports of Seattle and Port Townsend. Issued by the Tidal and Current Survey Division of the Hydrographic Service, in the Department of Marine and Fisheries of the Dominion of Canada. Thirty-first Year of Issue. Pp. 80. (Ottawa: F. A. Acland.)

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 2, September. Compiled by Agnes Elisabeth Glennie. Pp. iv+89. (London: H.M. Stationery Office.) 2s. net.

London University Guide and University Correspondence College Calendar, 1931-1932. Pp. 247. (Cambridge and London: University Correspondence College.) 2s. 6d.

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1929-30. Pp. 30. (Aberdeen.)

Summary and Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929. Part 3. Pp. iv+89+8 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Report of the Department of Industries, Madras, for the Year ending 31st March 1930. Pp. vi+122. (Madras: Government Press.) 12 annas.

The University of Manchester: The Manchester Museum. Museum Publication 99: Report of the Museum Committee for the Year 1929-30. Pp. 27. 6d. net. Museum Publication 100. Notes from the Manchester Museum, No. 33: Three Manchester Botanists. Leopold Hartley Grindon, Charles Bailey, James Cosmo Melvill. (Course of Museum Lectures delivered November-December 1929.) By Prof. F. E. Weiss. Pp. 20+3 plates. 2s. 6d. (Manchester.)

Jubilee Congress of the Folk Lore Society, Sept. 19-Sept. 25, 1928. Papers and Transactions. Pp. 319+5 plates. (London: William Glaisher, Ltd.) 21s. net.

Board of Education. Report on the Science Museum for the Year 1929. Pp. 27. (London: H.M. Stationery Office.) 6d. net.

North-East Coast Institution of Engineers and Shipbuilders. List of Members, 1st August 1930. Pp. 48. (Newcastle-upon-Tyne.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 10, October. Abstracts Nos. 1854-2038. Pp. 341-378. (London: H.M. Stationery Office.) 9d. net.

Royal Agricultural Society of England. Agricultural Research in 1929. Pp. viii+182. (London: John Murray.) 1s.

FOREIGN.

The Rockefeller Foundation. Annual Report, 1929. Pp. viii+402. (New York City.)

Bulletin of the American Museum of Natural History. Vol. 60: The Birds of Matto Grosso, Brazil; a Report on the Birds secured by the Roosevelt Rondon Expedition. By Elsie M. B. Naumburg, with Field Notes by George K. Cherrie. Pp. vii+432+17 plates. (New York City.)

Proceedings of the United States National Museum. Vol. 78, Art. 9: American Two-winged Flies of the Genus *Stylogaster* Macquart. By J. M. Aldrich. (No. 2852.) Pp. 27. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Miscellaneous Publication No. 86: Outlines for Studies of Mammalian Life Histories. By Walter P. Taylor. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Scientific Publications of the Cleveland Museum of Natural History. Vol. 1, No. 3: A new Genus of African Starlings. By Harry C. Oberholser. Pp. 81-82+plate 17. (Cleveland, Ohio.)

Ministry of Public Works, Egypt: Physical Department. Further Experiments on the Discharge of Models of Sluices. By Dr. H. E. Hurst. (Physical Department Paper No. 25.) Pp. iii+23+19 plates. (Cairo: Government Press.) 10 P.T.

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 13: Relative Bestimmungen der Schwerkraft in Finnland in den Jahren 1926-1929. Von U. Pesonen. Pp. 168. No. 14: Anwendung der Lichtinterferenz bei Basismessungen. Von Prof. Y. Väisälä. Pp. 47. (Helsinki.)

United States Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 34: The Daily, Monthly and Annual Normals of Precipitation in the United States, based on the 50-Year Period, 1878-1927 inclusive. By P. C. Day. Pp. 101. (Washington, D.C.: Government Printing Office.) 35 cents.

The Museum of the Brooklyn Institute of Arts and Sciences. Science Bulletin, Vol. 4, No. 1: Maya Dates and what they Reveal; a Re-examination of the Evidence in Correlation between Central American and European Time Counts. By Herbert J. Spinden. Pp. 111. (Brooklyn, N.Y.)

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Classified List of Publications available for Exchange and Distribution, including the Publications of the State Entomologist's Office and the State Laboratory of Natural History. Pp. 30. Bulletin, Vol. 18, Art. 3: Epidemic Diseases of Fruit Trees in Illinois, 1922-1928. By L. R. Tehon and Gilbert L. Stout. Pp. 411-502. Bulletin, Vol. 19, Art. 1: The Fishes of Champaign County: a Study of the Distribution and Abundance of Fishes in Small Streams. By David H. Thompson and Francis D. Hunt. Pp. 101. Bulletin, Vol. 19, Article 2: Records of Spring Migration of Birds at Urbana, Illinois, 1903-1922. By Frank Smith. Pp. 103-117. (Urbana, Ill.: State Natural History Survey.)

Cornell University Agricultural Experiment Station. Bulletin 507: Motor Trucks on New York Farms. By C. W. Gilbert. Pp. 55. Memoir 132: Biochemistry and Biophysics of the Developing Hen's Egg. 1: Influence of Humidity. By Alexis L. Romanoff. Pp. 27. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 77, Art. 19: Notes on the Rhinotragine Beetles of the Family Cerambycidae, with Descriptions of New Species. By W. S. Fisher. (No. 2842.) Pp. 20. Vol. 77, Art. 20: The Taxonomy and Host Relationships of the Biting Lice of the Genera Dennyus and Eureum, including the Descriptions of a New Genus, Subgenus and four New Species. By H. E. Ewing. (No. 2843.) Pp. 16. (Washington, D.C.: Government Printing Office.)

Publikationer fra det Danske Meteorologiske Institut. Communications magnétiques, etc. No. 11: Le variometre de Copenhague, par D. la Cour et Viggo Laursen; No. 12: On the Scale Value and the Base Value of the H-Variometer, by V. H. Ryd. Pp. 11+11. (København: G. E. C. Gad.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Tome 3: Annuaire pour l'an 1931. Rédigé par V. V. Michkovitch. Pp. 146+3 planches. (Belgrade.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 271-273: A Study on the Decomposition of Potassium Ferrocyanide and of Potassium Ferricyanide by the Autoclave Treatment, by Tominosuke Katsurai and Tokunosuke Watanabe; Researches on the Cutting Force, 2: Cutting Action of Planing Tool, by Makoto Ōkoshi; Grain-Growth of Marble (Abridgement), by Masawo Kuroda. Pp. 189-227. (Tokyo: Iwanami Shoten.) 75 sen.

Mount Wilson Catalogue of Photographic Magnitudes in Selected Areas 1-139. By F. H. Seares, J. C. Kapteyn and P. J. van Rhijn, assisted by Mary C. Joyner and Myrtle L. Richmond. (Papers of the Mount Wilson Observatory, Vol. 4.) (Publication No. 402.) Pp. 1+276. (Washington, D.C.: Carnegie Institution.) 8.00 dollars.

Contributions to Palaeontology from Carnegie Institution of Washington. 1: A Neocene Erosion Surface in Central Oregon, by John P. Buwalda; 2: The Dalles and Hood River Formations, and the Columbus River Gorge, by John P. Buwalda and Bernard N. Moore; 3: Oreodonts from the Sespe Deposits of South Mountain, Ventura County, California, by Chester Stock; 4: Carnivora New to the Mascall Miocene Fauna of Eastern Oregon, by Chester Stock; 5: Capromeryx minor Taylor from the McKittrick Pleistocene, California, by Eustace L. Furlong; 6: A Tertiary Vertebrate Fauna from the Upper Cuyama Drainage Basin, California, by C. Lewis Gazin; 7: A Tertiary Mammalian Fauna from the Mint Canyon Formation of Southern California, by John H. Maxson. (Publication No. 404.) Pp. iii+112+8 plates. (Washington, D.C.: Carnegie Institution.) 2.25 dollars.

Contributions to Embryology. Vol. 21,

Structure of Thyroid Gland in Man, by W. F. Reinhoff, Jr.; 124: The Age Factor in Grafts, by Vera Danchakoff and V. E. Danchakoff; 125: The Early Embryology of the Rabbit, by P. W. Gregory. (Publication No. 407.) Pp. iii+168+29 plates. (Washington, D.C.: Carnegie Institution.) 3.75 dollars.

Thermodynamic Relations in Multi-Component Systems. By Roy W. Goranson. (Publication No. 408.) Pp. xvii+329. (Washington, D.C.: Carnegie Institution.) 6.00 dollars.

Leonardo da Vinci, the Anatomist (1452-1519). By Prof. J. Playfair McMurrich. (Published for the Carnegie Institution.) (Publication No. 411.) Pp. xx+265+72 plates. (Baltimore, Md.: Williams and Wilkins Co.) 6.00 dollars.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 63: The Attempted Take-off of the "City of Tacoma" for the Trans-Pacific Flight at Kasumigaura, Japan. By Taituro Ogawa. Pp. 219-259+2 plates. (Tōkyō: Koseikai Publishing House.) 0.16 yen.

Proceedings of the United States National Museum. Vol. 77, Art. 12: Birds from the Small Islands off the Northeast Coast of Dutch Borneo. By J. H. Riley. (No. 2835.) Pp. 23+1 plate. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Circular No. 139: Method and Procedure of Soil Analysis used in the Division of Soil Chemistry and Physics. By W. O. Robinson. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.

Pp. 397-528. (Philadelphia.)

Ministère de l'Instruction publique et des Beaux-Arts. Enquêtes et documents relatifs à l'enseignement supérieur. 124: Rapports sur les Observatoires astronomiques de province et les Observatoires et Institut de Physique du Globe, année 1928. Pp. 115. (Paris: Imprimerie Nationale.)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 45: Hydromedusae collected in the South-Western Part of the North Sea and in the Eastern Part of the Channel in 1903-1914. By P. L. Kramp. Pp. 55. (Bruxelles.)

An Album of the Groups in the Verney-Faunthorpe Hall of South Asiatic Mammals of the American Museum of Natural History. Pp. 28+24 plates. (New York City.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 5, No. 4, October. Pp. 781-9[illegible]. (Washington, D.C.: Government Printing Office.)

Reprint and Circular Series of the National Research Council. No. 94: Eighth Report of the Committee on Contact Catalysis. By J. C. W. Frazer. Pp. 51. 50 cents. No. 95: Doctorates conferred in the Sciences by American Universities, 1929-1930. Compiled by Callie Hull and Clarence J. West. Pp. 49. 50 cents. No. 96: Second Report of the Committee on Photochemistry. By Hugh S. Taylor. Pp. 4[illegible]. 50 cents. (Washington, D.C.: National Academy of Sciences.)

State of California: Division of Fish and Game. Fish Bulletin No. 23: Success of the Purse Seine Boat in the Sardine Fishery at Monterey, California (1929-1930 Fishing Season). By J. B. Phillips. Pp. 30. Free. Fish Bulletin No. 24: An Analysis of the Catch Statistics of the Striped Bass (*Roccus lineatus*) Fishery of California. By J. A. Craig. Pp. 4[illegible]. Free. Fish Bulletin No. 25: Fishing areas along the California Coast for the Sardine (*Sardinia caerulea*). By the California State Fisheries Laboratory. Pp. 46. Free. Fish Bulletin No. 26: Seasonal Changes in the Daily Average Length of the California Sardine (*Sardinia caerulea*). By Frances N. Clark. Pp. 22. Free. (Terminal Island, Calif.: California State Fisheries Laboratory.)

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1929. (Publication 3034.) Pp. xiii+62[illegible]+91 plates. (Washington, D.C.: Government Printing Office.) 1.7[illegible] dollars.

Diary of Societies.

FRIDAY, DECEMBER 19.

LONDON SOCIETY (at Royal Society of Arts), at 5.—Prof. S. D. Adshead: South Essex: Its Docks, Industries, and Houses.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (in Mining Institute, Newcastle-upon-Tyne), at 7.15.—E. L. Champness and others: Are we justified in using Steel and other Materials of Foreign Manufacture in the British Engineering Industries?

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Cullen: Well Drill Blasting.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—R. C. Hawkins: Sales Aspects of Hotel Lighting.

JUNIOR INSTITUTION OF ENGINEERS (at Metallurgical Club, Sheffield), at 7.30.—P. S. Devereux: Chairman's Address.

INSTITUTE OF CHEMISTRY (London Section), at 8.—Dr. A. E. Dunstan: Gluckstein Memorial Lecture.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics and Comparative Medicine Sections), at 8.30.—Major A. A. Pryer, Dr. R. W. A. Salmond, Lieut.-Col. E. Middleton Perry, Dr. J. B. King, and others: Discussion on A Comparison of Radiological Problems in Man and Animal.

SOCIETY OF DYERS AND COLOURISTS (London Section).—Dr. Callan: Emulsifying Agents, Textile Assistants, and Finishing Materials: their Examination and Valuation.

MONDAY, DECEMBER 22.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. H. E. Merritt: Trends in the Transmission.

PUBLIC LECTURE.

FRIDAY, DECEMBER 19.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—J. Pryde: Human Engines.

CONFERENCE.

DECEMBER 19 AND 20.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Bedford College).

Friday, Dec. 19, 10 A.M. to 1.—Dr. M. C. Rayner: Observations on *Armillaria mellea* in Pure Culture with Certain Conifers.
J. G. Boswell: The Biochemistry of Dry Rot in Wood.
G. E. Blackman: The Effect of Nitrogen Compounds on the Botanical Composition of Grass.
Dr. W. H. Pearsall: Changes in the Constitution of *Beta* Leaves during Growth.
Dr. E. D. Adrian: The Activity of Isolated Nerves and Nerve Cells.
H. O. Bull: Conditioned Responses and Salmon Smolts.
2.15 to 4.—Dr. C. M. Yonge: The Relationship between Corals and Zooxanthellae.
Dr. T. A. Stephenson: The Growth of Corals.
E. Hindle: Thermophilous Organisms.
W. H. Thorpe: Experiments on the Biology of the Petroleum Fly *Psilopa petrolii*.
5.30 to 6.30.—E. Charles: Metabolic Changes associated with Pituitary Activity.
E. A. Spaul: Internal Secretions and Metamorphosis.

Saturday, Dec. 20, 10 A.M. to 1.—Symposium on the Permeability of Protoplasmic Membranes.
Prof. L. T. Hogben: Electrical Conductivity and the Permeability of Animal and Plant Tissues.
Prof. A. V. Hill: The Steady State across Biological Membranes.
A. D. Hobson: Changes in the Sea-Urchin Egg following Fertilisation.
R. J. Pumphrey: Electrical Potentials across the Membranes of the Trout Egg.
C. F. A. Pantin: Surface Permeability and the Evolution of the Blood Serum.

SATURDAY, DECEMBER 27, 1930.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Intellectual Co-operation.

THE inquiry into the work of the Committee on Intellectual Co-operation of the League of Nations, which has recently been carried out by a small committee under the chairmanship of M. Roland-Marcel, was promoted by the very success of the efforts of the Committee in this particular field of international co-operation. Problems were being submitted to the Committee in increasing numbers, and a real danger had already arisen when the committee was appointed in 1929, that efforts in the field of intellectual co-operation might either overlap unprofitably with the efforts of national organisation or be spread over so wide a field that, with the limited resources at the disposal of the Committee and of the International Institute of Intellectual Co-operation, effective attack on the individual problems would be impossible. No question of restricting the field of co-operation or the efforts of the various organisations already participating was raised. The existence of a very widespread realisation throughout the world of learning of the value and need for co-operation in thought, if the interests not only of peace but also of art and letters and science are to obtain adequate service in a world where politics and industry have already been internationalised, was evident and received further emphasis from the inquiry.

The committee's report covered the methods of work employed in this field, and certain recommendations were made regarding the constitution of the Committee on Intellectual Co-operation itself, together with a proposal to appoint an executive committee consisting of eight members to meet four times a year.

In addition, a programme of work was drafted on broad lines indicating the order of precedence to facilitate concentration upon a selected range of problems. Included in this programme are the development of the exchange of ideas and the promotion of personal contacts between intellectual workers of all countries; co-operation between institutions engaged on work of an international character; the general study of certain major problems of international bearing; international protection of intellectual rights; and in particular, the propagation by educational methods of the principle of the League of Nations, and a recommendation that the interrupted general inquiry into the position of intellectual life in different countries should be resumed.

Up to the present the conception of intellectual co-operation which has apparently dominated the

work of the Committee of Intellectual Co-operation and of the International Institute is one of co-ordinating the intellectual activities of the world, improving facilities for intellectual life where required, and generally promoting unity between the national groups of learning.

This conception, which was possibly the only one that a temporary committee with limited resources could have adopted, is, however, far from adequate to the problem as it is now revealed. Co-operation in the field of learning must follow the lines of co-operation in the field of industry, and effective collaboration must be established between men of science of different countries in the solution of certain problems. Such a conception would involve the Institute of Intellectual Co-operation becoming a kind of international academy where men of learning would assemble, and inevitably much larger resources than those at present available would be required.

It is, however, such a conception of intellectual co-operation which has inspired the most successful efforts in the field of international science, whether directed by the Committee on Intellectual Co-operation or not. The success of the health work of the League of Nations, as represented by the investigations of the malaria commission, the sleeping sickness commission in Africa, the Singapore Epidemiological Intelligence Bureau, etc., is the fruit of deliberate co-operation in a carefully selected field, the organised attack by scientific workers of different countries upon a common problem. Similar remarks apply to the work of the Committee itself in such fields as those of bibliography, library co-operation, the compilation of an annual list of notable books, and the inquiry into the durability of printed documents.

The revised constitutions recommended for the International Committee and Institute justify some hope that they will be more adequate to discharge the functions required by this conception of intellectual co-operation. There are, however, two points on which it is necessary to insist. The selection of the problems for international co-operation is a critical factor in determining the success of efforts in this field. Not only must the range of subjects be one commensurate to some extent with the resources available, but also it must be one which appeals sufficiently to the majority of the countries represented to ensure the loyal and energetic support of the national groups. Much of the work inevitably must be carried on through the national committees and other channels, and any lack of sympathy of understanding between these and the International Committee would undoubtedly be disastrous.

Equally important, however, is full freedom in selecting the problems for co-operation. Nothing would more surely jeopardise efforts in this field than limitations dictated by political considerations or prejudice. Real co-operation in the field of learning is only possible when the form and extent of that co-operation is determined by the free selection of appropriate problems by the workers themselves, influenced solely by considerations of the available resources and the advantages accruing to mankind.

It must be admitted that while direct political pressure is unlikely, it is difficult to detect or resist indirect pressure. For this reason the active prosecution by the Committee of inquiries concerning the international protection of intellectual rights is highly desirable, and there should be no diminution in the support given to the Advisory Committee on Professional Workers, set up by the International Labour Office in 1928, and on which the Committee on Intellectual Co-operation is represented.

For the full service of science or of any other branch of knowledge in the international sphere, the existence of representative professional organisations in the different countries, having an independent outlook and status, is of fundamental importance. Such organisations are more than a mere safeguard against the political control of efforts in the field of learning. Their contribution and participation are indispensable if the work of intellectual co-operation is to be continuously directed in practical channels and the dissipation of effort in academic or sterile directions is to be avoided.

Co-operation in thought is an essential condition of any form of international progress, and while efforts in the field of intellectual co-operation may well have a powerful indirect influence in promoting other forms of international co-operation, any divorce between learning and action in field of intellectual co-operation itself would be fatal to such an influence. For this reason a much closer association between the work of the International Committee and that of the national committees and of the national professional organisations is indispensable, if learning is to exert decisive influence in any field of international relations, and if the scientific study of international affairs is to be no mere academic formula but vital contribution of science in shaping the destiny of civilisation.

Mr. Winston Churchill on Miseducation.

My Early Life: a Roving Commission. By the Rt. Hon. Winston S. Churchill. Pp. 392 + 16 plates. (London: Thornton Butterworth, Ltd., 1930.) 21*s.* net.

NOT only out of the mouth of babes but also of public characters may come wisdom—even from a Winston Churchill. The autobiography he has recently published is full of meat for the would-be student of education. Obviously, being the son of his father, with the possibility of genes—this in recognition of the Bishop of Birmingham's reversion to bionomics—from other peculiar forbears, he could not be educable in any ordinary way. He has written a most fascinating account of his irresponsible upbringing, which should shame the devil in all but one of his schoolmasters. The book is to be studied by every teacher who desires to play an honest hand, a warning to every parent.

He went to a most fashionable and expensive preparatory school at seven. He had been so happy, he says, in his nursery with his wonderful toys: a real steam engine, a magic-lantern and a collection of soldiers already nearly a thousand strong. At school it was to be all lessons, seven or eight hours a day except half-holidays, football or cricket in addition. At once he was set down to master the First Declension Mensa, a table; mensa, O table, etc. He gives a most amusing account of his subsequent interrogation by the form master. He found the vocative a complete puzzle: why two meanings to the same word—why at one time 'a table', then 'O table'? Told that the latter was used in talking *to* a table, he ingenuously and naturally replied, that he never did. "If you are impertinent, you will be punished . . . let me tell you, very severely", was the conclusive reply. Flogging with the birch, in imitation of Eton, was the great feature in the school curriculum—the floggings "exceeded in severity anything that would be tolerated in any of the Reformatories under the Home Office". Being constitutionally unable to learn Latin, he had his plentiful share of whippings. So he hated school and lived a life of anxiety there during more than two years. The greatest pleasure he had was reading: when nine and a half, his father gave him "Treasure Island", which he devoured with delight. What a book this has been for youngsters—I well remember how it electrified my children, in fact, all of us, when it came out.

"My teachers saw me at once backward and precocious, reading books beyond my years and yet at the bottom of the Form. They were offended. They had large resources of compulsion at their disposal, but I was stubborn. Where my reason, imagination or interest were not engaged, I would not or I could not learn. In all the twelve years I was at school no one ever succeeded in making me write a Latin verse or learn any Greek except the alphabet. I do not at all excuse myself for this foolish neglect of opportunities procured at so much expense by my parents and brought so forcibly to my attention by my Preceptors. Perhaps if I had been introduced to the ancients through their history and customs, instead of through their grammar and syntax, I might have had a better record."

Here the interesting question may well be asked: Whether customs and history can, in any way, take the place of language study? Surely, it is mere pretence to say they can. The study of a language is something apart. Classical custom and history are profitably studied, I venture to think, only in a language with which the student is familiar. Warde Fowler is certainly the best of guides to Rome.

Churchill fell into a low state of health but was only removed from the school after he had a serious illness; he was sent to a small school at Brighton, kept by two ladies, in which he found an element of kindness and sympathy conspicuously lacking in his first school. Query: Should not preparatory schools all be in the hands of ladies? He remained there three years and gradually grew stronger. He was allowed to learn things which interested him—"French, History, lots of Poetry by heart, and above all Riding and Swimming".

He went to Harrow when he was twelve, entering "the inhospitable regions of examinations, through which for the next seven years I was destined to journey". The whole philosophy of examinations is to be read in the following passage in which he sets out this theme:

"These examinations were a great trial to me. The subjects which were dearest to the examiners were almost invariably those I fancied least. I would have liked to have been examined in history, poetry and writing essays. The examiners, on the other hand, were partial to Latin and mathematics. And their will prevailed. Moreover, the questions which they asked on both these subjects were almost invariably those to which I was unable to suggest a satisfactory answer. I should have liked to be asked to say what I knew. They always tried to ask what I did not know. When I would have willingly displayed my knowledge, they sought to expose my ignorance. This sort of treatment had only one result: I did not do well in examinations."

Yet as a man he has done well in after life, as do multitudes who, like him, fail at school. In my long

experience, it is never safe to write down a boy a fool: development so often waits upon age and opportunity. The account which Mr. Churchill gives of his performance at entrance to Harrow is most amusing: he was unable to answer a single question in the Latin paper. Yet the head master, Mr. Weldon, admitted him—doubtless upon his name. He was placed in the bottom form, of which he was last of all during nearly a year. Here comes a golden passage:

"... being so long in the lowest form I gained an immense advantage over the cleverer boys. They all went on to learn Latin and Greek and splendid things like that. But I was taught English. We were considered such dunces that we could learn only English. Mr. Somervell—a most delightful man, to whom my debt is great—was charged with the duty of teaching the stupidest boys the most disregarded thing—namely, to write mere English. He knew how to do it. He taught it as no one else has ever taught it. Not only did we learn English parsing thoroughly, but we also practised continually English analysis. Mr. Somervell had a system of his own. He took a fairly long sentence and broke it up into its components by means of black, red, blue and green inks. Subject, verb, object: Relative Clauses, Conditional Clauses, Conjunctive and Disjunctive Clauses! Each had its colour and its bracket. It was a kind of drill. . . . As I remained in the Third Form (β) three times as long as anyone else, I had three times as much of it. I learned it thoroughly. Thus I got into my bones the essential structure of the ordinary British sentence—which is a noble thing. And when in after years my schoolfellows who had won prizes and distinction for writing such beautiful Latin poetry and pithy Greek epigrams had to come down again to common English, to earn their living or make their way, I did not feel myself at any disadvantage. Naturally I am biassed in favour of boys learning English. I would make them all learn English: and then I would let the clever ones learn Latin as an honour, and Greek as a treat. But the only thing I would whip them for is not knowing English. I would whip them hard for that."

I would *force* this passage upon the attention of every English teacher and whip him hard until he mastered its meaning and acted in its spirit. In one of the schools with which I am connected, in which the curriculum had been entirely classical and mathematical, several years ago the decision was taken, partly owing to my insistence, to substitute English for Latin in the Lower School and then to enforce Latin only upon boys of distinct literary ability. The attempt was a failure because the classical masters would not and could not teach English: so they soon reverted to their early evil course of general Latin torture. The experiment has been an interesting one, confirming my suspicion that Latin needs but a lesser level of intelligence in the teacher, also explaining the failure of our schools under classical leadership. As a teacher, in my own subject, I have always insisted upon training in English composition being made part of the course—with little result, I fear as an example, judging from complaints such as that made recently by Sir William Pope. The time is at hand, however, when we must recognise our own language and those of other moderns.

Winston Churchill spent four and a half years at Harrow, three in the Army class. Officially, he never got out of the Lower School. He had a wonderful memory. While apparently stagnating in the lowest form, he gained a prize open to the whole school for reciting to the head master twelve hundred lines of Macaulay's "Lays of Ancient Rome" without making a single mistake. He passed the preliminary examination for the Army, while still almost at the bottom of the school. Here—let all mark this—his nursery toys came in. He was embarked on a military career. This orientation, he says, was entirely due to his collection of toy soldiers. He had ultimately nearly fifteen hundred. He tells how he arranged his forces, how his father one day made a general inspection and studied the scene with a keen eye and captivating smile. At the end, the father asked him if he would like to go into the Army. Thinking it would be splendid to command an Army, he said 'Yes' at once and was taken at his word. He afterwards learnt that his father had thought he was not clever enough for the Bar. However, the toy soldiers had turned the current of his life.

It took him three tries to pass into Sandhurst. He has much to say about Latin and mathematics and examinations, in this connexion, that should be of great interest to teachers generally. At the close of his career at the Royal Military College, he had been nearly twelve years at school:

"Thirty-six terms each of many weeks (interspersed with all-too-short holidays) during the whole of which I had enjoyed few gleams of success, in which I had hardly ever been asked to learn anything which seemed of the slightest use or interest, or allowed to play any game which was amusing. In retrospect these years form not only the least agreeable, but the only barren and unhappy period of my life. I was happy as a child with my toys in my nursery. I have been happier every year since I became a man. But this interlude of school makes a sombre grey patch upon the chart of my journey. It was an unending spell of worries that did not seem petty, and of toil

uncheered by fruition; a time of discomfort, restriction and purposeless monotony.

". . . I would far rather have been apprenticed as a bricklayer's mate, or run errands as a messenger boy, or helped my father to dress the front windows of a grocer's shop. It would have been real; it would have been natural; it would have taught me more; and I should have done it much better.* *Also I should have got to know my father*,† which would have been a joy to me.

"Certainly the prolonged education indispensable to the progress of Society is not natural to mankind."

Cannot we make school—'natural to mankind'? Surely, we must! Surely we could, if sympathy and scientific thought were brought to bear upon the task!

The desire for learning came upon Churchill when he was nearly twenty-two, a cavalry officer at Bangalore. It is a fascinating and suggestive story. He had picked up a wide vocabulary but caught himself using many words the meaning of which he could not define precisely. (We all do this but how many recognise their deficiency.) He had heard a friend say: "Christ's Gospel was the last word in Ethics". This sounded good but what were ethics. They had never been mentioned to him at Harrow or Sandhurst. There was no one at Bangalore to tell him about ethics for love or money. Other similar needs pressed upon him. Someone spoke of the Socratic method. What was that? Then there was history. He had always liked history but at school was given only the dullest, driest, pemmicanised forms like "The Student's Hume". How true is this and not of history alone! So he set himself to read history, philosophy, economics and things like that. The effect upon him is summarised in the following most noteworthy statement:

"When I am in the Socratic mood and planning *my* Republic, I make drastic changes in the education of the sons of well-to-do citizens. *When they are sixteen or seventeen*† they begin to learn a craft and to do healthy manual labour, with plenty of poetry, songs, dancing, drill and gymnastics in their spare time. They can thus let off their steam on something useful. It is only when they are really thirsty for knowledge, longing to hear about things, that I would let them go to the university. It would be a favour, a coveted privilege, only to be given to those who had either proved their worth in factory or field or whose qualities and zeal were pre-eminent. However, this would upset a lot of things; it would cause commotion and bring me perhaps in the end a hemlock draught."

May we not hope that it is not too late for him yet to qualify for that draught? Why not make himself Minister of Education in the next Government; then, following Christ's example, clear out the money-changers from the school temples.

The one strange thing is that nowhere in the book is the slightest reference made to the part played by 'natural science' and 'scientific method' in our affairs, beyond the vague statement:

"I wonder often whether any other generation has seen such astounding revolutions of data and values as those through which we have lived. Scarcely anything material or established which I was brought up to believe was permanent and vital, has lasted. Everything I was sure or taught to be sure was impossible, has happened."

Is the explanation, 'faulty schooling' or 'innate disability'—such as that shown towards learning Latin?

To me the book seems to be the most fascinating and important contribution to the study of educational practice of recent times, showing as it does the great need of an entire departure in method. On all grounds it is to be commended both to teachers and parents of sufficient intelligence to read between the lines and ponder the lessons it conveys; with sufficient courage to defy present soul-killing school conventions.

HENRY E. ARMSTRONG.

* It is noteworthy that nowhere does Churchill mention having had manual instruction.
† My italics.

Applied Optics.

(1) *Applications of Interferometry.* By W. Ewart Williams. (Methuen's Monographs on Physical Subjects.) Pp. vii+104. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.

(2) *An Introduction to Applied Optics.* By Prof. L. C. Martin. (The Specialists' Series.) Vol. 1: *General and Physiological.* Pp. ix+324. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 21*s*. net.

(3) *The Use of the Microscope: a Handbook for Routine and Research Work.* By John Belling. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xi+315. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s*. net.

(4) *Lecture Experiments in Optics.* By B. K. Johnson. Pp. 112. (London: Edward Arnold and Co., 1930.) 8*s*. 6*d*. net.

THE value of all branches of physics to industry is becoming more and more obvious every year, and manufacturers are finding that many important processes hitherto carried out empirically by their workmen, by methods depending

solely upon previous experience, can be controlled with far greater certainty by the use of physical apparatus. Among these controls there are many based more or less directly upon applications of optics, and the books under review contribute to the study of these applications.

(1) This is more particularly true of the first of the above books, upon the applications of interferometry, in which is given very concise explanations of a set of closely allied phenomena which have many important applications in metrology, in the study of spectra, and in the final surfacing and testing of lenses, lens-systems, and prisms. Interferometry has recently been brought into special prominence due to the famous experiments of Michelson and Morley, which have led to a revolution in our conception of the universe through the theories of relativity, largely suggested by and founded upon these experiments.

After a general introductory chapter, the author deals successively with interference phenomena under the following classification: (*a*) From a point or line source as in the Rayleigh interferometer and diffraction gratings; (*b*) involving a division of amplitude (Newton, Brewster, and Jamin); (*c*) by Michelson's method; (*d*) by simultaneous division of amplitude and wave front (Fizeau, Twyman and Green, Köster); (*e*) involving multiple beams (Fabry and Perot, Lummer).

This classification, while not free from criticism, will be of assistance in enabling the reader to distinguish between the different varieties of phenomena which can be produced—and no one can help being struck by the many types of interference which are possible and by its numerous applications. Each of the six chapters is followed by a valuable list of references to original papers on the subject of the chapter.

(2) We have in Dr. Martin's "Applied Optics" (of which this is announced as the first volume only) a general theoretical and practical treatment of the subject, which is based throughout on the ray or geometrical basis. In defending this mode of treatment, he rightly says that "the wave theory is no nearer 'reality' than the ray. It tells us nothing as to what actually happens in the region of the focus."

In the first two chapters are obtained the formulæ for lenses, single and in combination, and examples are given of trigonometrical ray-tracing. Chap. iii., on the "Physical Study of Light", deals briefly with diffraction, interference and its effects, radiation, and absorption. In the next chapter the aberrations of optical systems are dealt with—the sine condition, Seidel's aberrations, Petzval's condition, with their formulæ; but for the calculation of aberration-free systems the student is referred to Conrady's well-known "Applied Optics and Optical Design". In Chap. v. the author describes the eye and its properties, but he returns to physical optics—polarisation, crystallography, dispersion achromatism, and lens working—in the next two chapters; we should have thought that these chapters should have preceded Chap. v., for in the last chapter he deals with visual optics and the correction of defective eyesight.

All this is treated clearly and carefully and without the aid of higher mathematics; it should prove of very great assistance, not only to the ordinary students and those who desire to proceed to the higher branches of applied optics and optical design, but also to those who wish to understand thoroughly the refractive errors of the eye and their correction.

(3) The third book is essentially a practical one, giving empirical directions for the management of the microscope. It is probably not too much to say that the greater percentage of the users of the microscope do not know how to take full advantage of the wonderful instrument with which the manufacturers have provided them. The modern objective is perhaps one of the greatest products of inventive skill to be found in any field, and, when used as it should be, is a marvellously perfect instrument. Indeed, the workmanship of the lenses and their mounting are usually so good that the objective can generally be relied upon to give images which approximate closely to those theoretically possible; but only by close attention to every detail of manipulation is it possible to obtain such an image, and this, of course, is especially true of the high-power immersion objective.

It is in the management of the illuminating system that most users of the microscope fail. For some twenty or thirty years there was great controversy as to the correct method of illumination for high-power work, but it is now generally agreed that each point of the object should be illuminated by a cone of light focused as sharply as possible upon it. For this, a well-corrected sub-stage condenser must be employed to focus the source of light upon the object, and the aperture of this cone of light should be nearly as large as the aperture of the objective, if the objective is to be used to its full advantage. In Belling's book, the methods of centring and focusing the condenser, the mirror to be used, the type of lamp with its ground-glass screen and diaphragm, the aperture of the incident

cone of light, the use of colour screens, are all fully treated, with directions which no one should find difficulty in following.

In the first six chapters the several types of microscope are described, but there appears to be little guidance to the purchaser of the instrument as to the type which would best suit the work for which he is proposing to use it. Then follow the chapters on illumination, light filters, the condenser, the mounting of objects, the objective and other cognate subjects; in all, there are twenty-seven chapters. The more important chapters are summarised, and there is also added to several of them a list of rules. There is thus a good deal of repetition which some readers will think unnecessary, but it may be helpful in impressing the necessary steps upon the beginner. No attempt is made to give any theoretical discussion of the rules recommended; there appears, for example, to be no reference to the size of the diffraction disc, and no explanation why the limit of resolving power should depend upon the working aperture. Rules are all given empirically.

The book is written by a practical user of experience, and should be valuable to anyone who finds himself confronted with a complicated piece of apparatus, usually with very little reliable help. There is added a glossary, and a list of 157 references to books and papers on the use of the microscope.

(4) The fourth book is intended for the use of a lecturer or lecture-demonstrator in optics, and explains how the fundamental lecture experiments should be set up for class teaching. Projection experiments illustrating the laws of reflection and refraction and the passage of light through prisms and lenses are described in a thoroughly practical manner; in most cases diagrams are given, often also descriptions and photographs of the apparatus to be used. These experiments are followed by the more difficult projections of interference, diffraction, and polarisation phenomena. The ripple experiment and the projection of a flat soap or celluloid film would be much improved by the use of a large convex lens, say 4 in., 6 in., or even 8 in. diameter with a focal length of 20 in. to 30 in., placed over the ripple tank or film; the distances should be so arranged that this lens should either focus a slightly divergent beam from the lantern on the aperture of the projecting lens, or form an image of the arc itself upon the lens without the interposition of the ordinary lantern condenser. The beam should be reflected down through this large lens, on to the film placed horizontally; the light that is reflected back from the film passes a second time through the lens, and just before it reaches its focus it should be reflected forward by a prism into the projecting lens. When the projecting lens is being used for the projection of ripples, an iris diaphragm placed in or near it will help to intensify the image and show up the ripples.

R. S. C.

Hydrogen Ion Concentration of Plant Cells.

Hydrogen-ion Concentration in Plant Cells and Tissues. By Prof. James Small. (Protoplasma-Monographien, Vol. 2.) Pp. xii+421. (Berlin: Gebrüder Borntraeger, 1929.) 30 gold marks.

THE difficulties in the way of determining the hydrogen ion [illegible]ntration of the interior of plant cells are great and they have retarded any real advance in our knowledge of the operation of hydrogen ion concentration as a factor governing the activities of the cell. Of the three more obvious methods, the most attractive, that of using micro-electrodes, has proved unsuitable even in the case of single cells, as apparently the results are liable to be affected very considerably by the oxidation-reduction potential of the protoplasm. A second method, that of measuring the hydrogen ion concentration of the expressed plant sap, has been much used, in spite of the known objections that it allows loss of carbon dioxide and also represents materials from cells of very different types, as well as from different parts of the same cell. The third method, that of examining the behaviour towards a suitable range of indicators of sections of plant tissue, has been largely used and developed by Prof. Small and his collaborators, and in this volume he summarises the results they have obtained, as well as the information available from other sources.

The data thus brought together are representative of a very wide range of plant types, and they include the reactions of the various tissues in the organs examined, as well as observations on the diurnal and seasonal variations. In regard to the latter, it is shown that the general tendency of plant tissues is to be more acid in winter. On the other hand, the external cells, which are generally more acid than the inner ones, tend to have a lower acidity in winter. Of equal interest is the author's discussion of the hydrogen ion concentrations of different parts of the same cell, and the observation that the cytoplasm and vacuole may have widely differing pH values. Thus in the

more acid cells of potato stems, for example, the cytoplasm was pH 5·9, the vacuole sap pH 4·8–5·2.

Of great value also is the discussion of the buffer systems responsible for the regulation of acidity in plant saps. The plants examined all differ in detail, but the present data show that the phosphates and bicarbonates, together with the salts of organic acids, exert with the free acids a predominant influence in regulating the pH of the sap. The systems present vary, of course, with the plant investigated. In sunflower, the rather feeble buffering effects are apparently due to phosphates chiefly. In apple juice, malates and malic acid appear to play a predominant part. The bicarbonate system so characteristic of animal tissues appears to be much less important in plants, which is not perhaps surprising in view of the great metabolic differences between plant and animal. The continuation of this work will be awaited with great interest by plant physiologists, who are, in the meantime, under a great debt to the author for marshalling the available masses of data into an intelligible and convenient form. W. H. P.

Our Bookshelf.

The Law of Aviation. By Dr. G. D. Nokes and Dr. H. P. Bridges. Pp. xix + 220. (London: Chapman and Hall, Ltd., 1930.) 12*s.* 6*d.* net.

THIS book is divided into two sections, dealing with conditions of peace and war respectively. Part I., "Peace"—which naturally deals with the laws, both national and international, governing civil aviation—is as satisfactory as any publication can be at present, remembering the state of flux in which aviation must inevitably be for many years yet. For example, the authors mention that the British Order in Council of 1923 "has been amended since that date not less than ten times".

The first part, dealing with British law, is clearly and fully set out, and constitutes an excellent standard text-book on the subject as it stood at the date of issue, but it should be read subject to alterations by the flood of subsequent amendments.

The chapters on international law are less definite. While the book sets out the laws, both ratified and otherwise, it necessarily cannot always give an account of interpretations of these that have not yet arisen. Unhappily, many nations to-day are using these laws obstructively, in a manner directly opposed to the obvious spirit of them.

The chapter dealing with regulations for safety in flight, both for airworthiness of aircraft and navigation rules, are in a happier condition. These regulations are now tending towards unification between the more important nations, and it is possible to discuss them with more confidence.

Part II. covers the regulation of military aeronautics in war and neutrality. It automatically divides itself into two broad divisions. The ordinary recognised rules of combat, modified as necessary to suit aircraft requirements, are obvious, and the authors' interpretation of them is quite definite. The type of warfare peculiar to aircraft—as, for example, bombing of towns, the exact rights of an airman escaping from a wreck by parachute, etc.—can only be covered by expressions of opinion. Even so, such opinions are valuable coming from legal experts, as both writers are. This section is provocative rather than informative, and it is of the utmost value if read from this point of view.

Lehrbuch der chemischen Physik. Zugleich dritte Auflage des "Grundrisses der physikalischen Chemie". Von Prof. Dr. Arnold Eucken. Pp. xvi + 1037. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 56 gold marks.

PROF. EUCKEN'S book "Grundriss der physikalischen Chemie" has now developed into a "Lehrbuch der chemischen Physik". The change of title follows naturally from the fact that the physical aspects of chemistry have developed so rapidly in recent years as almost to obliterate the boundary between the two subjects. Thus, on one side, thermodynamical theory has led to the replacement of concentrations by activities; on another side, quantum theory has made the specific heats of solids a matter for complex physical investigation; and, finally, the application of spectroscopy to the problems of atomic and molecular structure has made it necessary to include a treatise on optics in every work devoted to the study of physical chemistry. Whilst, therefore, space must still be found for the familiar concepts of mass action and the phase rule, there is an irresistible tendency for books on physical chemistry to become even more physical in character, until they become in fact books on chemical physics instead of physical chemistry.

Prof. Eucken's book covers more than 1000 pages and is therefore almost at the extreme limit of bulk for a text-book to be read *in extenso*, even by an advanced student in physical chemistry. Any further expansion would almost inevitably relegate it to the class of works of reference, from which particular chapters may be picked out for special study. Indeed, it already has distinct merits from the latter point of view, since the author has been able to give an account of band spectra, and of some other rapidly developing lines of research, which may be of real service to those chemical students who follow the progress of modern physics with difficulty and with much retardation. A translation into English would, however, very greatly enlarge the scope of its usefulness both in Great Britain and in the United States, since it is a serious handicap to be obliged to read in an unfamiliar language a book of such a size and on a subject which cannot be made easy, even in the hands of the most competent teacher.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 309. Abt. 9: *Methoden zur Erforschung der Leistungen des tierischen Organismus.* Teil 2, Hälfte 2, Heft 3: *Methoden der Süsswasserbiologie.* Pp. 1385-1549. (Berlin und Wien: Urban und Schwarzenberg, 1929.) 9 gold marks.

THE present part of this very useful work is concerned with methods of research in fresh-water biology and contains chapters on a variety of subjects by well-known workers. The portion by Dr. W. M. Rylov on the Limnoneusten is perhaps one of the most interesting as it deals with a subject only comparatively recently brought into prominence. The study of the biology of those organisms which have to do with the surface film is rapidly becoming more and more developed, thanks to Dr. E. Naumann, who suggested the term ' neuston ' for the life in this particular habitat. Very special methods are here required, for those of the ordinary plankton worker cannot be used.

The most important members of the limnoneuston are bacteria, monads, and *Euglena*, which live in masses and cause a variety of colours on the water surface. Larger forms may also occur, such as small Entomostraca and insect larvæ. This film life is often at its maximum in the early morning hours, lessening in the afternoon and sometimes broken up in the evening. A windless day is best for collecting. Even an oil-immersion lens is included in the list of desiderata for the excursions of the out-of-door research worker.

Other sections deal with the collecting and culture of Bryozoa, culturing of phyto-plankton and zooplankton, methods of manuring aquaria, ponds, and lakes, measurement of the penetration of light into the water by photoelectric cells, and methods of studying plant and animal communities. Dr. E. Naumann's chapters on the breeding of phytoplankton, Cladocera, Ostracoda, Copepoda, and pelagic Rotatoria are specially good and give a large amount of information in a small space.

The Truth about Publishing. By Stanley Unwin. Third edition. Pp. 359. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.

THERE was a time when the craft of publishing was regarded as something as mysterious as the ' black art ', and perhaps scarcely less sinister. Even to-day the misunderstandings are scarcely cleared up: and the ' man in the street ' is still under the impression that the publisher is out to fleece the poor author while making enormous profits for himself. The only way to remove that impression is for the publisher to display his whole craft—frankly to lay all his cards upon the public's table: and this is what Mr. Stanley Unwin has done. In this book he describes with utter fidelity the reception and reading of manuscripts—with well-merited praise of the publisher's reader; the ' casting off ', and estimating of costs; the publisher's dealings with the author in all forms of agreement; the craft of book production; the business of selling and advertising; questions of copyright and ' rights ' generally; publicity, reviewers' copies, free copies, and literary agents.

All that Mr. Unwin says is true, and frankly and wisely he says it. The publisher has a difficult and responsible task. Apart from his technical and complicated business, he must have tact to deal with authors, a *flair* for what the public wants, judgment and sound literary taste—or at least the power of making right decisions from the ' reader's ' estimates—and, above all, a real desire to publish what is worth publishing. Mr. Unwin's book has already gone a long way towards developing a right understanding of the publisher's aims and work, and must be of the greatest help to the inexperienced author. The present writer, being himself an author-publisher, and thus able to see both sides of the publishing question, is glad of this opportunity of congratulating Mr. Stanley Unwin on writing so true and valuable an exposition.

Alluvium: Grundsätzliches und Programmatisches zur Geologie der jüngsten erdgeschichtlichen Epoche. Von Kurd von Bülow. Pp. viii + 178. (Berlin: Gebrüder Borntraeger, 1930.) 13·50 gold marks.

THE author uses the term ' alluvium ' in a stratigraphical sense, to include both the epoch that dates from the beginning of the last retreat of the ice and the various deposits which have been formed—and still are being formed—in different parts of the world during this unfinished epoch. Without going into great detail, a very clear and concise summary of our present knowledge of post-glacial deposits is presented. Geographical distribution, relations to climate, petrological characters, stratigraphical succession, and biological considerations all receive their due recognition. The descriptions of the deposits themselves are based on a cross-classification of climatic zones against facies. The latter include sub-aerial (æolian and soils); sub-aqueous (fluviatile and lacustrine); organic; glacial and fluvioglacial; marine and littoral; and volcanic. So far as practicable, each of these groups is described in turn for the polar, tropical, desert, and temperate zones.

The method is a valuable one, for not only is it well designed to cover the whole field, but it also brings out the many gaps that still remain to be filled up by further exploration and research. To afford an ideally sound basis for comparative stratigraphy and palæoclimatology, the changing characters of each facies as it is traced over the whole earth should be thoroughly known. This ideal is being actively pursued in the study of soils and peats, but even for these important facies it is still impossible to give a satisfactory world survey.

The book can be cordially recommended. It presents a well-balanced picture of a vast and ever-growing subject, and contains the very useful soil map of the world prepared by W. Hollstein for the "Handbuch der Bodenlehre." Not least of its merits from our point of view is the clarity of the style: the involved sentences beloved of many German authors are here notably rare.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Effect of Internal Stress on the Magnetic Susceptibility of Metals.

THE effect of cold-working or internal stress on the density, electric resistance, elastic constants, thermo-electricity, etc., for various metals and alloys has been a favourite subject of investigation, but few experiments have been made to ascertain the effect on the magnetic susceptibility of metals. We have been working at this subject for a considerable time and have found quite recently the extremely important fact that the diamagnetic susceptibility of a metal belonging to the cubic system decreases in a marked degree by cold-working, and that, by a severe cold-working, the susceptibility of copper is changed from diamagnetic to paramagnetic.

The cold-working was given to metals by means of a large press, the total maximum pressure of which amounted to 300 tons, or 300,000 kgm. All the necessary precautions for preventing the direct contact of the specimen with iron pieces, by washing it with acid, alcohol, etc., were taken. The measurement of susceptibility was made by means of Weiss's electromagnetic method (Honda's "Magnetic Properties of Matter" (1928), p. 125). Two of the most important cases are reported below.

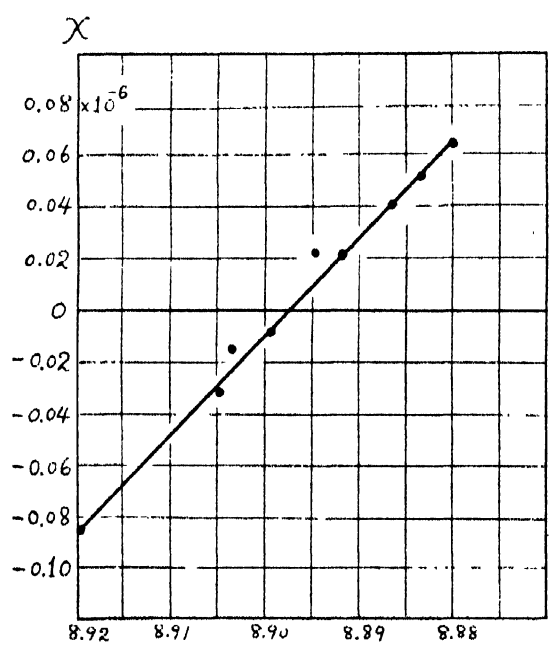


FIG. 1.—Copper.

(1) Copper: $\chi = -0\cdot083 \times 10^{-6}$, a weak diamagnetic metal. In general, the density of a metal diminishes with an increase of the degree of cold-working or that of internal stress. Hence we may take the change of density caused by cold-working as a measure of the internal stress. Fig. 1 shows a relation between the susceptibility and the density for different degrees of cold-working.

It is a remarkable fact that during the change of density from 8·921 to 8·887, the magnetic susceptibility of copper changes from diamagnetic to paramagnetic. The fact that this change is a true one was confirmed by an annealing experiment. It is well known that internal stress in copper is completely released by annealing it at 350°; hence the cold-worked copper specimen was vacuum-sealed in a small pyrex glass vessel and its susceptibility at different temperatures was measured during a very slow heating and cooling. The result is shown in Fig. 2. The paramagnetic susceptibility of the cold-worked copper rapidly decreases in the range 230°-330°, where the internal stress is released, and takes its original diamagnetic value $-0\cdot083 \times 10^{-6}$ at 350°. During cooling, the susceptibility remains almost constant down to room temperature.

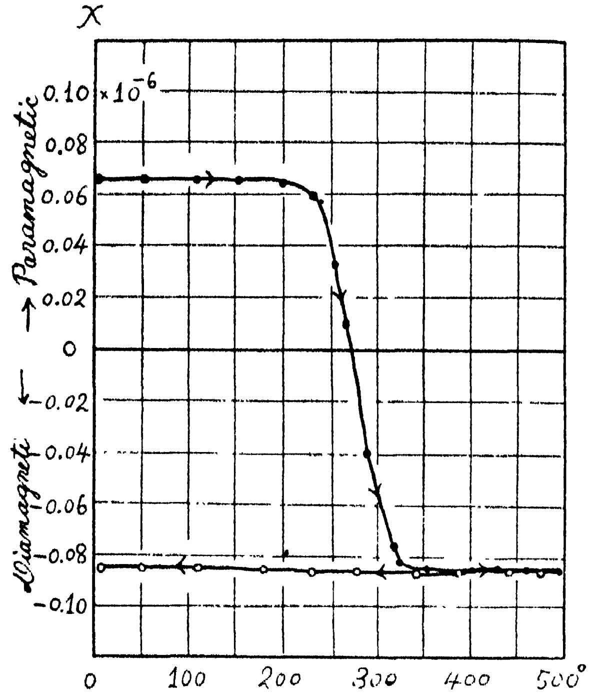


FIG. 2.—Cold-worked copper.

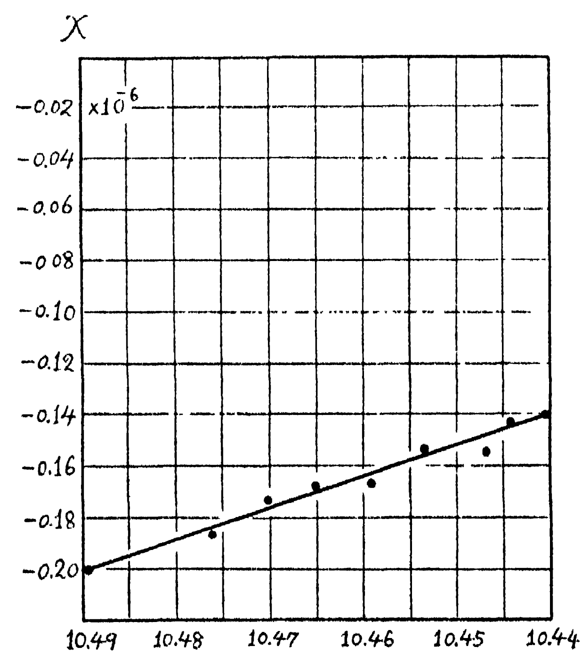


FIG. 3.—Silver.

(2) Silver: $\chi = -0\cdot200 \times 10^{-6}$, a diamagnetic metal. Figs. 3 and 4 show similar curves corresponding to Figs. 1 and 2 respectively. Thus, during the change of density from 10·489 to 10·439, the dia-

magnetic susceptibility changes from $-0{\cdot}200 \times 10^{-6}$ to $-0{\cdot}140 \times 10^{-6}$. From the course of the curve, it might be expected that at an extremely high stress (density $= 10{\cdot}365$) the susceptibility of cold-worked

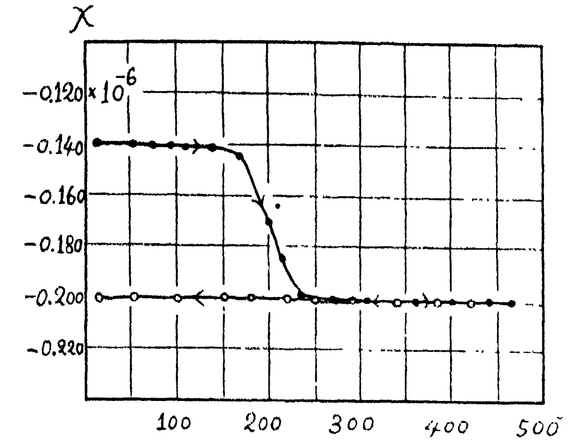


FIG. 4. -Cold-worked silver.

silver wi change from the diamagnetic to a paramagnetic. The annealing experiment (Fig. 4) shows also that the change is a true one.

Thus we have now two examples, in which the magnetic susceptibility of a substance changes its sign with external conditions, namely, tin and copper; the former (*l.c.*, p. 134) changes its sign with temperature and the latter with internal stress.

According to Honda's theory of magnetism (*l.c.*, p. 185), the magnetic susceptibility of a substance is the sum of a paramagnetic term χ_p and a diamagnetic one χ_d, that is,

$$\chi = \chi_p - \chi_d.$$

By applying a stress to a metal its density diminishes, and this will cause an increase of χ_p by the decrease of mutual action among neighbouring atoms (*l.c.*, p. 181), and also an increase of χ_d by an increase of bound electrons (*l.c.*, p. 186) at the cost of free electrons, so that in the case of diamagnetic metals the difference $-(\chi_d - \chi_p)$ may numerically decrease as in the case of silver, and may even become positive as in the case of copper, provided that the rate of increase of χ_p is greater than that of χ_d.

KOTARÔ HONDA.
YOSOMATSU SHIMIZU.
Research Institute for Iron, Steel, and Other Metals,
Sendai, Japan, Oct. 27.

Effect of a Direct Current on the Frequency of a Sonometer Wire.

IN a communication in NATURE of May 31, p. 819, Messrs. D. V. Gogate and Y. G. Naik describe an experiment showing that a vibrating sonometer wire undergoes a lowering in frequency when placed in a D.C. circuit. They affirmed that this unexpected result was due neither to the heating of the wire nor to a magnetic action, but at the time offered no explanation of the cause. In their experiment a sonometer wire was tuned to the frequency of an electrically driven fork so that synchronous vibrations of a large amplitude were set up in the wire. When a direct current was sent through it, the amplitude was immediately reduced, and could be restored again to its original width by shortening a little the distance between the bridges, thus showing that the frequency of the wire had been lowered.

This seemingly inexplicable phenomenon aroused some interest in this laboratory, and at the suggestion of Dr. S. J. M. Allen a detailed investigation was carried out. It was found that there is nothing mysterious about the effect. It is simply the result of a decrease of tension in the vibrating portion of the wire due to thermal expansion and the friction at the bridge. This explanation can be verified by the following experiments:

(1) The experiment of Messrs. Gogate and Naik was repeated and similar results were observed.

(2) To test the effect of heating on the wire, a still wire was strung parallel and close to it. When a current was sent through this still wire, a decrease in amplitude of the vibrating wire, similar to that of the previous experiment, was observed. However, when a sheet of mica was interposed between the two so as to cut off immediate heat transfer, the passage of a current through the still wire produced no change in amplitude. The effect of heating was further tested by holding a hot rod close to the vibrating wire. A change in amplitude and accompanying change in frequency, similar to that produced by the current, was at once observed, thus showing that the change in frequency was due to heating.

(3) The fixed end of the wire was attached to a small spring balance which was firmly clamped to the first bridge. Tension was maintained by a weight and pulley. When a current was sent through the vibrating wire, a displacement of the pointer on the balance, as viewed through a low-powered microscope, indicated a decrease in the tension of the vibrating portion. When the current was broken, the pointer moved back to its original position. This proves that the frequency is lowered by a decrease in tension. A curve plotted with change in tension as ordinates and current as abscissæ takes the form of a parabola, but if the square of the current is used as abscissæ the result is a straight line, showing that the change is directly proportional to the heating of the wire.

Wires of different materials were used. It was found that for those having large expansion coefficients the tension change was greater than the corresponding change for wires having small expansion coefficients; for example, the tension change for German silver, having a coefficient of 0·000018, was almost twice as great as that for steel with a coefficient of 0·000010. This shows that the change in tension is dependent upon the expansion of the wire.

As the wire expands and moves over the bridge its motion is opposed by the friction of the bridge so that the slack in the wire is not all taken up by the weight. The tension in the vibrating portion, then, will differ from that on the opposite side of the bridge by an amount equal to the frictional force at the bridge.

(4) To test the effect of the bridge friction, the sonometer was placed in a vertical position and the bridge replaced by a pulley, thus reducing the friction to a minimum. Then, when a current was passed through the vibrating wire, no change in amplitude, and consequently no change in frequency, could be detected, even though large currents were passed through the wire.

Quantitative results will be published elsewhere.

ROLAND SCHAFFERT
(Laws Fellow in Physics).
University of Cincinnati,
Nov. 13.

A Biological Station for the Red Sea.

THE Red Sea is one of the most interesting in the world, and the usefulness of a biological station on its shore scarcely needs emphasis. Owing to its peculiar physical features—desert coasts and a shallow sill separating it from the Indian Ocean—warm water, with active coral growth, and, with

that, the Indo-Pacific fauna, extends much farther north than in any other sea, vigorously growing reefs occurring even at the entrance to the Gulf of Suez in latitude 28° N. Living corals and Alcyonaria of tropical genera are to be found even at Suez, while at a point a few miles south is a bed of at least sixteen species of coral with four of Alcyonaria; coral may, however, grow without any reef formation, and it is doubtful whether a growing reef exists within the Gulf of Suez.

Though much has been done on coral variation, ecology, and physiology, much more remains, and the whole tropical fauna offers problems which have only been touched as yet. A laboratory accessible from

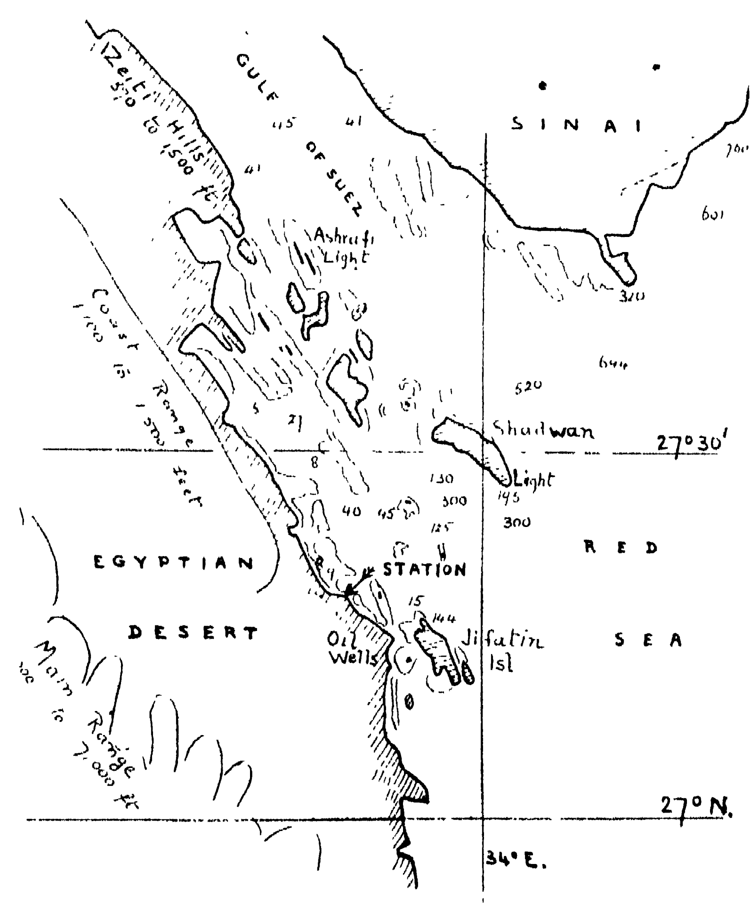


FIG. 1.

the universities of the Old World, and on this classic ground, the origin of so many types, has long been wanted. It will therefore be of interest to all biologists to hear that the new Faculty of Science in the University of Egypt has not been slow to realise the advantage in which it is placed with regard to tropical marine biology, and had carried out two expeditions to the Red Sea before I myself became actively interested.

The site finally selected is near the Ghardáqa Oil Fields (the name is given as "Hurghada" on the charts, an inversion of the Arabic), within the shelter of the Jifatin and other islands, in lat. 27° 13′ N. A glance at the chart (Red Sea, Strait of Jubal), reproduced as Fig. 1, shows that we are near the southern end of the remarkable maze of reefs and islands, occupying the north-west corner of the Red Sea just south of the entrance to the Gulf of Suez, which is a continuation of the Zeiti coast range and ends in the high island of Shadwan. We thus have every form of reef at our doors, a great area of sheltered water of varying depths, with the 100 fm. line only a few miles to seaward. Our buildings will be on a raised coral reef, the flat surface of which is disintegrated into a gravelly sand; below is a little beach, and reef flats with weeds and marine phanerogams, with scattered corals and Alcyonaria along its edge. A short distance to sea is as beautiful a coral bed as I have seen anywhere, rising to the surface to form a reef flat of the simplest construction. The outer reefs are of greater age and more complex construction, with a different fauna of corals; while of the Alcyonaria, for example, *Tubipora* grows in large masses, the red skeleton completely hidden under the long, grey, or grey-green polyps. As in most tropical seas, the Alcyonaria are both abundant and varied; *Xenia* along shore, the large fleshy forms on the outer reefs, the lovely scarlet or yellow *Spongodes* and the rarer hard-stemmed gorgonians, in deeper water, and other groups, like these, rare and inconspicuous in European seas, are to be seen here in all their beauty merely by looking over the side of a boat.

There is therefore little or no need for a show aquarium at Ghardáqa: Nature provides more than could be shown in any tanks, however well stocked and skilfully kept; and, as the station is for the use of students and research workers only, this expensive department is to be dispensed with. In addition to the vessels used for research inside the laboratories, it is proposed to build two or three shallow ponds on the reef flat, in which the water will be circulated by pumps, and in these close observation of experimental animals will conveniently be carried out, or material can be kept alive until needed indoors. There is plenty of sheltered, yet clean, water in which cages, etc., can be safely anchored.

The station should be useful to other than marine biologists, forming a centre from which the desert fauna and flora, both of the plain and mountains, may be studied more thoroughly than is possible from a temporary camp and when restricted to the cooler months. To the geologist the region is of exceptional interest, not for its oil yield alone, and combined biological and geological exploration of the adjacent islands and reefs may throw light on the coral reef problems. For the inland excursions the necessary motor transport will be provided.

The climate of the Red Sea has an evil reputation, quite undeserved so far as Ghardáqa is concerned, since it is well north of that area of low barometer which separates the prevalent north-west and south-east winds of the ends of the sea, and in which those "cities of dreadful night", Port Sudan, Suakin, and Massawa, have the misfortune to be placed. This is a point of importance to university research workers, who are often free only in the summer months, and it is hoped that, in the selection of the site and design of the buildings, my long experience of the hot central section of the Red Sea will enable me to ensure comfort at all seasons. Data provided by the meteorological office of the Egyptian Government show that at Ghardáqa the average maxima are higher by 1·5° C. than in Cairo during the winter, an advantage to Ghardáqa; in May the same, namely, 32° C.; in June and July slightly lower, and half a degree

higher in August, September, and October. The highest averages are in August, the maximum then being 35·6° C., the minimum 25° C. (77° F.). In point of personal experience, Ghardáqa is far more comfortable than Cairo in August, since every building is open to the breeze, and the wearing of coats, collars, and ties is not enforced.

The station is readily accessible, by land from Cairo, by sea from Suez. The former route involves a night in the train and an eight-hour journey by car across the desert and the Red Sea mountains, following the old road by which the Romans carried porphyry from their quarries in the mountains. From Suez the Anglo-Egyptian Oil Co.'s steamers sail three times a week, reaching Ghardáqa in 16 hours, and supply the oil camp with abundance of fresh water and provisions, so that the hardships of desert life are conspicuous by their absence.

It is hoped that the station will be complete in about a year's time, not only as regards laboratories, apparatus, machinery, and launch, but also with rest houses for research workers and students.

CYRIL CROSSLAND.

University of Egypt,
Cairo.

Change of the Dielectric Constant of Nitrobenzene with Temperature.

I HAVE made a study of the dielectric constant of nitrobenzene as a function of temperature, using a method depending on the beats of two high frequency oscillation circuits, as described by M. Wolfke and W. H. Keesom.[1] Some details concerning the apparatus have been published already in a short note on the dielectric constant of ethyl ether.[2]

It should be stated that the temperature was determined with an error not exceeding 0·005°, and

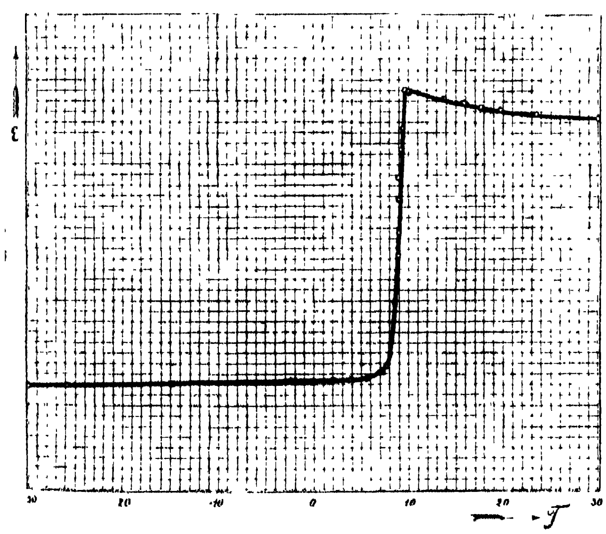


FIG. 1.

the changes in the fifth decimal of the value of the dielectric constant were still discernible.

The changes of the dielectric constant of nitrobenzene with temperature have been studied by Abegg and Seitz.[3] These authors, however, used under-cooled liquid which was not purified sufficiently to obtain results with a very high degree of accuracy, as they themselves point out in their paper.

In my experiments the nitrobenzene was obtained from benzene crystals and was carefully purified by means of the most recent methods. It was afterwards fractionised five times at the interval of 0·05° C.

The dielectric constant was studied through the temperature interval −75°, +30°; special care being taken in the neighbourhood of the liquefaction point. The measurements were made both at increasing and decreasing temperatures.

With decrease of temperature the dielectric constant of nitrobenzene steadily increases from the value 35·4 at 30·01° up to the maximum value 35·18 at 9·6°, in the immediate neighbourhood of the solidifying point. A sharp decrease is then observed down to the value 11·82 at 7·713°, and then a slow asymptotic decrease down to the limiting value 9·709 at −75° C.

These observed changes of dielectric constant of nitrobenzene with temperature do not agree with the results of Abegg and Seitz.

Some irregularities in the rate of change of the dielectric constant in the region of sharp decrease (that is, between 9·6° C. and 7·713° C.) suggest the possibility of some complications in the neighbourhood of the solidifying point of nitrobenzene. A further study will be made to clear up this question.

The change of the dielectric constant of nitrobenzene at temperatures described above is represented on the accompanying graph (Fig. 1).

A full report of the investigations concerning ethyl ether and nitrobenzene will appear in the *Comptes rendus des Sciences de la Soc. Polon. de Physique*, Warsaw, and the *Physikalische Zeitschrift*.

J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Nov. 13.

[1] Comm. Leiden, 190a.
[2] NATURE, Oct. 25, 1930, p. 649.
[3] *Ann. d. Phys.*, 60, 54; 1897.

Persian Science and Jundishapur.

MAY I take the opportunity, afforded by the review in NATURE of Dec. 6 of Sir Percy Sykes's "History of Persia", of directing attention to a point of interest to students of the history of science?

Readers of NATURE will be aware that what we call 'Arabic' science was to a very large extent the work of Persians who wrote in Arabic, though deriving from Greek, Syrian, and Hindu origins. It is also generally known that one of the greatest centres of Persian science was the school or university of Jundishapur. But there appears to be no general agreement as to where this school was situated; and I am hopeful that readers of NATURE may be able to throw some light on the matter. I give below some of the divergent views of authorities I have consulted. It will be noted that the name is spelt in a number of different ways, and, but for encroaching unduly on the space available I would accompany this letter with a plea that a little science should be applied to the transliteration of Oriental names.

Gibbon in his "Decline and Fall of the Roman Empire", chap. xlii., places Gondi Sapor near Susa. Browne in "History of Persian Literature", vol. 1, p. 305, quotes from Carl Brockelmann to the effect that Jundi-Shapur was in Khuzistan, which does not conflict with Gibbon's statement. Sykes in his "History of Persia" (I have not yet seen the latest edition), vol. 1, p. 437, states that Gundisapur is the city of Shapur near Kazerun. This does not agree with the statement that it was in Khuzistan, which also has the support of the "Encyclopædia of Islam" under the heading 'Djundai-Sabur'. The "Encyclopædia Britannica", 10th ed., art. "Arabian Philosophy", refers to "Gandisapora or Nisabur in the east of Persia", thus giving the city a third location. In the 11th edition it is spelt "Junday Shapur" in the article on "Disful", and "Gundev-Shapur" in the article on "Shapur". Both articles place it near Susa. But in

the 14th edition the index says: "Gandisapora, see Nishapur". I find no mention of Gandisapora in any of the articles in this edition referring to Nishapur, so must assume that they are supposed to be the same place. But Nishapur is in Khorasan, whereas the other sites are in Khuzistan and Fars respectively. Berthelot, "Histoire des Sciences", vol. 2, introduction, refers to Gandisapora but does not say where it was. Other references bearing on this matter will be found in Sarton's "Introduction to the History of Science", p. 435, and in "Lands of the Eastern Caliphate", by Le Strange, pp. 262-3; but they do not enable me to decide definitely where this city, so important in the history of science, actually was.

It may be that differences of opinion have arisen through the name of the Persian king Shapur I. (also spelt Sapur, Sapor, Sapores, etc.) being closely associated with Nishapur (Nisabur, Naysabur, Niv-Shapur, etc.) in Khorasan (Khurasan, Korasan, etc.); also with Shapur (Bishapur, Nishapur, Bih-Shapur, Wih-Shapur, Bana Shapur, Shahristan, etc.) in Fars; also with a third city the ruins of which are still to be seen on the road between Shuster and Disful.

Sir Percy Sykes informs me that the city in Fars, near Kazerun, which he believes to have been Jundishapur, was very important with Sasanian bas-reliefs and is still termed 'the city of Shapur'.

HUGH P. VOWLES.

20 Ridgway Place, Wimbledon, S.W.19,
Dec. 8.

Determination of the Velocities of Projectiles by Light Interception.

WE have developed a light interception method for the determination of the velocity of projectiles in the immediate neighbourhood of the muzzle.

The principle of the method is shown in Fig. 1.

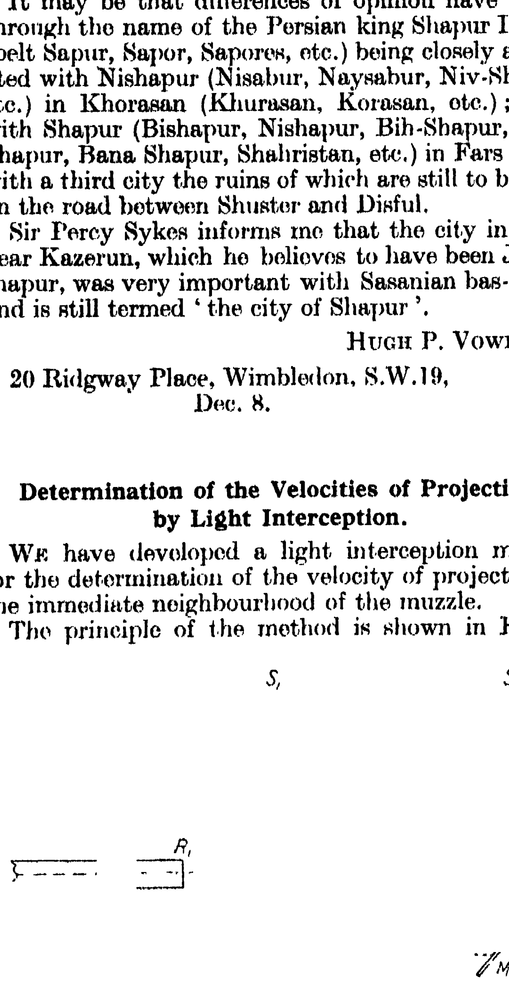


FIG. 1.

RR_1 is the gun. Two beams of light S_1I_1 and S_2I_2 cross the line of flight of the projectile and are brought to a fine focus upon it. The beams are turned by mirrors M_1M_2 and gathered to linear foci, colinear in a vertical sense, on the film of a high-speed camera. The projectile in its flight intercepts first the beam S_1I_1 at I_1 and then the beam S_2I_2 at I_2, causing breaks in the bands of light photographed on the film of the high-speed camera. Time marks are impressed upon the film by means of an Eccles' valve-maintained tuning-fork of 1000~ which carries a small concave mirror on one prong and deflects a beam of light falling upon it. Knowing the distance I_1I_2 and the time between interceptions on the film, the velocity of the projectile may be readily determined. One beam alone may also be used for velocity determinations if the length of the projectile is known.

The method has been used successfully for the determination of the velocity of rifle bullets and shot-gun ejecta. Fig. 2 is a photograph of a rifle bullet velocity determination with two interceptions. In

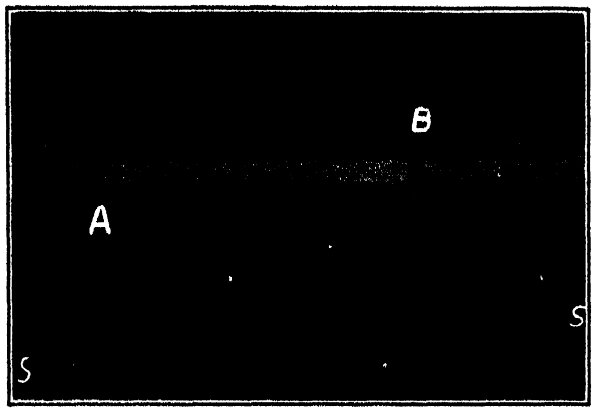


FIG. 2.—A and B indicate the first and second interception of the line of flight by light rays. SS is the time marking.

the discharge from a shot-gun, the interceptions are complex, showing shot column, wad, and cards.

A complete description of the method is being published at an early date.

JAMES TAYLOR.
ROBERT WARK.

Research Department (Nobel Section),
Imperial Chemical Industries,
Stevenston, Ayrshire,
Nov. 11.

Viscosity of Electrolytes.

AN important conclusion arrived at in two recent papers on the viscosity of electrolyte solutions [1] is that the relative viscosity of all electrolytes must be greater than unity at high dilutions. It follows from this that the phenomenon of 'negative viscosity', which is well known to occur in solutions of salts of potassium, rubidium, etc., must disappear at the highest dilutions, and that the presence of these salts in very small concentration must increase the viscosity of water.

Heretofore there has been no authenticated instance of this phenomenon. We have therefore measured

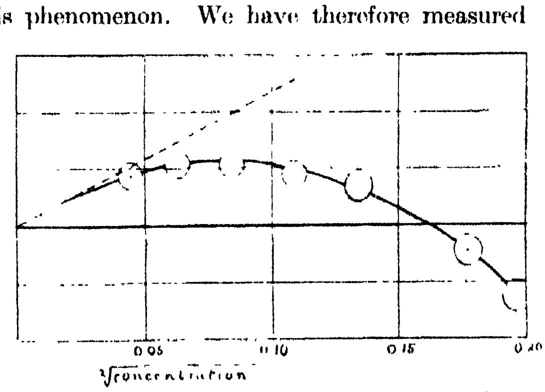


FIG. 1.

the viscosity of dilute aqueous solutions of potassium chloride at 18° C. in silica and glass viscometers of the Washburn-Williams type. Our results for the glass viscometers are represented in the accompanying diagram (Fig. 1), in which relative viscosity is plotted against the square root of the concentration of the solution.

These observations seem unequivocally to show viscosities greater than that of pure water up to a concentration of 0·025 N. The dotted line represents the limiting slope predicted by the Dole-Falkenhagen

equation; it will be seen that this line is tangential[1] to the extrapolated curve drawn through the experimental points. A good straight line is obtained by plotting $(\phi - 1)/\sqrt{c}$ against $\sqrt{c}$ (*vide* Jones and Dole) and its intercept on the axis of zero concentration is -0.0052, in satisfactory agreement with the value of -0.0046 predicted by the Dole-Falkenhagen equation. The values obtained in the silica viscometers are less concordant but indicate clearly the existence of relative viscosities greater than unity over the same concentration range as that indicated above. It is possible that measurements made with a capillary viscometer at these high dilutions are materially affected by some sort of electro-kinetic effect which will vary with concentration; it is possible, for example, that specific ion adsorption in the capillary may produce an electrical 'drag' on the flowing liquid. It is for this reason that we are carrying out measurements in both silica and glass viscometers.

W. E. JOY.
J. H. WOLFENDEN.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford, Dec. 1.

[1] Jones and Dole, *J. Amer. Chem. Soc.*, **51**, 2950; 1929. Dole and Falkenhagen, *Physikalische Zeitschrift*, **30**, 611; 1929.

Raman Spectra of Some Triatomic Molecules.

IT was observed by me [1] and also independently by Dickinson and West [2] that liquid sulphur dioxide gives three Raman frequencies. The measured wave-number shifts were 526, 1146, and 1340, the line corresponding to 1146 being much more intense and sharper than the two others. The spectrum of sulphur dioxide gas has since been successfully photographed by me and exhibits a frequency 1154, which is distinctly greater than the value 1146 obtained with the liquid and agrees much better with the infra-red value 1152 found for the gas by Bailey, Cassie, and Angus.[3] The two other lines are presumably too weak to be recorded in the case of the gas.

The spectrum of liquid hydrogen cyanide has also been photographed by me and shows a triplet giving the frequency shifts 2076, 2097·2, and 2122, of which the middle component is much more intense than the others: its value 2097·2 is probably accurate to within $\pm$ 0·2. Dadieu and Kohlrausch give it as 2092 and do not record its companions.[4] It is interesting to note that Barker,[5] working with hydrogen cyanide gas, found the corresponding infra-red absorption band at $4 \cdot 7\mu$ to be a triplet, the maxima appearing on his curves at 2088, 2103, 2117 wave-numbers, in each case only a few units different from the values reported above for the liquid.

The case of carbon disulphide has been the subject of investigation by several authors. Krishnamurti found recently [6] that the intense line at 655 has a feeble companion at 647, and that the line at 800 is also diffuse. His results have been confirmed by me, and in addition three new very feeble bands at 4438, 4605, and 4680 A. have been discovered in the spectrum of carbon disulphide excited by the mercury line 4358·3 A. when photographed with long exposures. If these are assumed to be due to Raman transitions, they give us three new characteristic frequencies of carbon disulphide, namely, 412, 1229, and 1577.

S. BHAGAVANTAM.

210 Bowbazar Street, Calcutta,
Nov. 7.

[1] *Ind. Jour. Phys.*, **5**, 35; 1930.
[2] *Phys. Rev.*, **35**, 1126; 1930.
[3] NATURE, **126**, 59; 1930.
[4] *Berichte*, **63**, 1657; 1930.
[5] *Phys. Rev.*, **23**, 200; 1924.
[6] *Ind. Jour. Phys.*, **5**, 105; 1930.

Dangerous Properties of Ethylene Chlorhydrin.

IN the issue of NATURE for Sept. 8, 1928, p. 376, appeared a note on a paper by Mr. F. E. Denny read at the annual meeting of the Society of Chemical Industry in New York, in which he advocates the use of ethylene chlorhydrin for speeding up the sprouting of potatoes, and in which it was indicated that the use of this substance is quite safe from the point of view of the workmen applying it.

During the course of its work in connexion with safety in chemical factories, the Association of British Chemical Manufacturers has recently had brought to its notice (*Zentr. Gewerbehygiene*, 1927, **4** (9), 712) information indicating that this substance possesses unsuspected toxic properties, and that several deaths have occurred in Germany from inhaling the vapour. A somewhat similar case with a fatal termination is reported, for the first time in Great Britain, in the annual report of the Chief Inspector of Factories and Workshops, 1930, p. 95.

The substance apparently acts as a metabolic poison with a specially severe effect on the nervous system, producing muscular weakness, inertness, refusal of food, sleepiness, and finally death by paralysis of respiration.

In view of the increasing use of this substance as a solvent for resins, wax, cellulose, and in the lacquer, paint, and pharmaceutical industries under conditions encouraging evaporation, it seems advisable to direct attention to the above observations, particularly as the substance itself is apparently innocent of all dangerous properties and its action is for that reason all the more subtle.

J. DAVIDSON PRATT.

Association of British Chemical
Manufacturers,
166 Piccadilly, London, W.1,
Dec. 5.

Determinism.

THE implications of Heisenberg's principle of uncertainty are often seriously confused owing to the ambiguity of the expression 'to determine'. In the present connexion this should mean 'to cause'; what further meaning should be assigned to 'cause' itself is here immaterial. Among other physicists, Prof. G. P. Thomson asserts in "The Atom" (p. 190) that "physics is moving away from the rigid determinism of the older materialism into something vaguely approaching a conception of free will". In any such statement 'determinism' appears to have the sole meaning of 'unvarying causation', apart from which 'free will' is totally irrelevant. Most unfortunately, however, 'to determine' often means merely 'to ascertain', as when we say we cannot 'determine' the exact state of the case. On pp. 193, 194, then, Prof. Thomson substitutes this alternative meaning: "velocity is quite uncertain. A similar result applies if we try to determine the velocity of the electron. . . . There is an exact reciprocity between the exactness with which position and momentum can be determined." Here 'to determine' plainly means not 'to cause', but simply 'to ascertain'. But every argument that, since some change cannot be 'determined' in the sense of 'ascertained', it is therefore not 'determined' in the absolutely different sense of 'caused', is a fallacy of equivocation.

J. E. TURNER.

University of Liverpool,
Nov. 10.

A New Theory of the Evolution of the Insects.

By Dr. R. J. TILLYARD, F.R.S.

A CRITICAL study of the various theories extant concerning the origin and evolution of the insects as a class reveals that there is so far no general agreement amongst biologists on the point at issue. Handlirsch derives them direct from Trilobites. A long line of authors champion the theory of derivation from Crustacea; well-known exponents of this theory are Hansen, G. H. Carpenter, and Crampton. Versluys would derive them, with all other Arthropoda, from the Onychophora, by way of the Myriopoda, considering both Trilobites and Crustacea as side-branches which took to the sea. The famous Campodea Theory of Brauer is only one of a number of more or less diverging views which would derive the insects more or less directly from some type of Myriopoda.

It is interesting to notice which type is considered the most primitive of all insects, according to these various theories. For Handlirsch, the original insect was a winged Palæodictyopteron which arose somewhere in the Carboniferous; the Thysanura and other supposedly primitive apterous forms are, for him, debased side-branches of an originally winged main stem. For those who would derive insects from Crustacea, the family Machilidæ of the Thysanura is the most primitive type. Those who support the myriopod theory find the closest connexion between the Symphyla on one side and the Campodeidæ on the other.

All the theories so far put forward appear to fail at some critical point. Few entomologists can believe that winged insects preceded the oldest wingless forms; it is on this point that Handlirsch's theory, so clearly and fascinatingly presented by its talented author, fails to make appeal. The argument on segmentation drives the adherents of an origin from Crustacea to support a fairly highly evolved type of crustacean, somewhere near the lower Malacostraca, as the ancestor of Machilidæ; but such a theory breaks down when put to the test of detailed analysis. The old crux of the position of the genital pore still stands unsurmounted by those who would like to derive the Campodeidæ from the Symphyla. There is, in fact, no generally acceptable theory as yet.

Where nobody has succeeded, it would seem indeed rash for anyone to make a further attempt. I have, however, done so, not so much with the hope of convincing everybody that I have found the solution, as with the desire to stimulate new lines of thought on a very old problem.*

The theory is built up from the results of an analysis of the evolution of (*a*) segmentation, (*b*) the walking leg, and (*c*) the reproductive system, in insects and other arthropods. As the results obtained from all three analyses were found to agree quite closely, the general theory so constructed was then applied to the evolution of other organs, including the various internal systems, and also to the embryology, with the result that it appears to stand the tests quite well. It also does no violence to the geological record.

In segmentation, attention may be directed to the existence of a nauplius larva in the more primitive types of Crustacea, and to the 'telescoping' of this larval type into the embryology, in certain specialised types such as crayfishes and syncarids. The conclusion is drawn that the Crustacea are derived from a *nauplioid ancestor*, though not from any actual type of nauplius. This would imply *an original lesser amount of segmentation* both in the head and in the body of the animal. As regards the head, the suggestion arises, by comparison of the nauplius head with that of *Peripatus*, that it was originally only four-segmented, and that the mouth was originally closed behind by a flap or process which was not formed from segmental appendages, but was merely a process of the mandibular segment. From this arose the paragnaths in Crustacea and the hypopharynx and maxillulæ or superlinguæ of insects. The addition of either one or two maxillary segments to the head gave rise to all the five- or six-segmented heads now found in Myriopoda, Insecta, Crustacea, etc.

Turning next to segmentation in the Myriopoda, we meet the phenomenon of *anamorphosis*, or the addition of segments during ontogeny by interpolation in front of the anal or preanal segment. Such addition may take place either singly or in groups. The young larva hatches out with relatively few body segments, and at each instar there is an increase by anamorphosis, until the full number is reached. An analysis of the ontogeny of the primitive myriopod group Pauropoda shows that the young hatch out with only six postcephalic segments, of which only the second, third, and fourth carry legs. This is the 'six-legged larva'. It is followed by a ten-legged larval stage, a twelve-legged stage, and a sixteen-legged stage, while the adult pauropod has twelve postcephalic segments and nine pairs of legs. Emphasis is laid on the fact that the total segmentation of the pauropod, inclusive of its five head segments, is less than the total of twenty-one or twenty-two required to derive a machilid direct from a lower malacostracan or a leptostracan.

While all Progoneata appear to be anamorphic, and also many Opisthogoneata, there are also certain higher chilopods which, like the crayfishes, have telescoped all their larval segmentation stages into the egg, and hatch out with the full number of segments belonging to the adult. This phenomenon is termed *epimorphosis*. It is clear that epimorphic forms are, in this respect, more advanced than anamorphic ones.

* The complete new theory may be read under the title "The Evolution of the Class Insecta" (*Papers and Proceedings of the Royal Society of Tasmania*, 1930), which is an amplification of a presidential address on the same subject given in Brisbane in May last, before Section D of the Australasian Association for the Advancement of Science.

When we turn to the insects, we find that almost all of them are epimorphic, namely, the whole of the Thysanura and Pterygota. One small group, the Protura, still exists which exhibits anamorphosis; the larval form has nine abdominal segments, and three more are added just in front of the last, in the form of ring-segments, before the adult stage is reached.

This analysis now brings us to a hitherto neglected group, the Collembola or springtails. These differ from all other insects in having only six abdominal segments right through their embryology, their larval stages, and the adult. A close comparison can be made between this condition, which is really that of possessing *nine* postcephalic segments, and the twelve-legged larvæ of Pauropoda and Symphyla. It is suggested that this condition is even more primitive than that of the anamorphic groups, and should be distinguished as *protomorphic*.

We thus have three stages of evolution in segmentation of terrestrial arthropods: (1) *Protomorphism*, in which an original small number of segments is retained throughout the ontogeny; (2) *anamorphism*, in which this original number is raised, bit by bit, by addition of new segments near the hinder end at ecdysis; and (3) *epimorphism*, in which all this larval addition is telescoped into the embryonic period, so that the young larva hatches out with the full number of segments. The Collembola are claimed to be remnant of the original protomorphic ancestors or Protaptera; but for the fact that their abdominal appendages have been specialised to serve another function, that of jumping, instead of remaining as walking-legs, they could be classed as very primitive opisthogoneate myriopods. The Protura are a remnant of the later developed anamorphic groups of hexapods. The Thysanura must have begun as Entotrophica and later become more vigorous and developed exserted mouth-parts. The Pterygota or winged insects must have sprung direct from a dorso-ventrally flattened lepismatoid type.

The analysis of the walking-leg brings out two points. First, that there is no evidence of an undoubted exopodite in the legs or maxillæ of terrestrial arthropods, and therefore no need to derive insects from marine forms. Secondly, that the most primitive walking-legs are those of the Symphyla and Collembola, both of which are only actually four-segmented, ending in a claw and empodium.

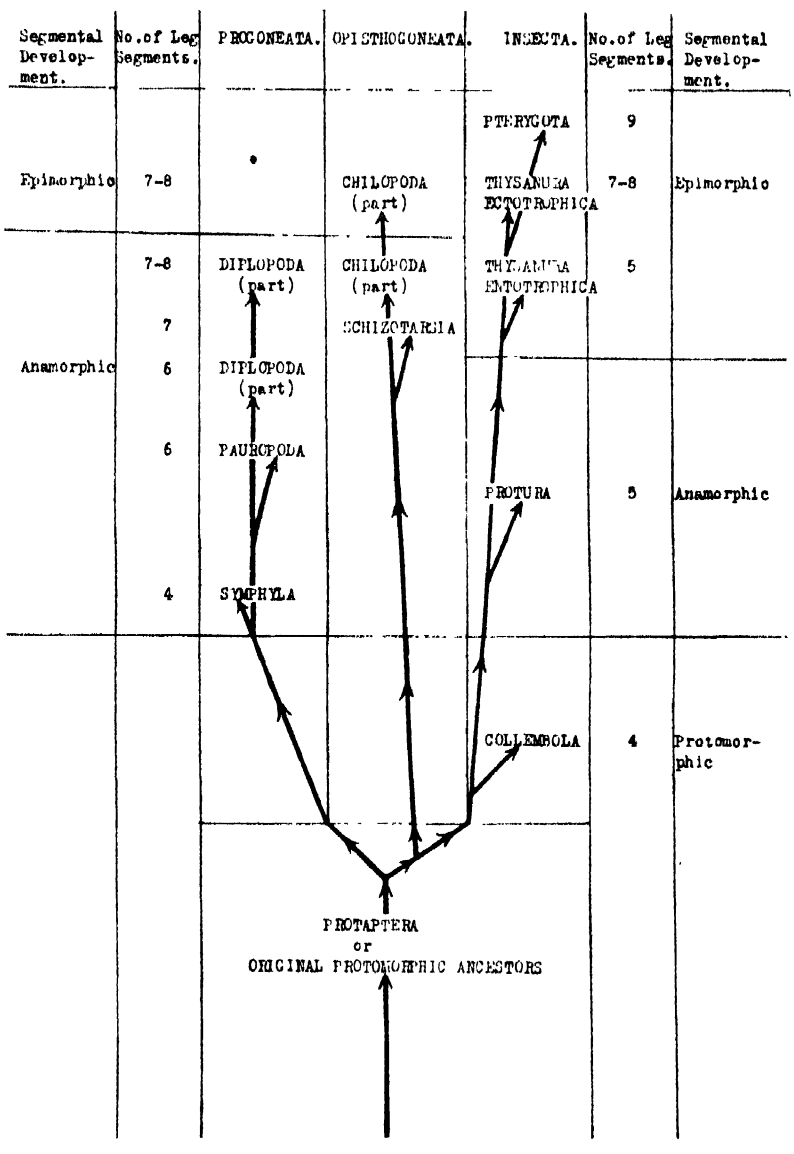


FIG. 1.

The abdominal styles and exsertile vesicles of the Thysanura are homologous with those of the Symphyla, both belonging to the subcoxal region. The legs of Collembola are even more primitive than those of Symphyla in not possessing either of these organs and also in the non-development of any definite scheme of chitinisation of the subcoxal region.

The evolution of the leg in Myriopoda may be followed out through stages with six, seven, and eight segments, that of insects through stages with five, seven, eight, and nine segments, the latter being the types having a tarsus with five divisions. The additional subdivisions do not take place similarly in myriopods and insects, and hence it is not allowable to homologise the separate segments above the original four in the two types.

Coming next to the crux of the reproductive system, and dealing first with the Japygidæ and the primitive Pterygota, we are led to the conclusion that the Thysanura-Pterygota line originally possessed eight pairs of gonads segmentally arranged, of which one pair has been lost in the

Japygidæ. Counting thoracic and abdominal segments all as postcephalic, the most posterior position of the gonopores in Progoneate types is the *fourth postcephalic segment*, while the most anterior position in Opisthogoneate types is actually the *eighth, in Collembola*. Thus both types can be simply derived from an original ancestor *which possessed only five pairs of gonads*, in the fourth to eighth postcephalic segments respectively. These must be conceived of as having originally opened segmentally by paired gonopores. The linking up of the gonads on each side by paired gonoducts, to open into the fourth postcephalic segment only, gave the primitive progoneate condition, while a similar linking, with backward opening into the eighth, gave the primitive opisthogoneate condition, as in Collembola.

The conclusions arrived at by the above three lines of analysis are so closely similar that it is possible to exhibit them all in a single phyletic diagram (Fig. 1). The original common ancestor of myriopods and insects must have differed from the Onychophora in not being epimorphic and in having fewer body segments. This common ancestor, the Protaptera, would have merited the status of a class. It divided, first of all, into progoneate and opisthogoneate forms; and, very soon after, the opisthogoneate types divided into Myriopoda Opisthogoneata and true Insecta or Hexapoda The Collembola are the only remaining remnant of all the ancient protomorphic types. They were quite well developed in the Lower Devonian. The progoneate types culminated in the higher diplopods, leaving the pauropods on one hand and the Symphyla on the other as lowly anamorphic types The opisthogoneate myriopods ran out into the higher Chilipoda, which are epimorphic; but, while still anamorphic, they gave rise to another highly evolved type, the Schizotarsia, with annulate legs and large compound eyes. The hexapod or insect line, leaving the Collembola and Protura far behind as lowly side-branches, ran rapidly through the Thysanura Entotrophica to the Thysanura Ectotrophica, and so to the winged forms of Pterygota, probably somewhere in the Carboniferous.

The probable geological horizon of the hypothetical ancestral Protaptera is Upper Silurian, and their ecology is that of terrestrial forms dwelling in moist places and feeding on primitive plant life.

Progress in Education and Research in Agriculture and Fisheries.

INCREASING recognition is being given to the fact that many problems connected with agriculture need the help of the trained research worker as well as that of the practical man. During the last twenty years, since the appointment of the Development Commission, steady and rapid progress has been made, until at the present time the ramifications of the system of research and advisory work set up by that body extend over a surprising variety of problems. Three reports recently issued, one by the Development Commissioners, and two by the Ministry of Agriculture on agricultural research institutes and research and education respectively, present a comprehensive picture of the existing state of affairs in Great Britain.

The report of the Development Commission* falls into four sections, the first two of which relate to the grants which have been recommended for the development of agriculture, rural economy, fisheries, and harbours, and describe the purposes for which these advances are being used. The third part of the report relates to action taken under Part 2 of the Act of 1909 in connexion with the compulsory acquisition of land for road improvements. The fourth part deals with the financial position of the Development Fund at the end of the year 1929–30. The advances recommended from the fund amounted to £721,653, as against £394,752 in the previous year. The large increase for agriculture and fisheries is attributable to recommendations for capital expenditure out of a special grant of £500,000 made for unemployment relief. Schemes relating to fishery harbours and reclamation are receiving special attention, and any economic schemes of reclamation which may be put forward will receive favourable consideration.

Among the activities of the Commission, those dealing with the development of the countryside make a wide appeal. Rural industries are being aided and developed in thirteen counties by means of grants to be expended according to local needs for the organisation of classes and the staging of exhibits at shows. Some counties now have permanent showrooms for exhibiting craftsmen's goods. The building of village halls is much encouraged by a system of loans which has now been thrown open to the whole country by the establishment of *ad hoc* committees in counties not having a community council. The success of the scheme is such that in the first three months of 1929, 279 villages made inquiries as to loans, and during that period fourteen loans, amounting in all to £3833, were approved.

Another feature of the year's work of the Development Commission has been the adoption of methods for the relief of the fishing industry by remission of debts and by reconditioning of harbours with the view of the development of fisheries. A total sum of £34,770 was recommended during 1929–30 for the maintenance of fishery research. The grants are for 'directed' researches, deliberately planned to find a solution of problems affecting the commercial fisheries, and 'free' researches, the object of which is to advance that knowledge of marine life in relation to its whole environment upon which the solution of practical problems ultimately depends. The fisheries section of the report sets forth much interesting information, and is calculated to surprise the average reader by the

* Development Commission. Twentieth Report of the Development Commissioners, being for the Year ended the 31st March 1930. Pp. 247. (London: H.M. Stationery Office, 1930.) 3s. 6d. net.

extent and variety of the attempts to improve our knowledge of matters appertaining to the important sources of food in river and sea.

The position of affairs relating to agricultural research is set out more fully in the report issued by the Ministry of Agriculture and Fisheries.* Here, again, it is obvious that a very wide field is being surveyed, and that a multitude of problems relating to agriculture in the widest sense are being probed. These investigations are nearly all carried out at the research institutes and at advisory centres, by specially appointed staffs. It is scarcely possible to give even the briefest outline of the activities of the stations, which range from every aspect of plant and animal growth in health and disease to problems of agricultural economics, engineering, food preservation, and transport. The main lines of research in progress are indicated in a series of short reports drawn up by the heads of the various institutes, but of necessity they can do little more than indicate the object of the experimental work and the more striking of the results already obtained. It is apparent that steady progress is being made and much valuable information obtained and disseminated, the output apparently being limited only by the staff and money available. The attempt to establish *Spartina townsendii* (rice grass) in Essex is interesting. The primary object is to prevent coast erosion, other considerations being the provision of a supply of seed to meet overseas demands and the establishment of a crop which could be used as an emergency feed for stock and to provide material for examining other economic possibilities of the plant. Attempts at overseas transport have shown that seed is unsatisfactory for long journeys involving passage through the tropics, but that cuttings can be successfully carried so far as Singapore if shipped in cool chambers between 30° and 40° F.

Fluctuations in the number of wild rodents are of importance on account of the economic effects of these animals on agriculture and forestry. The co-operation of numerous observers throughout the country has been enlisted to obtain data about cycles in numbers of field mice and squirrels, the cyclical variation being apparently affected by disease and by certain climatic factors as yet not properly understood.

The other report issued by the Ministry of Agriculture and Fisheries† indicates a gradual but steady expansion of the system of agricultural research and education in Great Britain, this being regarded as convincing proof that a genuine need of agriculture in the country is being met by this means.

Agricultural research owes much to the financial aid received from the Empire Marketing Board, which has facilitated considerable extension during the past few years. In 1929 the expenditure on research from all sources amounted to £19,694 on capital account and £288,012 for maintenance grants, more than half of the expenditure taking the form of grants to research institutes. The most important single development has been the formation of eight Imperial bureaux, which have been established in close connexion with existing research institutes. These deal with soil science, animal nutrition, animal health, animal genetics, agricultural parasitology, plant genetics (herbage plants and others), and fruit production. It already seems certain that the opportunities thus afforded for mutual interchange of ideas and information will benefit British agriculturists as well as overseas workers.

Attention is directed to the serious scarcity of students, trained in biological science, capable of filling the various posts in the Empire which from time to time offer themselves; special steps have since been taken to attempt to remedy this by increased publicity of the possible opportunities awaiting trained biologists.

The report, as a whole, confines its attention to an outline of the position of the Ministry's various activities with regard to agricultural research, local investigations and advisory work, scholarships, and provision of technical advice. Detailed accounts of the scientific results are not included, as they are published elsewhere.

Agricultural education during 1928–29 continued to make steady progress, but showed no features of outstanding importance. Special attention was devoted to the problem of providing suitable agricultural instruction for country boys and girls between the ages of fourteen and sixteen years, and certain experimental courses in Shropshire met with such success that the possibility of more extended schemes has come under consideration. Further success has attended the Ministry's recognition of farm household management as a branch of agricultural education, scholarships being provided at certain institutes.

Improvements in the position of veterinary science are overdue, and proposals have been put forward for the reconstruction of the Royal Veterinary College with the view of establishing the work on a sound basis, the recommendations being very far-reaching.

The progress of dairy education is reflected in the rapid improvement in the milk supply throughout England, the producer, on the whole, turning out a much higher grade product than formerly. As a result, the interest of sanitary inspectors has been aroused, and many of these are endeavouring to keep in touch with the dairy instructors.

Horticultural education is steadily increasing, and during 1929 two more county authorities began to provide facilities in this respect. A noteworthy advance has been made with regard to instruction in the cultivation of crops under glass, as complete courses of practical and technical instruction for the commercial glasshouse industry have been established by the Herts education authority, in co-operation with the Lea Valley Growers' Association. Bulb-growing provides an example of a

* Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1928–29. Pp. 247. (London: H.M. Stationery Office, 1930.) n.p.

† Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1928–29. Pp. 100. (London: H.M. Stationery Office, 1930.) 1s. 6d. net.

highly specialised industry which is benefiting by county and Government assistance, comprehensive trials and experiments dealing with problems peculiar to the industry being carried out in various centres, notably Scilly, Cornwall, and Lincolnshire.

On the advisory side, continued progress has been made in the inspection and certification of growing crops, chiefly potatoes, strawberries, and black currants; of goods intended for export, including nursery stock; and in the enforcement of the various orders against destructive insects and pests. The value of this phase of work is enhanced by the stringent import regulations in force in many other countries, as it is most important that the high reputation of the English certificate of health should be maintained.

W. E. B.

News and Views.

THE following sectional presidents have been appointed for the centenary meeting of the British Association, to be held in London on Sept. 23–30 next year, under the presidency of General Smuts: Section A (Mathematical and Physical Sciences), Sir J. J. Thompson; Section B (Chemistry), Sir Harold Hartley; Section C (Geology), Prof. J. W. Gregory; Section D (Zoology), Prof. E. B. Poulton; Section E (Geography), Sir Halford Mackinder; Section F (Economic Science and Statistics), Prof. E. Cannan; Section G (Engineering), Sir J. Alfred Ewing; Section H (Anthropology), Prof. A. R. Radcliffe-Brown; Section I (Physiology), Dr. H. H. Dale; Section J (Psychology), Dr. C. S. Myers; Section K (Botany), Prof. T. G. Hill; Section L (Educational Science), Sir Charles Grant Robertson; Section M (Agriculture), Sir John Russell. On Wednesday, Sept. 23, the ceremony of installing General Smuts as president of the Association, and a reception of delegates, will be held in the Albert Hall during a private view of the exhibition which is being arranged in connexion with the Faraday centenary celebrations, and will be open, for this occasion, to members of the British Association.

DYESTUFFS have occupied considerable attention in Parliament recently, the debates incidentally directing the limelight of public attention on to the part played by organic chemistry in framing the nation's destiny. In the House of Commons on Dec. 17, the Government's majority in favour of allowing the Dyestuffs (Import Regulation) Act, 1920, to lapse next month had fallen from thirty to six – a small number, seeing that 482 members voted, but sufficient to reject the amendment inserted by the House of Lords in the Expiring Laws Continuance Bill. Mr. Graham, the President of the Board of Trade, disagreed with the view that opportunity for further inquiry was necessary, holding that there has already been made a full and impartial review of the case by the Dyestuffs Industry Development Committee, which was representative of both dye manufacturers and dye users. This committee was unable to give any clear direction to the Government; the decision of the latter, he said, was well founded and should be maintained. Sir P. Cunliffe-Lister said that the committee's report urged the Government to pursue inquiries further and endeavour to reach agreement between makers and users as to the measure of protection necessary and the form which it should take. He challenged the Government to disclose the views of the Service departments, and declared that a substantial section of dye users opposed the lapse of the Act. Sir H. Samuel again opposed the continuance of the Act; is there any probability, he asked, that a new inquiry will lead to any more agreed and unanimous a report than that which has already been issued?

LABOUR members were not solidly ranged in support of the Government's attitude; Mr. Wise, Mr. Denman, Major Church, and Mr. Strachey advised acceptance of the Lords' proposal to continue the Act for one year. Mr. Wise expressed his belief that the growth of the dyestuffs industry in Great Britain has had very valuable effects on research, but he doubted whether all is being done that might be expected. It would be in the best interests of British industry and the vital interests concerned in dyes and chemicals if the Act were continued for a short period. Mr. Denman said that we need more experiment; we have shown ourselves intolerant of experiments and drop them at the moment when they are becoming interesting and worth continuing. He advised a test of the new conditions, followed by an inquiry, before a final decision was reached. Major Church said that virtually every scientific body in the country has condemned the non-continuance of the Act. With one accord eminent scientific workers at the Bristol meeting of the British Association last September suggested that it would be an act of incredible folly to withdraw the protection which has been given to our dye industry, and he did not think the House could afford to ignore the considered opinion of that body. Mr. Strachey declared that if Britain is to survive as an industrial nation, it will be primarily by the development and application of science throughout the industrial and economic system, and the action of the Government would attack the interests of science both directly and indirectly by allowing the Act to lapse. Speeches in favour of temporary continuation of the Act were delivered by Mr. Remer, Sir H. Croft, Mr. Marjoribanks, Mr. E. D. Simon, and Sir R. Horne, whilst Mr. J. H. Hudson, Sir D. Maclean, and Mr. Shaw opposed it; the Secretary of State for War (Mr. Shaw) admitted that the experts in his department advised that it is essential to maintain a chemical research industry, and that, failing it, there must be something comparable to safeguard the country.

INSISTING on its amendment, which has the effect of continuing the Dyestuffs (Import Regulation) Act for another year, the House of Lords on Dec. 18 returned the Expiring Laws Continuance Bill to the

House of Commons. It was admitted, said Viscount Hailsham, that dye-making is an industry of national importance, that the dye-makers are supported by the Institute of Chemistry and the Federation of British Industries in anticipating that lapse of the Act would check research and undermine the economic position, and that the Government's advisers on matters of national security consider that the lapse would be attended by danger. Lord Parmoor voiced the Government's protest, while Lord Darling reiterated that the question is one of the safety of the country. The subsequent debate in the House of Commons, which terminated with the acceptance of the Lords' amendment, disclosed little of scientific interest: it was concerned rather with views on the relations between the two Houses, with the organisation of the dyestuffs industry, with allegation and retort. The series of debates in Parliament has perhaps served a useful purpose other than that which necessitated it. The public has been reminded that organic chemistry stands in a unique and responsible position on the quarter-deck of the ship of State. Lip service at least, and perhaps a worthier tribute, has been rendered to the claims as well as to the achievements of research. All parties agreed that chemical research must go forward in support of industry and of defence; there were even references to the reasonableness of paying for such research as is desired. We hope that, in the comprehensive inquiry which will in due course be held, the voice of chemical science will be heard as attentively as that of economics.

THE birthday anniversaries of three veteran workers in science and educational progress are called to remembrance this month. On Dec. 12 last, Prof. W. C. Unwin, "a master and teacher of the science of engineering"—to use the appraising words of the late Sir William White—entered on his ninety-third year. He was born at Coggeshall, Essex, in 1838, educated at the City of London School, and began his notable technical career as a pupil in the firm of William Fairbairn, Manchester. Prof. Unwin was elected to the fellowship of the Royal Society in 1886. Dr. William Garnett, who was born at Portsea, will celebrate his eightieth birthday on Dec. 30. Like Prof. Unwin, he was educated at the City of London School. Proceeding to St. John's College, Cambridge, he graduated fifth wrangler. Entering the Cavendish Laboratory, Dr. Garnett enjoyed the distinction of being the first demonstrator of physics there under James Clerk Maxwell. From 1904 until 1915, Dr. Garnett was educational adviser to the London County Council. Prof. S. H. Vines, who was elected a fellow of the Royal Society in 1885, will be eighty-one years of age on Dec. 31. A graduate of Christ's College, Cambridge, he was formerly Sherardian professor of botany in the University of Oxford.

THE centenary of the birth of the British chemist, Augustus Matthiessen, which occurs on Jan. 2, recalls a career successfully devoted to science in spite of great physical infirmity, but one which came to a close all too soon, in tragic circumstances. Born in London, Matthiessen's life-long defect was due to a paralytic seizure in his infancy. From an early age, however, he displayed a taste for chemistry and at the age of twenty-one was able to go to Giessen, and later on to Heidelberg, working under Will, Buff, Bunsen, and Kirchhoff. Graduating Ph.D. at Giessen, he became known for his isolation of pure calcium and strontium by electrolytic means and for his study of electrical conductivity. Returning to London, he continued his studies under Hofmann, fitted up a laboratory at 1 Torrington Place, and from 1862 until 1868 was lecturer in chemistry at St. Mary's Hospital and after that lecturer at St. Bartholomew's Hospital. His work on electrical standards, undertaken voluntarily for the British Association, occupied the years 1862–1865, and in 1869 he was awarded a Royal Medal of the Royal Society for his investigations on the physical, electrical, and chemical properties of metals and alloys. For a year he was one of the editors of the *Philosophical Magazine*. He died on Oct. 6, 1870, at the early age of thirty-nine years.

A RECENT *Daily Science News Bulletin* issued by Science Service, Washington, D.C., gives a brief account of the meeting at Washington of the first Inter-American Conference on Agriculture, Forestry, and Animal Industry. At this meeting plans were discussed for protecting the great tropical forests of the Americas from careless exploitation such as has laid waste the forests of other parts of the world. It is estimated that there are some 3,000,000 square miles of forest lands in the twenty Latin republics, an area larger than the total area of continental United States exclusive of Alaska. Practically no research has been undertaken in these forests, and the estimate of the volume of timber they are said to contain (at least six thousand billion board feet) is admitted to be purely guess-work. Mr. W. T. Cox, consulting forest engineer of the Tropical Plant Research Foundation, said that "too little is yet known about the forests of tropical and sub-tropical countries". He urged extensive forest exploration aided by aeroplane, so as to obtain not only botanical information of the numerous trees but also commercial classifications. The training of young men in forestry and the development of these vast forests along scientific principles was advised.

INTERNATIONAL foresters heard something of the undeveloped state of the forests of the Latin Americas at the Forestry Conference at Rome in 1926. The proceedings of the Sub-Committee dealing with Tropical Forestry at that Conference show that there is a vast amount of information already gathered concerning some of the tropical forests, and the perusal of Stebbing's "Forests of India" would disclose the methods by which the tropical and sub-tropical forests of India and Burma have been brought under an intensive management during the past sixty years or so. At this Washington Conference other speakers dwelt upon the dangers of diseases and epidemics due to their accidental introduction, and to the necessity of organising this matter upon international lines. Prof. D. M. Matthews, University of Michigan, was more practical when he pointed out the dangers of

looking for temporary reward rather than to ultimate benefit when forests were cut down. He also directed attention to the degrade of the land which follows reckless exploitation, and the danger to agricultural areas. Others pointed out the necessity of studying the little-known or unknown timbers of this tropical forest area, "with a view to their possible uses in future decades when both Latin American countries and the United States will have to turn to these forests for most of their lumber". This shows a better realisation of the case, and the Conference to some extent grasped the present position.

THE executive of the Comité International Radio-Maritime at its meeting in Brussels in September last discussed the possibility of the transmission of pictures to ships by means of radio. On land, between fixed places, picture and facsimile reproduction is an accomplished fact, and Marconi engineers have obtained excellent results even when the places are thousands of miles apart. The technical and commercial experts recognise that such a service as the transmission of weather charts to ships' commanders for their guidance in navigation would raise considerably the factor of safety of navigation. They concluded, however, that it would be premature to undertake a service of facsimile transmission to ships at sea. Both technical and commercial difficulties stand in the way. In the present state of the system's development, the question of cost is a serious obstacle. Such a service would doubtless enable ships to make quicker voyages and appreciably reduce risk. It would supply the master of the ship with weather charts which would give him a visual indication of the weather conditions all round him. In order to justify itself, the service would have to be perfectly trustworthy and sufficiently accurate technically to ensure good reception. The apparatus, therefore, would have to be elaborate, and the weather chart service would cost probably not less than a guinea per day to ship-owners. The time occupied in the transmission of a weather chart would be about twenty minutes, during which the handling of the ordinary traffic would have to be suspended. The technical difficulties that are not yet overcome are the interference from other signals and atmospherics and, in addition, the phenomenon of 'fading'. These might render maps or charts illegible in parts and even misleading.

WHEN the English railway companies were first grouped together it was expected that more satisfactory results would be obtained by shareholders, passengers, and those who use the railways for the transport of goods. According to the views expressed by Sir Philip Dawson at a luncheon of the Batti Wallahs' Society on Dec. 11, "grouping has proved to be of no good whatever". The obvious thing for the railways to do is to adopt the most modern methods whatever they may be, but instead of doing this they do nothing. He believed that if they needed the money for the good of the public the Government would be willing to guarantee the amount. The investment would be quite sound. Unlike road and other employment schemes, it would pay dividends. The electrical manufacturers of Great Britain have supplied the world with the best machinery for electric traction. There is no reason why the country should not have the best equipped electric traction system in the world. Main line electrification has proved successful in Sweden, Japan, India, New Zealand, and many other countries. Actual electrification of the railway lines is easier now than it was a few years ago because of the progress that has been made with the grid. Sir Philip Dawson believes that main line electrification will soon be embarked upon, and that such electrification will become one of the great economic factors of the future. The Southern Railway has now 300 route miles electrified, making altogether 800 track miles. In spite of road competition, the increase in passengers carried during the last year was 35 per cent. This success is due to the fact that the comfort of the passengers has been studied. The services are fast and the trains sufficiently frequent to make the consulting of a time-table unnecessary.

THE success which has followed the introduction of high voltages for the distribution of electric power has led engineers to plan the use of still higher voltages. In Germany, for example, there is a closely meshed network 4700 miles in length working at 100,000 volts. In addition, Germany has now 750 miles of overhead mains operating at 220,000 volts. Even this high pressure is not considered sufficient to transmit great quantities of energy over hundreds of miles, and 380,000-volt lines are now being considered. At present the voltage economically practical is limited by the corona losses, but this limit can be raised considerably by employing suitable cables and insulators. To test the insulators which work at a pressure of 380 kilovolts, it is found that a voltage of a million is not adequate. In *AEG Progress* for December there is a description of a two-million volt laboratory which has been erected in the Porcelain Factory of Ph. Rosenthal and Co. As two million volts will arc over a distance of 16½ feet, a very large building had to be erected. It has no windows, as all the tests are carried out in darkness so that the faintest glow may be detected. On one side of the building there is a large hole, 27 feet in diameter, for leading out when necessary a two-million volt conductor. The high pressure is produced by two transformers with their secondaries in series and their primaries in parallel. The alternator has a capacity of a thousand kilovolt-amperes at a million volts. A large amount of power is thus available. The flashovers produced by this plant make a noise like the bursting of a high explosive, and physically are very similar to lightning. To measure the voltage, spherical electrodes each eight feet in diameter are used.

THE work of draining the Zuider Zee, the great national enterprise of the Netherlands, is now in full progress (NATURE, Sept. 21, 1929, p. 446). It is estimated that when all the land considered in the scheme has been reclaimed from the sea the area of the country will be increased by about one-seventh.

The first and smallest of the four areas into which the undertaking has been divided, and comprising nearly 50,000 acres, has been provided with two pumping stations, one at Medemblik and the other at Den Oever. When the area has been reclaimed, these stations will be permanently used for drainage purposes. In the *Brown Boveri Review* for November there is an interesting account of the novel electrical equipment at the Medemblik station. At Den Oever the water is pumped out by three centrifugal pumps driven by Diesel engines. At Medemblik the centrifugal pumps are driven by three-phase motors. The station is supplied with current at 50,000 volts. Each of the induction motors driving the pumps is rated at 660 kilowatts and runs normally at 107 revolutions per minute. By electrical devices, however, the speed can be varied between 88 and 120 revs. per minute, so that the operation may always be under the most favourable conditions. Owing to their slow speed, the motors had to be constructed with 56 magnetic poles. They always run at their maximum efficiency and power factor. The electrical station has been working continuously since last February.

ON Nov. 17, there was opened at the American Museum of Natural History a new South Asiatic Hall, the stocking of which was due to the enthusiasm of two British sportsmen, Lieut.-Col. J. C. Faunthorpe and Arthur S. Vernay. The hall is a fine tribute to the art of taxidermy in the Museum and to painstaking efficiency which led to the collection in India not only of the animals themselves but also of the plants, foliage, and representative sketches which combine to give a natural setting to the animal groups. The actual work of collection has been in progress since the first expedition was sent out in 1921, and the new hall itself has been in preparation during the last five years. The exhibited series consists of twenty large habitat groups showing all the more important of the Indian mammalia, but in addition the collectors brought back about 450 specimens now in the study collections. This fine gift- for the cost of the expeditions was borne by Mr. Vernay--arose from an almost chance visit paid by the late Col. Faunthorpe to the New York Museum, when, disappointed with the Indian animals exhibited, he expressed to Prof. H. Fairfield Osborn his willingness to make efforts to replace them. Needless to say, his project received every encouragement and support, and an unequalled South Asiatic Hall is the result. The official dedication of the hall was commemorated by the publication of a large brochure containing reproductions of photographs of all the groups. It should be a useful book to the enterprising museum curator, if only because it indicates suitable landscape treatment for the surroundings of different well-known species.

So often we have referred to the educational activities, amongst children, of certain American museums, that it is a pleasure to commend the excellent work being accomplished by some provincial museums in Britain. At the Cardiff Conference of the Museums Association in June, two papers were read on the subject of a rural museum service, pointing out what has been done, particularly at Batley and Huddersfield, and what could be done with further encouragement and help from education authorities (*Museums Journal*, November). The main theme centred round the distribution and circulation of specially prepared educational groups amongst schools; and the interest taken in the papers and in the subsequent discussion showed how keenly alive provincial museum curators are to the educational possibilities of their collections and to the need for making an impression upon young minds. In an editorial article upon the subject of rural museums for Britain, the school service is commended, but the remark is made that " it is hard to see why the teaching of children in (not from) elementary schools should be a function of museums ". Of course, the use of the museum should be a function of the education authority, but by hook or by crook the museums must get a footing in the world of elementary education, and the museums service to schools, apart from its own value, is a means of demonstrating to authorities slow to realise the possibilities that it is worth while to collaborate with museums.

A LARGE collection of neolithic implements from the Cotteswolds, numbering some eight thousand specimens, has recently been acquired by the Cheltenham Museum through the generous gift of Miss E. A. Paine. The collection was formed by her brother, the late Mr. A. E. Paine, who devoted many years of his life to the study of the neolithic period in that area. The collection is fully illustrative of the development of the new stone age industries of the district, and in addition to finished implements, includes flakes, cores, and fabricators, as well as implements in various stages of manufacture. There is also a representative series of polished implements, rare from this area. In an account of the collection which appears in the *Gloucestershire Echo* of Dec. 5, it is said that the collection is the finest from the Cotteswolds in existence. Incidentally, the writer of the article states that while the Museum contains objects from the long barrows of the neighbourhood, the culture of the round barrows is not represented, although it is well known that many of these have been opened and that their contents are still in existence but are not available for study. Perhaps Miss Paine's example may stimulate one or more private owners to emulate her generosity.

DR. MARCEL FOSSEYEUX, the indefatigable general secretary of the French Society for the History of Medicine, has recently compiled and published a bibliography, arranged according to authors and subjects, of the papers read before the first six international congresses of the history of medicine, held at Antwerp (1920), Paris (1921), London (1922), Brussels (1923), Geneva (1925), and Leyden and Amsterdam (1927) respectively. The great variety of the subjects is shown by the fact that they have been classified in the following fifteen sections: (1) bibliography, terminology, inscriptions, etc.; (2) education, schools and faculties, corporations;

(3) medical doctrines, methods, and processes of examination; (4) biographies (by far the largest section); (5) history of anatomy; (6) history of diseases such as plague, leprosy, syphilis, and nervous disorders; (7) surgery, obstetrics, ophthalmology, and stomatology; (8) pædiatrics; (9) dietetics, therapeutics, pharmacology, hydrology, and climatology; (10) public health and epidemiology; (11) veterinary medicine; (12) medicine and art; (13) medicine and literature; (14) hospitals, public assistance, and military medicine; (15) folk-lore, charlatanism, mystic medicine, popular medicine, and primitive medicine.

THE November number of the *King's College Hospital Gazette* was published as a centenary number and contains a sketch of the history of the Medical School, 1830-1930, the Medical Faculty having been established the year after the founding of the College. For some years the students suffered from the drawback of having to obtain practical instruction in the neighbouring hospitals, until in 1839 the first King's College Hospital was opened upon the site of the old St. Clement Danes workhouse in Portugal Street, Lincoln's Inn Fields. One hundred and twenty beds were at once available, and by 1872 this had increased to 172. In 1909 King Edward VII. laid the foundation stone of the new Hospital at Denmark Hill, which was opened four years later. Of the many famous men who taught in the old hospital, such as Richard Partridge (1805-1873), Robert Bentley Todd (1809-1860), Sir William Fergusson (1808-1877), Sir William Bowman (1816-1892), and others, Dr. Willoughby Lyle gives many interesting notes. Fergusson, a brilliant operator, it was said 'had the eye of an eagle, the heart of a lion, and the hand of a lady'. Lister joined the hospital in 1877, and it was in the old buildings in Portugal Street in July 1892 that he delivered his last clinical lecture. Patient to a degree, he disliked carelessness, but his failing was unpunctuality. The last meeting of the Committee of Management in the old buildings was held in July 1913, and patients were admitted and work commenced in the new hospital at Denmark Hill in October of the same year.

THE sixteenth Report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria (Union of S. Africa, Dep. of Agricult.: The Government Printer, Pretoria, 1930. Pp. vi + 592), maintains the high standard of previous volumes and is admirably produced and illustrated. The Director, P. J. du Toit, and R. A. Alexander have found that it is possible to immunise horses against horse-sickness by means of formalised virus. The bacteria of botulism are surveyed at length by E. M. Robinson. Parasitology has several papers devoted to it. The important subject of mineral deficiency and metabolism as it affects animals is considered in seven communications. The production of bacon is the subject of a valuable study in which the influence of the breed of pig and variations in the feed of the animals upon the grade of bacon produced have been investigated. These papers are only a few of the studies dealt with in this volume.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 P.M. on Thursday, Jan. 8, an oil painting of Graham Bell, by Mr. W. W. Russell, R.A., will be presented to the Institution by Sir Hugo Hirst.

AT the recent council meeting of the Yorkshire Philosophical Society, York, Prof. G. Baldwin Brown, Watson Gordon professor of fine art in the University of Edinburgh, and Dr. R. Mortimer Wheeler, Keeper and Secretary of the London Museum, Lancaster House, were unanimously elected honorary members of the Society.

SERIOUS losses are liable to occur from certain diseases, particularly piroplasmosis and anaplasmosis, in British cattle imported into South Africa, South America, and elsewhere, and this risk acts as a deterrent to the export trade. The Ministry of Agriculture and Fisheries announces that immunisation against piroplasmosis and anaplasmosis can now be carried out at the Ministry's Veterinary Laboratory at Weybridge. For particulars application should be made to the Secretary of the Ministry, Whitehall Place, London, S.W.1.

WE learn from a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., that quarantine restrictions on Florida fruit and vegetable shipments have been wholly removed as from Nov. 15 last. These restrictions were put into force in order to protect the rest of the United States against the Mediterranean frit fly which was discovered in certain Florida orchards in April 1929. Energetic measures of repression were put into operation almost immediately the discovery was made, and these appear to have been so efficacious that Florida is now restored to complete parity with all other States so far as such shipments are concerned. The lifting of the quarantine regulations, however, does not mean that the usual vigilance will be relaxed, since the possibility has to be provided for that complete eradication of the pest has not yet been achieved.

THE Medical Research Council announces that it has awarded three Dorothy Temple Cross Research Fellowships for 1930-31, these being the first appointments to be made under the terms of the recent benefaction in that name for research fellowships in tuberculosis, as follows: Dr. A. I. G. McLaughlin, Chief Assistant, Tuberculosis Department, St. Thomas's Hospital, London; Mr. R. J. Matthews, Chief Tuberculosis Officer, Mid-Glamorgan area, and Medical Superintendent, Cymla Hospital; and Lieut. S. M. Burrows, R.A.M.C., attached Sudan Defence Force. Dr. McLaughlin has received a fellowship for the study of methods of diagnosis and treatment at some chosen centre in the United States. Dr. Matthews and Lieut. Burrows have received senior fellowships and will make special studies of problems of tuberculosis among the native population in Zanzibar and in the Bahr-el-Ghazal Province of the Sudan, under arrangements made by the Council with the respective governments.

AN important catalogue (No. 440) of some 2000 second-hand books on zoology, geology, and palæonto-

logy has just been received from Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1. Many rare works are included.

MESSRS. A. West and Partners, 36 Broadway, Westminster, have recently issued a catalogue of 250 pages, of surveying and drawing instruments, with sections devoted to photographic apparatus and plan reproduction materials. Besides the usual apparatus and fittings, there are described a new form of cabinet for filing plans by hanging them in steel clips; a computing board designed by Mr. R. O. Kapp for calculations of two-part tariffs involving the four quantities—the kw. charge, the unit charge, the load factor, and the total cost per unit; and the Bromostat method of reproducing plans.

MESSRS. C. F. Casella and Co., Ltd., have recently issued a new edition of their illustrated Catalogue of Surveying and Drawing Instruments, including theodolites, transit instruments, levels, barometers, telescopes, tide gauges, planimeters, etc. Besides giving the dimensions and prices of the instruments, notes are given on their construction and, in some cases, on their use also. Included in the catalogue are the prism attachment for use with theodolites for the observation of equal altitudes, designed by Mr. E. A. Reeves, and the prism alidade, devised by the Rev. A. J. Potter, an instrument depending on a simple optical principle, which does not appear to have been used in this connexion hitherto. A new form of cathetometer is described; while among the barometers shown is an interesting reproduction of an instrument made about 1690 by Tompion, "the father of English clockmakers", who, it will be recalled, lies in the nave of Westminster Abbey, in the same grave as his famous apprentice, George Graham.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An assistant agricultural chemist in the Department of Agriculture and Horticulture of the University of Bristol—The Agricultural Advisory Office, 22 Berkeley Square, Bristol (Jan. 3). A visiting teacher of mathematics for the Paddington Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (Jan. 5). A graduate assistant master for physics at the Middlesbrough Junior Technical School—The Director of Education, Education Offices, Middlesbrough (Jan. 5). A principal of the Torquay Technical College—The Secretary, The Castle, Exeter (Jan. 8). Civilian education officers, Grade III., in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1 (Jan. 17). A professor of geology at the University College of Wales—The Financial Secretary, University College of Wales, Aberystwyth (Feb. 14).

Our Astronomical Column.

Pluto.—As noted in NATURE for Sept. 27, Prof. M. Wolf found an image on a plate exposed at Königstuhl on Jan. 23, 1914, which was conjectured to be Pluto. A comparison made by Messrs. Bower and Whipple with their ephemeris in *Lick Obs. Bulletin*, No. 427, gave residuals of 112·5″, 25·2″ in R.A. and Decl., so that the identity appeared doubtful (*Harv. Circ.*, 142). But in *U.A.I. Circ.*, 305, Dr. Zagar publishes new elements of Pluto, in which he has applied perturbations by all the large planets, so that they should be somewhat more exact than the Lick elements (the difference between them is not great). The new elements represent the 1914 position within 0·6″, so that there is little doubt that it belongs to Pluto. It extends the arc of observation by nearly six years, the previous date of the earliest images being December 1919 (Mt. Wilson).

Prof. H. N. Russell discusses the orbit of Pluto in the *Scientific American* for December. He considers the resemblance to the predicted orbit of Prof. P. Lowell to be far too close to be ascribed to chance, and concludes that it is the planet to which Lowell's analysis pointed. He also makes some interesting comments on the relations of Pluto to Uranus and Neptune. It takes about 500 years for Neptune to gain a revolution on Pluto, so the two planets will not be so near to each other for 500 years as they were at the conjunction a few years ago. It will be some 9000 years before the two planets will be at their minimum distance from each other, which is about $2\frac{1}{2}$ astronomical units. Pluto comes slightly inside Neptune's orbit, its perihelion distance being 29·80 units, but its high inclination (17° 7′) prevents a very near approach. Zagar's date for the next perihelion passage is 1989 Aug. 28·72; Lowell predicted March 1991.

Masses and Rotations of Planets.—Mr. V. V. Narlikar, 136 Victoria Road, Cambridge, notes in a letter to the Editor that if the planets are arranged in order of angular velocity of rotation, we get nearly the same order as when they are arranged in order of mass, the larger masses having the smaller periods of rotation. He observes that this may throw some light on the origin of the planetary system, as the orbital speeds of particles near a large mass would be higher. It is doubtful whether much stress can be laid on his result. The difference of angular velocity of the four giant planets is very small compared with their difference of mass; further, Neptune, though more massive than Uranus, has a slower rotation. At least two of the inner planets, the earth and Mercury, have had their angular velocities diminished by tidal action, so that their present rotations are not much guide to the primitive ones. Still, the point is worth mentioning, as it may be one of the many factors on which the early rates of rotation depended. The masses of the asteroids are very small; still, many of them are inferred to have rapid rotations from changes in their light.

The Leonid Meteors. The date of the next expected maximum of the Leonid meteors is now approaching, being due in 1932 or 1933. The *Daily Science News Bulletin* of Nov. 18 and Nov. 21, issued by Science Service, Washington, D.C., states that the meteors this year were more numerous than was expected, the display being the best since 1901. Dr. Olivier states: "It was much better than we expected and greatly encourages us to think that there may be a great shower in two or three years". The maximum occurred on the early morning of Nov. 17, which was a day later than he expected; the hourly rate was two or three times as great as he expected, and many of the meteors were fire-balls with long-enduring trains.

It is extremely difficult to make accurate forecasts for meteors, as their orbits are not identical with that of the parent comet; further, those that we meet in any year have never been seen before, so we can only guess at their position, knowing that of other meteors at a considerable distance from them.

Research

Peruvian Weights.—In *Man* for December, Erland Nordenskiöld discusses the ancient Peruvian system of weights on the evidence of two collections of stones presumed to be weights. Although individual objects regarded as weights have previously been described, this is the first account of any series from which some idea of the Peruvian system might be deduced. The first series is from the collection of Dr. E. Gaffon in Berlin. It comprises 13 stones and was discovered in the Hacienda de Sagrario, near Huacho. With the series was a small beam balance and a basket-work case. The weights were enclosed in a neatly finished cloth bag. With one exception the weights are water-polished pebbles; the exception is said to be of meteoric iron. The stones fall into two series, one of four stones, the other of nine. When the series of nine is arranged according to weight, it appears that the heaviest is eighteen times the weight of the smallest, the intervening units being 3, 5, 10, 12, 15, and the aggregate sum of all the units 85. The weight of the smallest is 1·53 gm., of the heaviest 27·50 gm. In the series of four, the largest again appears to equal eighteen units of weight, weighing 29·17 gm., and the smallest five units, at 8·10 gm. This system appears to show Spanish influence. The author, however, believes he has discovered in the collections of the Gothenburg Museum a series which is uninfluenced by the Spanish system, in a number of stones contained in a cloth bag from Pachacamac. In this series of nine stones, five suggest a unit between 3·72 gm. and 3·86 gm., while the remaining four, if taken in pairs, probably constitute units in the same system. There again occurs a weight which is eighteen times the unit, and it is, therefore, suggested that the figure 18 in the previous system is a survival of the ancient and original system. It may be due to the necessity of measuring some compound in which one of the ingredients had to be eighteen times another—such, for example, as the proportion of copper to tin in making bronze (5-6 per cent of tin in the Inca bronzes).

Excavations in Syria.—The results obtained in 1929 and 1930 by the French archæological expedition to Syria of the Académie des Inscriptions et Belles Lettres are described by M. Schaeffer, the leader, in the December issue of *Antiquity*. The work was begun as the result of the accidental discovery of a burial vault at Minet el Beida which contained Mycenæan and Cypriote pottery dating from the thirteenth century B.C. The excavations on this site have revealed an important cemetery containing several large rectangular tombs with corbelled vaults, approached through a short vestibule with stairway, the whole being built of well-worked stone blocks. One of the tombs was hidden under an important building and other more important buildings connect directly with the tombs. One building cleared this year contained thirteen halls, rooms, and passages, without counting the upper story, the staircase and landing of which are preserved. North of the tombs, towards the sea, at a depth of between 0·50 m. and 1·50 m. lay about eighty deposits of Mycenæan, Cypriote, and local pottery, bronze implements, and a variety of other relics, some of Egyptian provenance, and including statuettes of Syrian and Egyptian deities. A large temple on the northern projection of the mound had two rectangular courts joined together and enclosed by thick walls. The name of the town, Sapounna, was recovered from one of the stelæ. Near by was a seminary for priests, equipped with a library with numerous inscribed tablets. Outstanding importance is given to the cuneiform tablets by the fact that most of them contain a script that is wholly unknown and had already become alphabetic. In the glossaries Sumerian is translated into a language at present unknown, instead of the usual Babylonian. From the important finds made to date, it is clear that Sapounna was an international commercial centre of first-rate importance, with a polyglot population whose priests must have spoken at least five languages, including that which is at present unknown to us; while in the pantheon, native Syrian deities appear side by side with those of Mesopotamia and Egypt.

Abnormal Incisor in a Coypu.—An abnormal incisor of *Myocastor coypus*, which recalls some of the examples in other mammals recently described by Prof. W. C. M'Intosh, is described and figured by Carlos Ruscom (*Physis: Rev. Soc. Argentina Cien. Nat.*, **10**, p. 162; 1930). In the degree of its abnormality this upper tooth is unusual, for, having been deflected off the line of its opposing incisor in the lower jaw, it has continued to grow until the tip has described a full circle and more. The usual length of the incisor of a coypu is 76 mm.: this one measures 156 mm.

Fresh-water Sponges from the Dutch East Indies. Mr. N. Gist Gee, in *Treubia* (vol. 12, 1; 1930), continues his work on fresh-water sponges, the first part of which contained an historical account (*Treubia*, vol. 11, 2; 1929). The present part provides descriptions and illustrations of a very large number of species. Fresh-water sponges are abundant in these regions, occurring in lakes, tanks, ponds, and running water, and many of them are described from living material; this gives much value to the work, for colour, form, and habit are specially noted, in addition to the spicules both of the sponge itself and of the gemmules. We have now a very good idea of the fresh-water sponge fauna of the Dutch East Indies, which is of considerable importance.

North American Retinellidæ.—After careful study of the anatomy of most of the species, H. B. Baker has attempted to classify the North American land snails of the genus *Retinella* (*Proc. Acad. Nat. Sci. Philad.*, vol. 82). Previous classifications based on the supposed presence or absence of an accessory left mantle-lappet are inaccurate, the structure being present in all. It seems that *Retinella*, *Glyphyalinia*, *Omphalina*, *Mesomphix*, and *Vitrinizonites* have two widely separated lappets on the left side of the mantle edge, but *Oxychilus* and *Zonites* have only one continuous lappet in that position. The shell characters that may be used for the distinction of species are growth sculpture, spiral striæ, and form of shell. A systematic list with localities and notes of the species of the genus form the bulk of the paper, which also includes descriptions of the new subgenera *Glyphyaloides* and *Glyphognomon*.

The Foraminiferal Family Polymorphinidæ.—In "A Monograph of the Foraminiferal Family Polymorphinidæ, Recent and Fossil" (*Proc. U.S. Nat. Mus.*, vol 77, pp. 1-195, pls. 1-40; 1930) Dr. J. A. Cushman and the late Dr. Y. Ozawa describe and figure all the species of the Polymorphinidæ. The first undoubted representatives are found in the Trias, but it is not until the Jurassic that the family becomes at all frequent. The affinities of the species which have been recorded from the Ordovician and the Devonian are uncertain. With regard to distribution, the authors state that smooth and rather primitive species have a long geological history and are widely distributed, whereas specialised forms are restricted to narrow limits both in the present oceans

and in the past. Similarly, some of the species of various genera that are highly ornamented or have very characteristic shapes do not range widely. In their remarks on the evolution of the family, it is stated that the Polymorphinidæ are certainly derived from some coiled form of the Lagenidæ such as *Marginulina* or *Vaginulina*. Many species are described or recorded from various horizons in the Jurassic, Cretaceous, and Tertiary formations of England.

Researches on *Caudina chilensis*.—This organism is a favourite subject for research, and is used in two interesting papers in the June number of the *Science Reports* of the Tôhoku Imperial University (Fourth Series—Biology), Sendai, Japan, vol. 5, No. 2, 1930: "Notes on the Development of a Holothurian *Caudina chilensis* (J. Muller)", by Densaburo Inaba, and "On the Circulation of the Perivisceral Fluid in *Caudina chilensis* (J. Muller)", by Masayasu Zazabi. The first describes the development from egg to larva and young stages, the work being carried out both on material reared from artificial fertilisations and on eggs and larvæ from the plankton. The Auricularia stage is omitted and the barrel-shaped larva is a Doliolaria, which is also the case in several cucumarians the development of which is known. The life-histories of members of the family Molpadiidæ, to which *Caudina* belongs, have not so far been investigated, and it is shown that it is more closely related to the Cucumariidæ than to the Holothuridæ or Synaptidæ. The breeding season at Asamushi, where the work is carried on, is in May and June, spawning taking place during the high tide which succeeds the day-time low tide. The structure of all the stages in development is carefully worked out and there are good diagrammatic text-figures and six plates. The second paper, dealing with the pericardial and the tentacular fluid in *Caudina*, shows that the current of the former progresses antero-posteriorly close to the body wall and returns postero-anteriorly along the centre of the body cavity. The pressure of the perivisceral fluid exhibits much variation and is much higher in adults than in the younger animals in a similar physiological state.

Genetics of Garden Beans.—There are many varieties of the garden bean, *Phaseolus vulgaris*, differing markedly in the colour and mottling of the seed, in flower colour, and in other characters. K. Miyake, Imai, and K. Tabuchi (*Jour. Coll. Agric. Imp. Univ. Tokyo*, vol. 11, No. 1) have made a further study the genetics of stem and flower colour, seed-coat colour, and pattern. They find pink stem recessive to red, the flower colour corresponding in each case, while green stems may bear flowers which are red, pink, flecked, or white. Varieties with flecked or white flowers always have green stems, but when these are crossed the stem is coloured. Red stem is epistatic to pink, and coloured stem is dominant to green. Pink × green stem gives red F_1 and in F_2 9 red : 3 pink : 4 green, showing the presence of two factors. As regards seed colour, black is found to be epistatic, and white hyperstatic to all others. Intermediate in the series are brown, purple, red, grey, and yellow, each apparently represented by a single gene. Piebald is recessive to self-colour, and there are three possible modifiers affecting the extension of the colour. The 'mottled' character is dominant and is linked to the recessive gene cream, with which it gives 2·6 per cent of crossing-over. The various types of bean studied are illustrated by two coloured plates.

Base Line Comparisons.—The Baltic Geodetic Commission has recently issued its first Special Publication (No. 1, Helsingfors, 1930, pp. 236), which is entitled "Measuring of Seven Base Lines of the Baltic Polygon, executed in the year 1929", by Ilmari Bonsdorff. The aim was to determine whether the base lines in the various countries surrounding the Baltic Sea, and partaking in the work of the Geodetic Commission, are really in agreement with one another. The seven base lines chosen were Szubin (5·1 km.) in Poland, Sveksna (6·5 km.) in Lithuania, Ösel (6·3 km.) in Estonia, Hanko (5·9 km.) in Finland, Enköping (6·9 km.) in Sweden, Öland (6·0 km.) in Sweden, and Lolland (6·8 km.) in Denmark; these were compared with the standard bases at Potsdam (240 metres) and Helsingfors (720 metres). Eight invar wires were used; four were Finnish and four Danish, and as their certificates indicated that their temperature coefficients were different, they were supposed to be drawn from different pieces of invar; it was found later that one set of certificates gave wrong values, and that all the wires were really drawn from the same piece. Afterwards it appeared that between the second and third measurements at Helsingfors all the eight wires lengthened by 0·082 mm., for no assignable cause. This seems to be the most serious cause of error in such geodetic measurements, apart from irregular lateral refraction depending on climatic conditions.

Echo-Sounding.—The depth shown by an echo-sounding machine requires correction for the slope of the bottom, since the strongest echo, which makes the record of the depth, is returned as a rule from the nearest point, which is not always vertically under the ship. A. L. Shalowitz (Slope Corrections for Echo Sounding: U.S. Coast and Geodetic Survey Special Publication, No. 165) considers that this correction is negligible if it is so small that the uncorrected sounding would be correct if displaced on the chart by a distance not greater than the width of the numerals expressing it, 0·16 inch on an American chart, and provides tables for the rapid recognition of such cases. At least two lines of soundings are required in order to determine the slope correctly. An objection to this suggestion is that a sounding would be entered uncorrected on a chart on a small scale but corrected on one on a larger scale. The paper is reprinted in the *Hydrographic Review*, vol. 7, No. 1 (Monaco 1930), which contains a number of original papers and reprints or abstracts from other journals. Among the original papers is a note, with illustrations, on the British Admiralty pattern echo-sounders for 250 fm. and 500 fm., made by Henry Hughes and Son; and in other papers reference is made to the Langevin echo-sounding apparatus used in Italian surveying ships, and the French Marti apparatus. E. Lübeke in a reprint recommends the use of the Admiralty "Tables of the Velocity of Sound, etc.", H.D. 282, for the reduction of soundings to be used for scientific purposes, but prefers a standard velocity of 1500 metres per second for practical purposes. M. Camille Vallaux discusses the present state of our knowledge of the Humboldt Current, and accepts the view that the cold greenish water rich in diatoms wells up from the continental slope, while the occasional patches of cold blue water come from greater depths. Capt. J. Luymes, of the Netherlands Hydrographic Office, gives a short history of oceanography, with a postscript dealing with the work of the *Willebrord Snellius* Expedition up to the end of the year 1929.

Fluid Flow at Corners.—The issue of the *Canadian Journal of Research* for September contains a contribution from the National Research Laboratories, Ottawa, dealing with the design of corners in fluid channels so that they may produce the minimum of disturbance of the uniformity of flow. The authors, Messrs. G. J. Klein, K. F. Tupper, and J. J. Green, by observations on the air flow in a wind tunnel 18 inches wide, bent at a right angle, find that strips of thin

metal a little more than an inch in width bent so that half their width is at right angles to the other half, and placed in the diagonal of the bend of the wind tunnel with their surfaces parallel to the two directions of flow, make a great improvement in the uniformity of the downstream flow. Strips of the same width bent so that their transverse section is a quarter of the circumference of a circle, and placed about half their width apart along the diagonal of the bend, produce a downstream flow which is very nearly uniform across the width of the tunnel. The authors point out that the same improvement may be made in the uniformity of the downstream flow in bent water- or steam-pipes in which the resistance has to be reduced to a minimum, by the introduction of bent vanes.

Joule's Thermometers.—The November issue of the *Journal of Scientific Instruments* contains a short note by Dr. J. R. Ashworth on the present state of two of the thermometers used by Joule in his researches on the mechanical equivalent of heat which are preserved in a wall case in the rooms of the Manchester Literary and Philosophical Society. The two are the *A* and *D* instruments mentioned by Joule in his paper in the *Transactions* of the Royal Society of 1850 as those with which his most accurate work was done, *A* being the calorimeter thermometer. Each was made by Dancer of Manchester in 1843, and is nearly a metre in length, with a spheroidal bulb and an arbitrary scale, the range of *A* being from 0° to 30° C., and of *D*, 0° to 100° C. Joule calibrated both and recorded the changes of the freezing-point readings on them from 1844 to 1882. Sir Arthur Schuster tested them again in 1892, 1893, and 1894, and Dr. Ashworth has again tested them this year. During the whole period the freezing-point records have risen; in the first six years *A* showed a rise of 0·33° C., and it is now 0·65° C. and appears to be approaching a limit exponentially. It would be interesting to know what other thermometers of this age are in existence, and how their freezing-point readings have changed since they were first determined.

Sulphur Hexafluoride.—The compound SF_6, discovered by Moissan in 1886, is of interest because in it sulphur is exerting its maximum valency and the resulting compound is chemically very inert. Shumb and Gamble, in the November number of the *Journal of the American Chemical Society*, describe the preparation of the compound from sulphur and fluorine (the only practical method), in the course of which they give details of a simple apparatus, in which monel metal was used, for the production of fluorine. The vapour-pressure curve, melting point (−50·8°), and gas density (5·10 when air = 1; theoretical 5·04) were investigated.

Oil-driven Locomotives.—To the valuable series of pamphlets issued by the Association of Engineering and Shipbuilding Draughtsmen has recently been added one on the internal combustion engine, by B. Reed. In England, America, Germany, Switzerland, Russia, and elsewhere, much experimental work is being done on oil-driven locomotives, and Mr. Reed's paper contains a review of the problems involved in the design of locomotives fitted with Diesel engines and many particulars of the oil-driven locomotives at work. The fuel consumption of a Diesel engine for traction purposes is about 0·43 lb. per b.h.p. per hour, but taking coal at 22*s*. 6*d*. per ton and Diesel oil at 90*s*. per ton, the thermal efficiency of the oil-driven locomotive must be at least 3·1 times that of the steam locomotive for there to be no increase in the fuel bill. Included in the pamphlet are tables of costs, curves of performance, sections devoted to the locomotive as a whole, the engine unit, and the various forms of transmission gear, while an appendix gives details of eight recent engines and a bibliography of articles on the subject published in the engineering Press. Like other publications of the Association, the pamphlet is obtainable from the Draughtsman Publishing Company, Ltd., 96 St. George's Square, S.W.

Utilisation of Waste Wood Chips.—At St. Helens, Oregon, an extensive plant has recently been put into operation by the Fir-Tex Insulation Board Co. for the conversion of the hitherto wasted Douglas fir chips from the lumber industry into board one inch thick for building and insulation work. An illustrated description of the plant by R. C. Smith appears in *The Valve World* for November 1930. The chips, of which the supply is almost unlimited, are first treated with steam, in 18 ft. spherical rotary digesters, and then are reduced to pulp by hammer shredders. From the storage chests the pulp is passed on to a Fourdrinier machine having a wire screen 13 ft. wide and 100 ft. long with eight presses, each with two rolls, the main rolls weighing 12 tons each. The board, emerging from the machine at the rate of about 20 ft. per minute, is automatically cut into lengths and is then passed to a drier 360 ft. long with eight decks heated by oil-burning furnaces. The plant is capable of producing 150,000 sq. ft. of one-inch board every 24 hours, but plans are already under consideration for the extension of the plant to ten times this capacity. The board has not only been used for building and refrigeration work but also tests in the sound studios at Hollywood have shown it to possess remarkable acoustic and sound-deadening properties.

Cooling Electrical Machinery.—After forty years' experience in the design of electrical machinery, engineers have found that the heating factor is the one which nearly always limits the size of electrical apparatus. The temperature rise of machinery in the early days was very difficult to guess, but now that the conductivity of insulating materials and the laws of the loss of heat by air convection currents are known, approximate values for this rise are easily found. The maximum permissible temperature rise of any portion of a machine, the so-called hot spot temperature, is determined by the standard specification. Unfortunately, it is difficult to get international agreement on permissible temperature rises. They naturally depend on permissible overloads and these vary in different countries. In Britain, for example, the maximum permissible temperature rise for the commutators of very small motors is 45° C., in America 65° C., and in Germany 60° C. As the overload conditions are often different, it is difficult to compare the relative value of home and foreign machines. In a paper read to the Institution of Electrical Engineers on Nov. 6, Mr. Hoseason described various methods of heat dissipation and compared their relative values. The cooling medium most frequently used is air. Large generators and motors generally work with a ventilating air circulation system closed on itself with a water-cooler in the path of the air. In these cases the heat passes from the surfaces of the hot parts into the circulating air, is conveyed to the water in the cooler, and then carried by an outlet into a pond or river. Hydrogen is now not uncommonly used in place of air in the closed circuit, on account of its high thermal conductivity and the less power required to keep it circulating. In air-cooled machines it is found necessary to circulate about 100 cubic feet of air per minute per kilowatt lost, and in water-cooled machines about a gallon of water per minute for the same loss.

Biological Control of the Greenhouse White-Fly.

By E. R. SPEYER, Entomologist to the Experimental and Research Station, Cheshunt.

THE greenhouse white-fly is a pest of a number of plants grown under glass, and has, during the past fifteen years, become so widely distributed in Great Britain, Ireland, and the Channel Islands that the owner of the smallest conservatory must by this time be familiar with it and with the sordid appearance of his plants when infested by this insect.

Through the researches of Dr. Ll. Lloyd at the Cheshunt Experimental Station in 1920, it was shown that the pest could be controlled in commercial tomato and cucumber nurseries by fumigation either with the cheap 'cyanide' process or with the vapour of the more expensive liquid, tetrachlorethane. His demonstration of the correct methods of fumigating so as to reduce injury to the tomato plant to a minimum resulted in an incalculable saving to the industry.

In spite of the comparatively widespread use of these fumigants, the general white-fly population continued to increase in subsequent years, the commercial grower began to realise certain difficulties connected with extensive fumigation, and certain varieties of greenhouse plants were found to be very seriously injured by the vapour of tetrachlorethane.

The appearance of a parasite enemy of white-fly in Surrey was recorded by the late Prof. H. Maxwell-Lefroy, but the habit of this particular species, which still exists in England, does not admit of its exercising any material measure of control over the pest. An allied hymenopterous parasite, *Encarsia formosa*, was found by Mr. L. Hawkins at Elstree, Herts, in 1926, and scales of white-fly, parasitised by this insect, were received at the Cheshunt Experimental Station through the *Gardeners' Chronicle*. Observations upon the habits of the parasite established the facts that it reproduces itself parthenogenetically; is capable of distributing itself quickly by flight not only within an area covered by glass, but in midsummer for distances of several miles over land interspersed with greenhouses; and that a complete control of white-fly infestation is obtained by it when warm temperatures prevail.

Anything approaching extermination of the pest within a short period of time could not be expected, as the parasite is entirely dependent upon the young stages of white-fly for its existence, and cannot survive the winter either out-of-doors or in unheated greenhouses. However, the results of distribution during the summer of 1927 were so promising, that an application was made to the Empire Marketing Board, which generously gave a grant for the erection of a glasshouse in which the parasite could be propagated upon a larger scale.

During the earlier investigations upon the breeding habits of the parasite, an important fact came to light, namely, that the percentage parasitisation of white-fly scales is not the same upon all types of plant. The tobacco plant in particular, when grown in small pots, produces a sticky foliage upon which the white-fly breeds readily, but to which the parasite shows some aversion. It is due to this fortunate circumstance that a stock of white-fly can be maintained so that a continuous supply of parasitised scales upon other plants is obtainable.

The method of distribution is simple and has been adhered to as being the best with which to establish the parasite in greenhouses. Tomato plants are grown in pots or in the ground; tobacco pot-plants infested with white-fly and with a certain number of parasitised scales upon them are introduced amongst the former. The white-fly soon distribute themselves and lay eggs upon the lowest branches of the tomato plants; the scales which result from these eggs readily become parasitised and are recognisable by the jet-black colour which they assume 11-14 days after each has received a parasite egg. This blackening marks the time at which the pupal white-fly is destroyed by the larva of the parasite within the scale-case. When a large number of black scales have made their appearance, the low branches are removed, packed in boxes, and sent out to the grower, who ties them into small bunches and hangs them about in his infested house for a period of three weeks, during which time the parasite larva pupates and finally emerges, through a hole which it cuts in the roof of the scale-case, as the adult winged parasite, which immediately begins to deposit eggs in white-fly scales in its new environment.

In the meantime, more white-fly have bred upon the now lowest branches of the original tomato plants, which are afterwards used as another supply for distribution, and so on. A single series of tomato plants will thus yield a continuous supply of parasites for several months if transferred to 12-inch pots when young or when grown in the ground. At least a thousand parasitised scales may be present upon a single tomato branch, and each parasite eventually emerging is capable of causing the subsequent destruction of some fifty white-fly scales.

Male parasites appear rarely and usually only when temperatures have fallen below 60° F. over a period of some weeks. Under such conditions the fertility of the female may be much reduced. Adults of both sexes measure rather less than $\frac{1}{40}$ in. in length, so that they are not readily noticed unless very large numbers are present.

The approximate number of parasitised scales distributed in this way to growers of glasshouse plants during the past four years may be of interest:

Year	Approx. No Distributed.	Recipients.	Localities.
1927	15,000	13	5 English 1 Welsh County.
1928	200,000		20 Counties, England and Wales.
	20,000		Royal Botanic Gardens, K
	20,000		Canada.
	10,000		Channel Islands.
Total	250,000		
1929	900,000	509	40 English Counties.
	20,000	28	Wales.
	30,000	14	Scotland.
	20,000	11	Ireland.
	100,000	16	Channel Islands.
Total	1,070,000	578	
1930	1,350,000	745	42 English Counties.
	40,000	38	Wales.
	50,000	16	Scotland.
	10,000	6	Ireland.
	50,000	22	Channel Islands.
Total	1,500,000	827	

Up to May 1930, boxes of parasites were distributed to applicants free of charge, but afterwards a charge had to be made to defray the cost of packing, etc., except to members and associates of the Nursery and Market Gardens Industries Development Society, Ltd., which controls the Cheshunt Experimental

Station. After this system was adopted, the number of applications fell off, so that the supply of parasites available exceeded the demand.

In 1928 reports were received from the majority of the recipients as to the measure of control which the parasite had effected. Apart from a negligible number of cases in which the parasite failed to establish itself, about half reported complete and the rest partial control. Owing to the numbers supplied, it was impossible to obtain similar information in later years, but many reports of complete control have come to hand from all quarters.

The working of the parasite is best judged of from tomato-houses in the Lea Valley, in some parts of which the pest has been extremely severe for many years. In these particular areas, it has been found unnecessary to make use of fumigants during both the last and the current year.

The very large number of parasites which continually escape from the breeding house at Cheshunt appear to have furthered the distribution of the beneficial insect throughout glasshouses in Hertfordshire, and the white-fly population of that county, in which there is almost as great an area of glasshouses as in the whole of the rest of Great Britain, has definitely been reduced to a small fraction of what it was five years ago.

Applications for white-fly parasites should be made to the Experimental and Research Station, Cheshunt, Herts, not later in the year than September, nor earlier than March, unless minimum night temperatures of 55° F. can be maintained in the greenhouse during the winter months. Particulars of charges, etc., will be forwarded immediately to applicants.

It is useless to introduce the parasite into greenhouses in which the white-fly is not breeding at the time of receipt of parasite material. The parasite is quite harmless to vegetation and to animals, and does not parasitise insects other than the white-fly. In cases of severe infestation, when immediate control of white-fly is demanded, the greenhouse may be fumigated with a half dosage of 'cyanide' or tetrachlorethane without injury to the parasite, which is also not materially affected by other fumigants and sprays generally used for the control of pests upon living glasshouse plants, with the possible exception of paraffin emulsion.

An illustrated account of the white-fly and its parasite was published in the *Journal* of the Royal Horticultural Society, vol. 54, part 1, p. 181, January 1929, and a detailed account of the life-history of *Encarsia formosa* appeared in the *Bulletin of Entomological Research*, vol. 18, pt. 3, p. 301, March 1927.

Current Mortality Rates.

THE recent inaugural addresses by Mr. H. M. Trouncer at the Institute of Actuaries in London and by Mr. Steuart E. Macnaghten at the Faculty of Actuaries in Edinburgh, besides dealing with certain technical matters, discussed subjects of more general scientific interest, and directed attention to the great decrease in the rates of mortality between ages 20 years and 70 years in the general population, and presumably also among the lives assured by the various companies in Great Britain.

Mr. Trouncer mentioned that it is common knowledge to insurance offices that investigate their own experience, that, apart from yearly fluctuations, the rates of mortality are now lighter than ever before. The two actuarial societies have in hand a new continuous investigation into the mortality experience of assured lives and annuitants, and while results with regard to the latter have already been published, with forecasts of future mortality and extensive tables, the work on assured lives has taken longer to arrange and the results for the three years 1924–26 will only be fully available early next year, but will be quickly followed by a further three years' experience. This last point is important, as there might be a danger in using the figures of three such light mortality years as 1924–26.

Mr. Macnaghten referred also to research into the effect of family and personal history and occupation and foreign residence on mortality and sickness, and reminded his audience that, a few years before the War, Mr. Lewis P. Orr delivered a valuable address on this subject and advocated that a bureau of research should be set up. The idea was received favourably and we have reason to believe that a scheme was actually worked out in a preliminary way and put before the insurance offices. Then the War came and all such work had to be put aside. In spite of various post-War difficulties, much has already been done to bring mortality statistics up-to-date, and it remains for the future to show how far the work can be extended to special classes of risk, as has been possible in the United States, where the War interfered less.

It would seem that an investigation into the mortality of assured persons who proceed to tropical or sub-tropical areas is required, and there is no doubt that the information at present available is incomplete and untrustworthy, though individual actuaries have done something to fill the gap, as, for example, Mr. H. E. Raynes, for East and West Africa. The risk in all such cases has decreased: mainly owing to the great advances in tropical hygiene and preventive medicine, though a little of the apparent improvement may be attributed to a wiser choice of the men sent abroad.

Mr. Macnaghten amused his audience by an example of the change in point of view. "It is difficult", he said, "to realise to-day that eighty years ago lives resident in the United States west of the Mississippi were not accepted for life assurance except on almost prohibitive terms." With a further improvement in conditions, with greater knowledge of how to live in unhealthy areas, and with accurate statistics to measure the risk, it is to be hoped that those who look back in future years will notice similar changes.

The British Industries Fair.

THE Committee which was appointed by the President of the Board of Trade in February 1930, under Lord Chelmsford as chairman, to examine the present situation of the British Industries Fair and to consider means of increasing its utility to British trade, in its report (London: H.M.S.O. Cmd. 3726. Price 6*d*. net) makes the basic recommendation that "the Fair should be developed so as to become a truly national manifestation of the quality and range of British products and an increasingly powerful factor in the expansion of our trade". Both Government and manufacturers generally should accord it more vigorous support, and the public should be encouraged to learn through the Fair that British

manufacturers can supply their needs. A policy of 'Sell British Goods' is at least as important as 'Buy British Goods', if for no other reason than the difficulties at present encountered by customers wishing to purchase British goods—difficulties which, in some cases at any rate, are due to the obvious reluctance or indifference of the retailer to sell British goods.

The British Industries Fair is the direct outcome of the measures taken by the Commercial Intelligence Branch of the Board of Trade, immediately after the outbreak of War in 1914, to deal with the situation which had arisen in many industries owing to the cessation of trade with enemy countries. From the first Fair, which was held in May 1915, in the Royal Agricultural Hall, London, with an exhibitors' floor space of 80,000 square feet, the size of the Fair has steadily developed; the Birmingham Section was started in 1920, and in the 1929 London Fair the area occupied by exhibits was more than 310,000 square feet. Since 1926 the Treasury has made a grant of £25,000 per annum for advertising purposes, but the Committee reports that it received overwhelming evidence that this sum was totally inadequate for effective world publicity, and recommends that the Government should establish a regular annual publicity grant of a minimum of £100,000 and recognise the Fair as an integral feature of British economic policy. The Committee agrees with the view that advertisement of the Fair abroad is of value to British industry generally, and records its conviction that expenditure of this character, by assisting the restoration of prosperity to British industry, will prove to be a national economy and be amply justified by results. The preponderance of evidence was emphatically against increasing charges for space as a contribution towards advertising expenses; and regarding the Fair as a means of expanding British industry, the Committee urges that the recommended national contribution is insignificant compared to the present expenditure on unproductive relief of unemployment which it is designed to reduce.

Other recommendations include the acquisition of a site easily accessible from central London, and its equipment with buildings capable of extension as required; the continuance and, if possible, supplementing of the Government banquet to celebrate the opening of the Fair; the establishing of a special Committee to direct the expenditure of the publicity grant, the administration of which and the management of the London Section should remain under the control of the Department of Overseas Trade; some extension of the hours of admission of the public to the London Section, stricter exclusion of the general public during the hours reserved for trade buyers, and an extension of the free passport *visa* granted to foreign buyers attending the Fair to cover at least three months and return visits to Great Britain during that time.

Lattice Distortion and the Hardening of Metals.

IT has hitherto been regarded almost as axiomatic that lattice distortion of a metal will result in hardening. Doubt of the universality of such a hypothesis is now justified, however, as the result of work done by W. L. Fink and K. R. van Horn, which formed the subject of a paper read on Sept. 10 before the Institute of Metals at its annual autumn meeting at Southampton.

The experiments recorded consisted in elastically deforming samples of 70:30 brass and duralumin by bending and, whilst still under stress, in measuring the hardness by the Rockwell apparatus on scale 'E'. X-ray examination was made simultaneously, and the effacement of the $K\alpha$ doublet, the diffuseness or elongation of the reflection images, and the widening of the diffraction rings, proved that lattice distortion had in fact been produced.

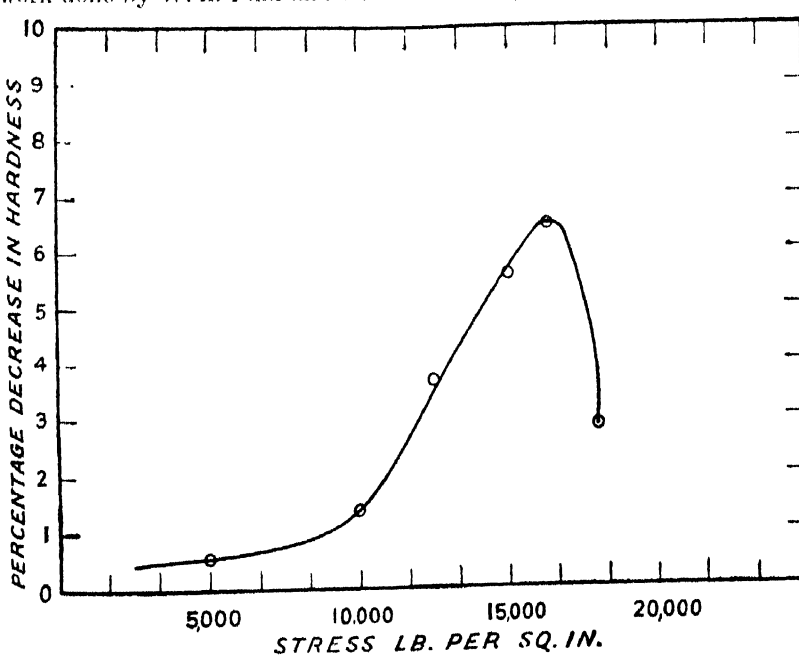


FIG. 1.—Relation between hardness and stress in duralumin. Reproduced by courtesy of the Institute of Metals.

In Fig. 1 the changes in hardness for the duralumin specimen are shown in relation to the stress set up. The material is at first softened and not hardened, the softening increasing with the stress up to the elastic limit. At stresses higher than this, the hardening resulting from the plastic deformation counteracts the softening effect and hardening commences. An exactly similar result was given by the work on the brass, which softened even more than did the aluminium alloy.

It is clear, then, that lattice distortion resulting from elastic deformation can be accompanied by an appreciable decrease in hardness. As the authors point out, however, it is conceivable that where lattice distortion is of a very local character, it may have the opposite effect and harden the material.

In corroboration of the results which have been obtained, the authors cite measurements made by Gayler and Preston on the aluminium alloy with 4·5 per cent of copper and by Chartkoff and Sykes on iron alloyed with 25 per cent of tungsten. In the former case, a specimen quenched from 500° C. and then aged first at room temperature and then for 3 hours at 200° C., which showed maximum lattice distortion, had a Brinell hardness number of 57.

The same specimen after an additional 21 hours at 200° C. had reached a maximum hardness of 78 but with considerably reduced distortion. The iron-tungsten alloy, which had been quenched from 1520° C., had a Rockwell 'C' hardness of 14 and pronounced lattice distortion. This alloy after a subsequent ageing for 40 hours at 800° C. was relatively free from strain but the hardness had risen to 39.

It would appear, then, that lattice distortion resulting from the precipitation of a new phase will, in some cases at least, reach a maximum and then partially disappear before the stage of greatest mechanical hardness has been attained. F. C. T.

University and Educational Intelligence.

THE eighteenth election to Beit Fellowships for Scientific Research, which are of the annual value of £250 and tenable at the Imperial College of Science and Technology, will take place on or about July 14 next. Not more than three fellowships will be awarded. Candidates must be less than twenty-five years of age at the time of election. Applications must be received by April 14. Particulars can be obtained, by letter only, from the Rector, Imperial College, South Kensington, London, S.W.

THE following scholarships will be offered for competition by the Institution of Naval Architects in 1931: *Naval Architecture*—Elgar Scholarship (£130 per ann. for 3 years) and the Vickers-Armstrong Scholarship (£150 per ann. for 3 years). *Marine Engineering*—Parsons Scholarship (£150 per ann. for 3 years) and the Denny Scholarship (£75 per ann. for 4 years). The Denny Scholarship is open to boys less than nineteen years of age who have not yet begun their apprenticeship, and is tenable at the University of Glasgow. The remaining scholarships are open to apprentices between the ages of eighteen and twenty-three, and are tenable at the Royal Naval College, Greenwich; University of Glasgow; Armstrong College; University of Liverpool; and the City and Guilds (Engineering) College. Particulars can be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE Meldola Medal (the gift of the Society of Maccabæans) is awarded annually to the chemist whose published chemical work shows the most promise and is brought to the notice of the administrators during the year ending Dec. 31 prior to the award. The recipient must be a British subject, not more than thirty years of age at the time of the completion of the work. The medal may not be awarded more than once to the same person. In awarding the medal for 1930 the adjudicators will, unless exceptional circumstances arise, give special consideration to work in inorganic or physical chemistry. The next award will be made in January, 1931. The medal is awarded on the advice of the board of examiners of the Institute of Chemistry sitting with representatives of the Society of Maccabæans. Communications should be addressed to the Registrar of the Institute of Chemistry, 30 Russell Square, London, W.C.1.

THE Commonwealth Fund of New York City, supported by gifts from the late Mrs. Stephen V. Harkness, has established for British graduate students a number of fellowships tenable at American universities. The fellowships are normally tenable for two years and are of the annual value of about £600. Thirty fellowships are available to graduates, either men or women, who are unmarried and not more than thirty years of age on Sept. 1; and ten are available to colonial graduates who have studied at a university in the British Isles and to graduates holding an appointment overseas under the British Government, the Government of India, or the Government of a British Dominion, Colony, Protectorate, or Mandated Territory. Candidates are required to produce evidence of proficiency in some recognised branch of university learning, and must also submit a definite scheme of research or study proposed to be carried out during their residence in the university to which they may be assigned. Applications must be forwarded through the authorities of the candidate's college or university and must reach the Secretary to the Committee, Mr. R. H. Simpson, 35 Portman Square, London, W.1, by Feb. 9, 1931, at latest. In 1930 the number of entries for ordinary and Dominion fellowships was 128 (104 men and 24 women); 35 candidates entered for the Service fellowships and three were appointed. Of the 32 fellows appointed, 20 came from the Faculty of Science and 12 belonged to the group of arts subjects.

Historic Natural Events.

Dec. 28, 1879. The Tay Bridge Storm.—On the evening and night of Dec. 28 a deep barometric depression passed along the north-west and north coasts of Scotland, moving north-eastwards. Violent gales from west and south-west were experienced over Scotland, the velocity reaching 88 miles per hour at Glasgow from 7.15 to 7.18 P.M. The storm is memorable for the destruction of the Tay Bridge at Dundee. The central raised portion of the bridge, 1050 yards long, broke away and at 7.30 P.M. a train and 75 persons, not one of whom was saved, plunged into the river. It seems probable that the bridge actually fell while the train was crossing. The wind at the time was blowing from west-south-west, almost directly across the bridge, and a continuous stream of sparks came from the wheels as the train passed across, caused probably by the force with which they were pressed against the lee rails. The bridge had only been opened to traffic on June 1, 1878; its rapid destruction showed that insufficient allowance had been made for the pressure of the wind, and led to a number of detailed studies on this subject.

Dec. 28, 1908. Messina Earthquake. The earthquake was very destructive within an area of less than 200 square miles. It is estimated that 75,000 persons (about half the total population) were killed in Messina, and 25,000 in Reggio and other places in Calabria. Less than ten minutes after the earthquake, both shores of the straits were swept by sea waves, which reached a height of 35 ft. on the Calabrian and 28 ft. on the Sicilian coast. A new series of levels made soon after the earthquake showed that both coasts had subsided, the Calabrian coast by 2[illegible] inches and the other by 28 inches.

Dec. 28-29, 1914. Gale off Dutch Coast.—One of the most violent gales of recent years struck the coast of Holland on the night of Dec. 28-29, 1914, after a very stormy month. On the morning of Dec. 29 the wind velocity at the Hook of Holland reached 94 miles per hour, and great damage was done to shipping. The gale was notable also for its long duration and great extent.

Dec. 30, 1788. Severe Cold in France.—It is recorded in the register of the Canton of La Châtre, Department of l'Indre, that "the frosts have been so severe this year in the month of December that the barometers (*sic*) have fallen two degrees lower than in 1709, especially Dec. 30. The snows covered the ground for more than six weeks."

Societies and Academies.

LONDON.

Linnean Society, Dec. 4.—**J. McLuckie**: On a natural *Grevillea* hybrid. Its hybrid character was first suggested by Fletcher and Musson (Linn. Soc. N.S.W., 1927) on facts of distribution and morphology. A comparative analysis of the hybrid and its putative parents is given. Two distinct types of *G. Gaudichaudii* occur in Nature, and their graphs reveal their differences. It has been synthesised artificially, and hybrid seedlings of the F_1 generation obtained. The experimental work reveals the comparative sterility of all three 'species'. The facts of distribution of *G. Gaudichaudii*, the results of a detailed analysis of its main morphological characters and of synthetic experiments in progress, seem to indicate that it is a natural hybrid between *G. laurifolia* and *G. acanthifolia*.—**B. Storrow**: Some fluctuations in zoological populations during the nineteenth century. The periods of major change are well marked, and the region affected is from the coast of Portugal to Spitsbergen. An amelioration of winter climate was due to a northerly extension of warm water which influenced the Arctic; the changed Labrador Current affected the fishes of the American coast from Newfoundland to Cape Cod. Local and widespread change, 1870–80, coincided with an increased contribution to the North Atlantic from the South Equatorial Current. The axis of the Gulf Stream approached nearer to the American coast, and the southward effect of the Labrador Current decreased. Such a change increases intermediate area of the North Atlantic. Variations in circulation and the incidence of fisheries become possible.

DUBLIN.

Royal Irish Academy, Nov. 10.—**E. J. Conway**: A statistical analysis of the law governing the urea excretion in man. The validity of an equation expressing the excretion of urea in the human subject has been demonstrated by statistical methods. This equation is similar in form to a diffusion equation and in fact only a special case of a general equation expressing either diffusion or secretion. The K of the equation is independent of the variables urine volume, blood concentration, and body weight. The influence of other unknown variables on K manifests itself in a peculiar frequency distribution.

EDINBURGH.

Royal Society, Dec. 1.—**G. Bond**: The stem endodermis in the genus *Piper*. In one group a continuous endodermis is present, in a second the layer present but is in a discontinuous condition, while a third group it is quite absent. This and other examples of variation in closely related types suggests that the stem endodermis can have little importance. The endodermis in *Piper* is also characterised by its persistence in the primary condition, its power of accommodation to the increasing bulk of the vascular cylinder, and by the irregular deposition of Casparian strips. In *Piper*, and possibly elsewhere, the Casperian strip is probably secreted by the endodermal protoplast.—**Alastair Graham**: On the morphology, feeding mechanisms, and digestion of *Ensis siliqua* Schumacher. There may be three or four apertures in the mantle—two posterior siphons and an anterior pedal aperture are of constant occurrence, but there may be a fourth aperture about the middle of the ventral surface. The foot contains six finite series of muscles and in the young animal a well-developed byssus gland of which no trace remains in the adult. The muscles and nervous system (remarkable for the large number of peripheral anastomoses) are described in detail. A comparison of the ciliary mechanisms of *Ensis* with those of other lamellibranchs, for example, *Ostrea*—an animal with widely different habits leads to the conclusion that throughout the class (except the septibranchs) these mechanisms will be found to be very similar. The style contains a strong amylase and also an oxidase; the digestive diverticula contain a protease, a lipase, a diastase, and a glycogenase.—**L. Mirskaia** and **F. A. E. Crew**: On the pregnancy rate in the lactating mouse, and the effect of suckling on the duration of pregnancy. Among primiparæ the pregnancy rate during lactation was found to be 24 per cent, among multiparæ 50 per cent, the difference being possibly a reflection of a difference in degree of somatic maturity. In all the cases of pregnancy during lactation the duration of gestation was prolonged. The figures do not confirm Daniel's law. Prolongation is due to an insufficiency of the hormone(s) responsible for the inception and maintenance of pregnancy.—**B. P. Wiesner**: Further observations on the mechanism of the diphasic sex cycle. Œstrogenic extracts from the anterior lobe and the gonadotropic substance of pregnancy urine interrupt pregnancy in mice in certain concentrations, but do not interfere with its progress in high concentration. The experiments are interpreted as supporting Wiesner and Crew's theory of the existence of two gonadotropic hormones. No gonadotropic hormones were found in placentæ of diphasic animals. The second phase of anterior lobe secretion in the mouse persists at least up to the twelfth day of pregnancy.

CAPE TOWN.

Royal Society of South Africa, Sept. 24. **E. Newbery**: The theory of electrolytic valve action. An insulating anodic film is built up, which is impermeable to the large anions usually present but permeable to hydrogen ions. As the films are very thin and the hydrogen ions very rapid, there is no difficulty in accounting for the observed rapid changes of potential and all the known phenomena of electrolytic valve action.—**B. F. J. Schonland**: Thunderstorms and the penetrating radiation (2). Thunderclouds which seem to have an excess positive charge elevated above a negative charge produce much larger reductions in the intensity of the penetrating radiation than the more usual type. This can be readily interpreted if the primary radiation consists either of positively charged particles or of ultra-gamma quanta, but it does not support the view that the radiation is made up of fast beta rays.—**C. van Riet Lowe**: Giant crescents. The term 'giant crescent' is used to describe an artefact that characterises a hitherto unnoted and unrecorded culture in the Stone Age of South Africa. Since the discovery of an isolated specimen by Stapleton at the Kasouga River mouth more than five years ago, a number of others have been found associated with a well-defined industry that was practised from Mazeppa to Algoa Bay along the south coast and so far inland as the Orange River an area that covers about 20,000 square miles. Technically and typologically the culture represents a transition from the Middle to the Later Stone Age and probably formed an integral part of a blending or contact between palæanthropic and neanthropic folk, the main influence being neanthropic. It shows remarkable affinities with the Late Mousterian and Early Aurignacian industries of Europe.—**A. C. Leeman**: Holism.

CRACOW.

Polish Academy of Science and Letters, July 7.—**St. Ziemecki**: An apparatus for the study of the Raman spectra of organic compounds. The apparatus proposed by Raman has been modified so as to permit the use of so little as 20 c.c. of liquid under examination. The experimental tube is placed in a bath of paraffin oil, which has the effect of reducing the reflections on the walls. The author considers that the study of the Raman spectrum of a substance will probably be regularly employed in organic laboratories.—**L. Marchlewski** and **Mlle. B. Charlampowiczówna**: The absorption of ultra-violet rays by certain organic substances.—**Mlle. A. Kozlowska**: The genetic elements of the steppe flora in Poland.—**L. Ejsmont**: *Astiotrema emydis*, a trematode of *Emys orbicularis*.—**E. Godlewski, jun.**: New researches on the phenomena of agglutination of the spermatozoids by sperm and by substances drawn from the organism of other species.—**S. Skowron** and **Mme. H. Skowron**: The action of tripaflavine on the karyokinetic division of the cell.—**T. Pawlas** and **S. Skowron**: The action of colouring matters derived from acridine on the male sexual cells and their production.—**Mme. Z. Kolodziejska** and **Mlle. W. Halber**: The chemical nature of the cancerous antigen. **Wl. Florkowski**: The lymphatic vessels of the head of the eel (*Anguilla anguilla*).—**A. Dunajewski**: The lymphatic vessels of the body of the eel (*Anguilla anguilla*). **P. Socha**: The development of the blood vessels in the brain of the frog.—**T. Marchlewski** and **Br. Slizynski**: The influence of prolonged selection on the development of a vestigial organ. An account of an attempt to increase the average length of the wings in the winged varieties of *Drosophila ampelophila*. **T. Marchlewski**: The craniology of the domestic dog.—**T. Marchlewski**: Certain factors determining the hereditary transmission of an abundant milk production in cows.—**J. Borowik**: The migration of *Pleuronectes limanda* in the central part of the Baltic.—**J. Borowik**: Marking *Pleuronectes* in the bay of Dantzig.

ROME.

Royal National Academy of the Lincei, May 30.—**U. Cisotti**: Isotropic tensors and hemi-isotropic tensors.—**G. Abetti**: Altitude of the chromosphere in 1929 and the course of the present solar cycle. Observations at Arcetri and Madrid in 1929 show that the total area of the solar protuberances (measured in units of protuberance), which fell by 53 from 1927 to 1928, diminished by 156 from 1928 to 1929. Thus the maximum of the present solar cycle has passed.—**A. Angeli**: Constitution and reactions of isomeric diazohydrates. An answer is given to Hantzsch's objections to the author's results and to the conclusion that stereoisomerism alone explains all differences in behaviour between normal diazohydrates and their isomerides.—**G. Bruni** and **G. Natta**: The crystal structure of thiophen. X-ray investigation of the crystal structure of thiophen by the powder method, with the aid of a special spectrograph adapted for use at low temperatures, shows that the crystal has a tetragonal cell with the axial ratio $a : c = 1 : 1 \cdot 32$. The lattice constants at -170° are: $a = 7 \cdot 225$, $c = 9 \cdot 54 \pm 0 \cdot 01$ A., $v = 498 \times 10^{-24}$ c.c. The unit cell contains four molecules C_4H_4S, and the density is 1·11. Use was made in the measurements of a metallic calcium anti-cathode, application of which is particularly advantageous in the examination of organic substances.—**S. Franchi**: Uniformity in character of the *Helmynthoida labyrinthica* zone from Ubaye to the Alps and to the Ligurian coast, and consequently its great chronological value.—**G. Levi** and **G. C. Dogliotti**: Structure and properties of the striated and reticula[r] fibrils in certain living tissues. The actual existenc[e] of these fibrils is demonstrated in a number of livin[g] organs, namely, the spleen, lymphatic glands, thymu[s] marrow, liver, kidneys. Study of the resistance t[o] tension of the fibrils in the spleen and liver by mean[s] of Péterfi's micro-manipulator shows that the fibril[s] are elastic in the ordinary sense of the term.—**G. Andreoli**: Limits and pseudo-limits of a succession. **Giuseppina della Moglie**: Study and tabulation of a particular function.—**Miron Nicolesco**: Theorems of the mean for functions of two real variables.—**Enrico Volterra**: Determination of the tensions in an elastic medium due to a small displacement of an immersed rigid sphere.—**F. Lamberti**: Investigations on the baricentric, scalar, and vectorial moments of the quantities of motion for a material system. **D. Bonvicini**: Certain fundamental theorems of electrodynamics and of the statics of elastic solids.—**E. Fermi**: Interpretation of the principle of causality in quantistic mechanics. An attempt is made to defin[e] up to what point causality may, according to quantisti[c] mechanics, be spoken of, and in what sense the statement that quantistic mechanics does not lead to a determination of future events, is to be understood. The case discussed is that of a point movable along a straight line, but the considerations advanced may b[e] readily extended to more complicated systems.—**E. Persico**: The relation $E = h\nu$ in wave mechanics. **Washington del Regno**: The laws of emission o[f] nickel. The few results yet published on the radiation of nickel indicate that the total emission of th[e] metal may be expressed by a relation of the Stefan Boltzmann type, $E = KT^n$, but somewhat divergen[t] values have been obtained for n by different investigators. By means of an experimental arrangemen[t] simpler and more certain in the determination of th[e] temperature of the emitting lamina than thos[e] previously used, the value 4·586 is obtained for [n] over the extended temperature interval 360°-60°. **G. Wataghin**: Seizure of electrons by ions. Applicatio[n] of the methods of wave mechanics is capable of furnishing an interpretation of the recent experimenta[l] results of Davis and Barnes on the seizure of electron[s] by α-particles.—**V. Ronchi**: Shadow fringes in th[e] study of very small spherical aberrations. Investigation of simple spherical aberration by means of shado[w] fringes shows that the deformations to which the fringes are subject are appreciable even when th[e] images no longer reveal the presence of spheric[al] aberration.—**G. R. Levi** and **D. Ghiron**: Oxidation [of] chlorites to chlorates by means of permanganate. This oxidation takes place quantitatively in col[d] neutral solution and is rendered more rapid by th[e] presence of salts of calcium, zinc, etc., which neutralis[e] the alkalinity of the process:

$$3ClO_2^- + 2MnO_4^- + 2H_2O \rightarrow 3ClO_3^- + 2MnO_2 + 2OH^-.$$

The course of the reaction is not disturbed by exce[ss] of the permanganate.—**G. Natta** and **A. Nasini**: Structure of inert gases (1). Investigation of xen[on]. At about 100° absolute, the side of the unit cell [of] xenon has the value $a = 6 \cdot 18 \pm 0 \cdot 02$ A., the volum[e] being 236×10^{-24} c.c., and the density, assuming th[at] the cell contains four atoms and taking $1 \cdot 65 \times 10$ gram as the weight of the hydrogen atom, 3·64. Th[is] value for the density corresponds with the expe[ri]mental value for liquid xenon at its boiling poin[t], namely, 3·06. On the assumption of the tangency [of] spherical atoms in the lattice, the apparent radius [of] the xenon atom is 2·18 A.—**A. Ostrogovich** and **Galea**: Investigations on γ-triazines. Syntheses [of] ethyl- and propyl-aminothioltriazines, and new dat[a] on methylaminothioltriazine. The conditions f[or] obtaining the higher homologues of methylaminothi[o]

triazine and aryl and arylalkyl derivatives of aminothioltriazine are given. The ethyl compound melts at 257°-258° and the propyl compound at 262°-263°. —**A. Desio**: The presence of the fossiliferous Silurian in the island of Coo (Ægean Sea).—**Romolo de Fazi**: Action of ultra-violet rays on the germination of barley for malting. The effects of the action of ultra-violet rays on germinating barley include acceleration of the germinating process, prevention of mould growth, and increase in the vitamin content. This treatment is found to be applicable, with beneficial results, to the manufacture of malt under industrial conditions.—**C. Guareschi**: First experimental results on the development of the otocysts of urodele amphibia. By means of a new experimental procedure, it is shown for the first time that the otocysts of urodele amphibia form a mosaic system.

SYDNEY.

Linnean Society of New South Wales, Sept. 24. **J. R. Malloch**: Notes on Australian Diptera (26). The group treated in previous papers in this series as subfamily Ochthiphilinæ is now regarded as of family rank. Keys are given to the genera.—**A. M. Lea**: Descriptions of new species of Australian Coleoptera (21). Eleven new species of Scarabæidæ and thirteen new species and five new genera of Curculionidæ, mostly from Australia, and three species from Fiji and two from Papua closely allied to Australian forms, are also described.—**J. Calvert**: An abnormal *Xanthium* burr. A burr in which two male florets occupy portion of the burr, whilst just alongside, a loculus contained what looked like an unopened floret. This made up one half of the burr, the other half consisting of the normal one-seeded loculus.—**W. W. Froggatt**: Notes on gall-making coccids, with descriptions of new species (2). Five species of *Apiomorpha* are described as new. In some cases the specific names of the Eucalypts on which the galls develop, which were previously unknown, are recorded. **C. Deane**: Trichopterygidæ of Australia and Tasmania: descriptions of new genera and species. Hitherto only six species of Trichopterygidæ had been described from Australia. The present paper adds eleven new species, classed in eight genera, six of which are new, most of them being very distinct. One new genus is blind, there being no eyes or eye sockets, nor any suggestion of a place for the eyes. *Rodwayia* is also blind, but differs in most other ways.

Official Publications Received.

BRITISH.

Livingstone College. Annual Report and Statement of Accounts for the Year 1929-30. Pp. 24. (London: Leyton, E.10.)

Transactions of the Optical Society. Vol. 31, 1929-30, No. 4. Pp. 169-240+vi. (London.) 10s.

Medical Research Council. Special Report Series No. 150: Medical Uses of Radium; Summary of Reports from Research Centres for 1929. Pp. 32. (London: H.M. Stationery Office.) 9*d.* net.

Colony and Protectorate of Kenya. Forest Department Annual Report 1929. Pp. 28. (Nairobi: Government Printer.) 1s.

Mysore Geological Department. Records, Vol. 27, 1928. Pp. iii+34. 2 rupees. Records, Vol. 28, 1929. Pp. iii+39. 2 rupees. (Bangalore: Government Press.)

Journal of the Chemical Society. November. Pp. iv+2401-2582+x. (London.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 3, Session 1929-30. Pp. xvii-xxiv+187-255. (Edinburgh.) 7*s.* 6*d.*

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, November. Pp. 741-837+xlii. (London.)

Ministry of Health. Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122D/T.) Pp. 21. (London: Ministry of Health.)

British Industries Fair. Report of the Committee appointed by the Board of Trade, under the Chairmanship of Viscount Chelmsford, to examine the present Situation as regards the British Industries Fair and to consider what Means can be adopted to increase still further its Utility to British Trade. (Cmd. 3726.) Pp. 30. (London: H.M. Stationery Office.) 6*d.* net.

Year Book of the Royal Society of Tropical Medicine and Hygiene, Session 1930-31. Pp. 41+xcviii. (London.) 5*s.* net.

London School of Hygiene and Tropical Medicine. Report on the Work of the School for the Year ended July 31st, 1930. Pp. 34. (London.)

Ministry of Health. Treatment of Tuberculosis: Analysis of Work done during the Year 1929 under the Schemes of Local Authorities for the Treatment of Tuberculosis, as shown in the Returns furnished in accordance with Memorandum 37/T. (Memo 131c/T.) Pp. 9. (London: Ministry of Health.)

International Federation of University Women. Bulletin No. 12: Report of the Fifteenth Council Meeting, Prague, July 1930. Pp. 111. (London.)

Proceedings of the Liverpool Geological Society. Session the Seventy-first, 1929-1930. Edited by C. B. Travis. Part 3, Vol. 15. Pp. xv+179-266. (Liverpool.) 5*s.*

Souvenir, Cinchona Tercentenary Celebration and Exhibition at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1. Pp. 115. (London: The Wellcome Foundation, Ltd.)

Borough of Buxton. Museum Guide. Pp. 20. (Buxton.) 6*d.*

Proceedings of the Royal Society. Series A, Vol. 130, No. A812, December 2. Pp. 238. (London: Harrison and Sons, Ltd.) 12*s.*

FOREIGN.

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Annee 2, No. 11, Novembre. Pp. 653-698. (Prague: Regia Societas Scientiarum Bohemica.)

U.S. Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 115: Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1930. Pp. ii+53. 10 cents. Research Paper No. 223: Apparatus for the Determination aboard Ship of the Salinity of Sea Water by the Electrical Conductivity Method. By Frank Wenner, Edward H. Smith, Floyd M. Soule. Pp. 711-732. 10 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 77, Art. 13: Some peculiar Spiral Fossil Forms from California and Mexico. By Wendell C. Mansfield. (No. 2836.) Pp. 3+2 plates. Vol. 77, Art. 14: New Forms of Sphecoid Wasps of the Genus *Didineis* Wesmael. By J. R. Malloch and S. A. Rohwer. (No. 2837.) Pp. 7. Vol. 77, Art. 51: Birds collected in Inner Mongolia, Kansu and Chihli by the National Geographic Society's Central China Expedition under the direction of F. R. Wulsin. By J. H. Riley. (No. 2838.) Pp. 39. Vol. 78, Art. 3: A new Species of Trematode Worm of the Genus *Ornithobilharzia* from a Canadian Goose. By Rudolf Wetzel. (No. 2846.) Pp. 4+1 plate. Vol. 78, Art. 8: Fossil Decapod Crustaceans from Mexico. By Mary J. Rathbun. (No. 2851.) Pp. 10+6 plates. Vol. 78, Art. 11: Restudy of some Burgess Shale Fossils. By George Evelyn Hutchinson. (No. 2854.) Pp. 24+1 plate. Vol. 78, Art. 12: Notes on the Types of American Two-winged Flies of the Genus *Sarcophaga* and a few related Forms described by the Early Authors. By J. M. Aldrich. (No. 2855.) Pp. 39+3 plates. Vol. 78, Art. 13: Exploration of Ruins in the White Mountain Apache Indian Reservation, Arizona. By Walter Hough. (No. 2856.) Pp. 21+10 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 12: The Five Monacan Towns in Virginia, 1607. By David I. Bushnell, Jr. (Publication 3070.) Pp. 38+14 plates. (Washington, D.C.: Smithsonian Institution.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 8: Yokuts-Mono Chiefs and Shamans. By A. H. Gayton. Pp. 361-420. 80 cents. Vol. 29, No. 1: Archaeology of the Dalles-Deschutes Region. By W. Duncan Strong, W. Egbert Schenck and Julian H. Steward. Pp. vii+154+28 plates. 2 dollars. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

University of Illinois: Engineering Experiment Station. Bulletin No. 211: The Torsional Effect of Transverse Bending Loads on Channel Beams. By Prof. Fred B. Seely, Prof. William J. Putnam, William L. Schwalbe. Pp. 66. 35 cents. Bulletin No. 212: Stresses due to the Pressure of one Elastic Solid upon Another, with Special Reference to Railroad Rails. A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in cooperation with the Utilities Research Commission. By Prof. Howard R. Thomas and Victor A. Hoersch. Pp. 56. 30 cents. (Urbana, Ill.)

Sveriges Geologiska Undersökning. Ser. Ca, No. 22: Gällivare malmfält geologisk beskrivning. Av Per Geijer. With a Summary: Geology of the Gällivare Iron Ore Field. Pp. 115+4 tavlor. 10 kr. Ser. Ca, No. 23: Långbans malmtrakt geologisk beskrivning. Av Nils H. Magnusson. Summary: The Iron and Manganese Ores of the Långban District. Pp. 111+5 tavlor. 8 kr. (Stockholm.)

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse Nr. 11: Ekspedisjonen til Østgrønland med *Veslekari* sommeren 1929. Av Anders K. Orvin. Pp. 85-146. Skrifter om Svalbard og Ishavet. Nr. 31: Verbreitung und Ausbildung des Mesozoikums in Spitzbergen, nebst einer Revision der Stratigraphie des Jura und der Unterkreide in Nowaja Semlja und einem Entwurf der mesozoischen Entwicklungsgeschichte des Barentsseeschelfes. Von Hans Frebold. Pp. 126+33 Tafeln. 17.00 kr. Nr. 32: Über Epidemien von unspezifischen Katarrhen der Luftwege auf Svalbard. Av Otto Abs. Pp. 27. 2.00 kr. Nr. 33: Ctenaspis, a new Genus of Cyathaspidian Fishes; a Preliminary Report. By Johan Kiær. Pp. 7. 1.00 kr. Nr. 34: Die Gattung Cerastium in der Flora von Spitzbergen. Von A. Tolmatchew. Pp. 8+1 Tafel. 1.00 kr. (Oslo: Jacob Dybwad.)

CATALOGUES, ETC.

Thermometric Lag. Pp. 16. (London: Negretti and Zambra.)

Pituitary (Posterior Lobe) Extract B.D.H. Pp. 4. 'Caprokol' Brand of Hexylresorcinal in Olive Oil. Pp. 4. (London: The British Drug Houses, Ltd.)

A Collection of Modern Books in all Classes of Literature. (No. 441.) Pp. 32. (London: Bernard Quaritch, Ltd.)

Bibliographie des Livres français sur l'Industrie et la Technologie publiée par les Maisons J.-B. Baillière et fils, Armand Colin, Ch. Béranger, Delagrave, Desforges-Girardot et Cie, Gaston Doin et Cie, Dunod, Gauthier-Villars et Cie, Leon Eyrolles, Edgar Malfère, Masson et Cie, Albin Michel, Société d'Éditions Géographiques Maritimes et Coloniales, l'Usine, 1919–1930. Pp. lxiv+234. (Paris: J.-B. Baillière et fils.)

Modern X-Ray Engineering: a Supplement to the General Catalogue. Pp. 80. (London: X-Rays, Ltd.)

Calendar for 1931. (London: British Museum (Natural History).)

Calendar for 1931. (Liverpool: The Liverpool Electric Cable Co., Ltd.)

Illustrated Books, 15th Century to Present Day. (Catalogue 533.) Pp. 72. (London: Francis Edwards, Ltd.)

Nickel Cast Iron: its Development and Present Position in Engineering Practice. (Nickel B7.) Pp. 28. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

TUESDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (1): Some Properties of Electrified Bodies (Juvenile Lectures).

WEDNESDAY, DECEMBER 31.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College, Victoria Embankment), at 5.

THURSDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (2): The Spark as a Current of Electricity (Juvenile Lectures).

FRIDAY, JANUARY 2.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—S. J. Davies: An Experimental Investigation into Induction Conditions, Distribution, and Turbulence in Petrol-Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7.—E. Fawssett and G. E. Moore: Apparatus and Methods for Accurate Maintenance of Large A.C. Energy Meters.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group Informal Meeting), at 7.—Discussion on Portfolio Prints.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Benton: Weighing Machinery.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. F. Smithson: The Triassic Sandstones of Yorkshire and Durham.—E. St. John Burton: Periodic Changes in Position of the Run, near Mudeford, Christchurch, Hants.

SATURDAY, JANUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (3): Air as a Conductor of Electricity (Juvenile Lectures).

CONFERENCES.

DECEMBER 31 TO JANUARY

GE

Wednesday, Dec. 31 (at Imperial Institute), at 5.30.—Suez Canal Film to be shown by Sir J. T. Davies.

Thursday, Jan. 1 (at London School of Economics).

At 11.30 A.M.—School Journeys Exhibition and Discussion.

At 2.—B. B. Dickinson: Presidential Address.

At 3.45.—Exhibition of Maps showing Agricultural Distributions in Scotland, prepared by H. J. Wood.

At 5.30.—A Regional Study of the Chod Villages of S.W. Bohemia—a Field Study by a Leplay House Group, with an Exhibit of Original Maps and Files of this and other Regions.

Friday, Jan. 2 (at London School of Economics).

At 10 A.M.—Major R. W. G. Hingston: In the Tree-Roof of the Guiana Forest (Lecture).

At 11.30 A.M.—Miss R. M. Fleming: Regions of Russia (Lecture).

At 2.30.—Meeting for Teachers in Secondary Schools for Discussion on a paper by B. C. Wallis on School Geography from the Point of View of an Examiner.

Meeting for Teachers in Primary Schools:—Geography and the Extension of the School Age. Discussion to be opened by E. J. Orford.

Saturday, Jan. 3 (at London School of Economics).

At 10.15 A.M.—Dr. P. W. Bryan: The Distribution of Houses in England and Wales as a Population Index (Lecture).

DECEMBER 31 TO JANUARY 7.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Wednesday, Dec. 31, at 3.—Sir Richard Gregory: The Worth of Science (Presidential Address).

FROEBEL SOCIETY AND JUNIOR SCHOOLS ASSOCIATION.

At 5.30.—J. Howard Whitehouse: Ideals and Methods in Education (Presidential Address).

BRITISH PSYCHOLOGICAL SOCIETY (EDUCATION SECTION).

At 5.30.—Prof. T. H. Pear: Learning how to Study (Lecture).

NEW EDUCATION FELLOWSHIP.

Thursday, Jan. 1, at 5.—Discussion on The Efficiency of the First School Examinations and their Relation to Matriculation.

SCHOOL NATURE STUDY UNION.

At 3.—Sir J. Arthur Thomson: The Beauty and Wonder of the World (Lecture).

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY.

At 5.—Mrs. Susan Isaacs, Miss S. M. Wortman, O. H. Latter, and Capt. C. W. Hume: Discussion on Humane Education in Schools.

DALTON ASSOCIATION.

Friday, Jan. 2, at 11.—G. W. Spriggs: Individual Work in Mathematics (Lecture).

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION.

At 2.—Dr. A. G. Maitland-Jones and others: Discussion on Hours of Sleep and the School Child in Day and Public Schools.

CHILD-STUDY SOCIETY.

At 5.30.—Prof. J. E. Marcault: What is Religious in the Child (Lecture).

MODERN LANGUAGE ASSOCIATION.

Monday, Jan. 5, at 11 A.M.—Prof. E. W. Scripture and Prof. P. Menzerath: Discussion on Experimental Phonetics.

NATIONAL COLLEGE OF TEACHERS OF THE DEAF.

At 11 A.M.—Dr. J. Drever: The Educational Handicap of the Deaf from a Psychologist's Point of View (Lecture).

JOINT CONFERENCE.

At 5.—J. Fairgrieve, Lt.-Gen. Sir William Furse, Miss B. Hosgood, C. B. Thurston: The Teaching of Geography. Chairman: Sir Richard Gregory.

CENTRAL COUNCIL FOR SCHOOL BROADCASTING.

Tuesday, Jan. 6, at 11 A.M.—Prof. Winifred Cullis and others: The Teaching of Biology by Wireless (Lecture-Demonstration).

BRITISH SOCIAL HYGIENE COUNCIL.

At 5.—Dr. H. Crichton Miller: Marriage, Freedom, and Education (Lecture).

MATHEMATICAL ASSOCIATION (at London Day Training College).

Monday, Jan. 5, at 3.30.—Sir Arthur S. Eddington: The End of the World (from the standpoint of Mathematical Physics) (Presidential Address).

At 5.—Prof. A. R. Forsyth: Dimensions in Geometry.

Tuesday, Jan. 6, at 10 A.M.—A. Robson and others: Discussion on The Report on the Teaching of Mechanics in Schools.

At 11.30 A.M.—W. Hope Jones, Dr. F. J. W. Whipple, P. M. Marples and others: Discussion on Gambling.

At 2.30.—Prof. J. E. A. Steggall: Faith and Reason in beginning the Calculus and Elsewhere.

At 3.45.—Prof. E. H. Neville: Limits in Geometry.

JANUARY 6 TO 9.

SCIENCE MASTERS' ASSOCIATION (at University, Birmingham).

Tuesday, Jan. 6, at 8.30 P.M.—Sir Charles Grant Robertson: Presidential Address.

Wednesday, Jan. 7, at 10.15 A.M.—J. Young: The Lunar Landscape (Lecture).

At 11.30 A.M.—Prof. W. N. Haworth: An Insight into Complex Molecular Structures (Lecture).

At 6.—Prof. Nash: The Work of the Physicist and Chemist in the Petroleum Industry (Lecture).

At 8.15.—The Lord Bishop of Birmingham: A Finite Universe (Lecture).

Thursday, Jan. 8, 10 to 11.15 A.M.—F. Fairbrother and others: Discussion on General Science.

At 12.—Prof. K. N. Moss: Scholarships offered in Coal Mining and Metal Mining.

6 to 7.15.—Prof. F. W. Burstall: The Science Education of the Boy up to Eighteen Years of Age (Lecture).

At 8.30.—Meeting of S.M.A. with Representatives of the Commission on Educational and Cultural Films.

Friday, Jan. 9, at 10 A.M.—Prof. H. Munro Fox: Zoological Experiments for School Work.

EXHIBITION.

JANUARY 6 TO 8.

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION OF ELECTRICAL, OPTICAL AND OTHER PHYSICAL APPARATUS (at Imperial College of Science and Technology), at 3 to 6, and 7 to 10.

Wednesday, Jan. 7, at 8 P.M.—E. Lancaster-Jones: Searching Minerals with Scientific Instruments (Lecture).

Thursday, Jan. 8, at 8 P.M.—Sir Gilbert Walker: Physics of Sport (Lecture).

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" Office.

Mathematics: Mechanics: Physics

Batten, T. C., and Brown, M. W. A School Algebra. Cr. 8vo. Part 1. Pp. x+198. (London: John Murray, 1930.) 3*s*.; with Answers, 3*s*. 6*d*.

Bieberbach, Ludwig. Theorie der Differentialgleichungen. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 6.) Dritte neubearbeitete Auflage. Roy. 8vo. Pp. xii+399. (Berlin: Julius Springer, 1930.) 21 gold marks.

Brillouin, Léon. La théorie des quanta. Deuxième édition. Les statistiques quantiques et leurs applications. (Recueil des Conférences-Rapports de documentation sur la Physique, Vol. 18.) Roy. 8vo. Vol. 1. Pp. 192. Vol. 2. Pp. 193-404. (Paris: Les Presses universitaires de France, 1930.) 125 francs.*

Broglie, Louis de. An Introduction to the Study of Wave Mechanics. Translated from the French by H. T. Flint. Demy 8vo. Pp. xi+249. (London: Methuen and Co., Ltd., 1930.) 12*s*. 6*d*. net.*

Broglie, Maurice de, und Broglie, Louis de. Einführung in die Physik der Röntgen- und Gamma-Strahlen. Übersetzt von L. von Seuffert. Roy. 8vo. Pp. viii+208+11 Tafeln. (Leipzig: Johann Ambrosius Barth, 1930.) 21 gold marks.

Brünold, Charles. L'Entropie: son rôle dans le développement historique de la thermodynamique. Roy. 8vo. Pp. v+221. (Paris: Masson et Cie, 1930.) 30 francs.*

David, Pierre. L'Électro-acoustique: rapports de l'acoustique moderne et de l'électricité. Conférence faite au Conservatoire National des Arts et Métiers le 9 mai 1930. (Conférences d'actualités scientifiques et industrielles, 11.) Roy. 8vo. Pp. 39. (Paris: Hermann et Cie, 1930.) 5 francs.*

Deans, W. M. Examples in Elementary Algebra. Gl. 8vo. Pp. 47. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s*.

Dedekind, Richard. Gesammelte mathematische Werke. Herausgegeben von Robert Fricke, Emmy Noether und Öystein Ore. Band 1. Roy. 8vo. Pp. iii+397. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 30 gold marks.

Deltheil, R. Erreurs et moindres carrés. (Traité du calcul des probabilités et de ses applications, par Émile Borel. Tome 1: Les principes de la théorie des probabilités, Fascicule 2.) Roy. 8vo. Pp. vi+161. (Paris: Gauthier-Villars et Cie, 1930.) 30 francs.*

Department of Scientific and Industrial Research: Illumination Research. Technical Paper No. 9: Reflection from Road Surfaces. By A. K. Taylor. Roy. 8vo. Pp. v+19. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Dobson, Charles G. The Arithmetic of Building. (Lockwood's Manuals.) Second edition, revised. Cr. 8vo. Pp. vii+84. (London: Crosby Lockwood and Son, 1930.) 2*s*. 6*d*. net.

Dougall, John, Arranged by. Test Papers in Algebra and Geometry. Gl. 8vo. Pp. 40. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s*.

Dresden, Arnold. Solid Analytical Geometry and Determinants. 8vo. Pp. 310. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

Gosselin, Albert, et Gosselin, Marcel. Constitution et thermochimie des molécules: les constituants moléculaires, les liaisons intramoléculaires, la valeur énergétique des liaisons. Sup. Roy. 8vo. Pp. vii+231. (Paris: Les Presses universitaires de France, 1930.)*

Guiller, George L. Kinematics of Machines. Second edition. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

Hadamard, J. Cours d'analyse professé à l'École polytechnique. Tome 2: Potentiel, calcul des variations, fonctions analytiques, équations différentielles et aux dérivées partielles, calcul des probabilités. Roy. 8vo. Pp. vi+721. (Paris: Hermann et Cie, 1930.) 140 francs.*

Heisenberg, W. Die physikalischen Prinzipien der Quantentheorie. Med. 8vo. Pp. viii+117+2 Tafeln. (Leipzig: S. Hirzel, 1930.) 7 gold marks.*

Hilbert, D. Grundlagen der Geometrie. (Wissenschaft und Hypothese, Band 7.) Siebente umgearbeitete und vermehrte Auflage. 8vo. Pp. vii+326. (Berlin und Leipzig: B. G. Teubner, 1930.) 18 gold marks.

Holmyard, E. J. Physics for Beginners. (Dent's Modern Science Series.) Gl. 8vo. Pp. viii+160+8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s*. 6*d*.*

Humphrey, D. Intermediate Mechanics: Dynamics. (Longmans' Modern Mathematical Series.) Demy 8vo. Pp. x+382. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s*. 6*d*.*

James, R. W. X-ray Crystallography. (Methuen's Monographs on Physical Subjects.) Fcap. 8vo. Pp. vii+88. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.*

Julia, Gaston. Principes géométriques d'analyse. Première partie: Leçons faites à la Sorbonne. Re... et rédigées par Marcel Brelot. (Cahiers scientifiques, Fascicule 6.) Roy. 8vo. Pp. vi+116. (Paris: Gauthier-Villars et Cie, 1930.) 25 francs.*

Kirchner, Fritz. Experimental Physik der Röntgenstrahlen. Roy. 8vo. Pp. 584. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 55 gold marks.

Knowlton, A. A., and O'Day, Marcus. Laboratory Manual in Physics. Med. 8vo. Pp. xi+127. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 8*s*. 9*d*. net.*

Lewis, C. N. School Certificate Heat. (Pitman's School Certificate Series.) Cr. 8vo. Pp. vii+270. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 4*s*. 6*d*.

Mackenzie, A. H., and Forster, A. Theoretical and Practical Mechanics and Physics, with a Chapter on Chemistry: a Preliminary Science Course. Cr. 8vo. Pp. xviii+288. (London: Macmillan and Co., Ltd., 1930.) 3*s*.*

Mahler, Gottfried. Physikalische Aufgabensammlung. (Sammlung Göschen, Band 243.) Neu bearbeitet von Karl Mahler. Vierte verbesserte Auflage. Pott 8vo. Pp. 136. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Miles, Egbert J., and Mikesh, James S. Calculus. Med. 8vo. Pp. xiii+638. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 18*s*. 9*d*. net.*

Paget, Sir Richard. Babel: or the Past, Present and Future of Human Speech. (To-day and To-morrow Series.) Pott 8vo. Pp. 93. (London: Kegan Paul and Co., Ltd., 1930.) 2*s*. 6*d*. net.*

Painlevé, Paul, Professées par. Leçons sur la résistance des fluides non visqueux. Rédigées par A. Metral et R. Mazet. (Chaire de mécanique des fluides et applications.) Première partie. Rédigée par A. Metral. Roy. 8vo. Pp. viii+183. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.*

Painlevé, Paul, et Platrier, Charles. Cours de mécanique: mécanique des solides indéformables, mécanique des milieux continus déformables, théorie sommaire des machines et de l'aviation, les mécaniques de Newton et d'Einstein. (Cours de l'École polytechnique.) Demy 4to. Pp. viii+644. (Paris: Gauthier-Villars et Cie, 1929.) 150 francs.*

Palmer, C. I. Practical Mathematics. Part 1: Arithmetic, with Applications. Third edition. Cr. 8vo. Pp. 164. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 6*s*. 3*d*. net.

Pigrome, E. R. Exercises in Arithmetic. Gl. 8vo. Part 4. Pp. 126. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 1*s*. 6*d*.

Plant, L. C. Agricultural Mathematics. Demy 8vo. Pp. 199. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12*s*. 6*d*. net.

Pohl, R. W. Einführung in die Mechanik und Akustik. (Einführung in die Physik, Band 1.) Sup. Roy. 8vo. Pp. viii+250. (Berlin: Julius Springer, 1930.) 15.80 gold marks.*

Poorman, Alred P. Applied Mechanics. Third edition. Med. 8vo. Pp. 306. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.

Pratt, A. S. Junior Test Examinations in Mathematics. (Test Examinations Series.) Fcap. 8vo. Pp. vii + 40. (London: Methuen and Co., Ltd., 1930.) 1*s*.

Routh, Edward John. The Advanced Part of a Treatise on the Dynamics of a System of Rigid Bodies. Being Part 2 of a Treatise on the whole Subject. Sixth edition, revised and enlarged. Demy 8vo. Pp. xiv + 484. (London: Macmillan and Co., Ltd., 1930.) 17*s*. net.

Saurin, C. W. The Wide Outlook Arithmetics. Ex. Cr. 8vo. Book 1. Pp. 64. (London, Glasgow and Bombay: Blackie and Son., Ltd., 1930.) 9*d*.

Shearcroft, W. F. F. Elementary Heat. Cr. 8vo. Pp. 224. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 3*s*. 6*d*.*

Shearcroft, W. F. F., and **Larrett, Denham.** Arithmetic for Schools. Cr. 8vo. Part 2. Pp. v + 113. 2*s*.; with Answers, 2*s*. 6*d*. Part 3. Pp. vi + 105. 2*s*.; with Answers. 2*s*. 6*d*. (London: Sir Isaac Pitman and Sons, Ltd., 1930.)

Sommerfeld, Arnold. Wave-Mechanics. Translated from the German edition by Henry L. Brose. Supplementary volume to "Atomic Structure and Spectral Lines." Demy 8vo. Pp. xii + 301. (London: Methuen and Co., Ltd., 1930.) 21*s*. net.*

Titchmarsh, E. C. The Zeta-Function of Riemann. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 26.) Demy 8vo. Pp. vi + 104. (Cambridge: At the University Press, 1930.) 6*s*. 6*d*. net.*

Tweedy, A. E. Senior Geometry. Cr. 8vo. Part 1. Pp. ix + 236. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s*. 9*d*.

Waldram, Percy J. The Principles of Structural Mechanics: without the use of Higher Mathematics. Second edition, revised and enlarged. Demy 8vo. Pp. 120. (London: B. T. Batsford, Ltd., 1930.) 12*s*. 6*d*. net.

Watson, Hubert. Practical Commercial Arithmetic. Demy 8vo. Pp. xiv + 272. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6*s*. net.

Wiarda, Gg. Integralgleichungen unter besonderer Berücksichtigung der Anwendungen. (Sammlung math.-phys. Lehrbucher, Band 25.) 8vo. Pp. iv + 183. (Berlin und Leipzig: B. G. Teubner, 1930.) 9.60 gold marks.

Wood, A. B. A Textbook of Sound: being an Account of the Physics of Vibrations, with special reference to recent Theoretical and Technical Developments. Demy 8vo. Pp. xiv + 519. (London: G. Bell and Sons, Ltd., 1930.) 25*s*. net.*

Engineering

Chapman, F. T. A Study of the Induction Motor. Roy. 8vo. Pp. xvi + 289. (London: Chapman and Hall, Ltd., 1930.) 21*s*. net.*

Cross, Harold H. U. Electric Testing Simplified: a Practical Manual and Bench Companion. (Lockwood's Manuals.) Cr. 8vo. Pp. xv + 191. (London: Crosby Lockwood and Son, 1930.) 5*s*. net.*

Fleming, Robins. Wind Stresses in Buildings. Roy. 8vo. Pp. 193. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s*. 6*d*. net.

Gruhn, Konrad. Anfangsgründe der Wechselstromtechnik. 8vo. Pp. vi + 82. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 5.80 gold marks.

Gutton, C. Les ondes électriques de très courtes longueurs et leurs applications: Conférence faite au Conservatoire National des Arts et Métiers le 6 mai 1930. (Conférences d'actualités scientifiques et industrielles, 13.) Roy. 8vo. Pp. 20. (Paris: Hermann et Cie, 1930.) 4 francs.*

Hague, B. Alternating Current Bridge Methods: for the Measurement of Inductance, Capacitance and Effective Resistance at Low and Telephonic Frequencies; a Theoretical and Practical Handbook for the Use of Advanced Students. (The Specialists' Series.) Second edition, revised and enlarged. Demy 8vo. Pp. xvi + 391. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15*s*. net.*

Hanton, Thomas G. Metalliferous Mine Surveying. Demy 8vo. Pp. xii + 234. (London: Crosby Lockwood and Son, 1930.) 15*s*. net.*

Judge, Arthur W. Engineering Materials. Vol. 3: Theory and Testing of Materials. Demy 8vo. Pp. 498. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 21*s*. net.

Lagron, Louis. L'appareillage électrique: le petit appareillage, le gros appareillage basse tension, l'appareillage haute tension, tableaux de distribution, postes de transformations ruraux; théorie, construction, applications. (Nouvelle Encyclopédie Électro-mécanique, No. 3.) Gl. 8vo. Pp. 587. (Paris: Albert Blanchard, 1930.) 36 francs.*

Langman, H. R. The Magneto Manual: a Practical and General Reference Work for Automobile Engineers, Aeronautical Engineers, Mechanics, Apprentices, Chauffeurs, Car-owners, etc. (Lockwood's Manuals.) Second edition enlarged. Cr. 8vo. Pp. xii + 246. (London: Crosby Lockwood and Son, 1930.) 7*s*. 6*d*. net.*

Maycock, W. Perren. Electric Wiring, Fittings, Switches and Lamps. Revised by P. Kemp. Sixth edition, second impression. Cr. 8vo. Pp. 638. (London: Sir Isaac Pitman and Sons, Ltd, 1930.) 10*s*. 6*d*. net.

Marryat, H., Edited by. Electrical Wiring and Contracting. Cr. 8vo. Vol. 6: Electric Lifts, Lamps and Illumination, House and Office Telephones. Pp. vi + 213. Vol. 7: Radio Installation Work, Industrial Installation Work, Theatre and Cinema Installation Work. Pp. viii + 326. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6*s*. net each.

Mines Department: Safety in Mines Research Board. Paper No. 60: Flame-proof Electrical Apparatus for Use in Coal Mines. Summarising Report by I. C. F. Statham and R. V. Wheeler. Roy. 8vo. Pp. 62. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Morris, Ray. Railroad Administration. Second edition, revised and largely rewritten, by William E. Hooper. Demy 8vo. Pp. xiv + 215. (New York and London: D. Appleton and Co., 1930.) 15*s*. net.

Moyer, J. A., and **Wostrel, J. F.** Industrial Electricity and Wiring. Roy. 8vo. Pp. ix + 469. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.

Mull, W., und **Reiher, H.** Der Warmeschutz von Luftschichten: seine experimentelle Bestimmung und graphische Berechnung. (Beihefte zum Gesundheits-Ingenieur, Reihe 1, Heft 28.) Fcap. folio. Pp. 26. (Munchen und Berlin: R. Oldenbourg, 1930.) 5 gold marks.*

Musil, Ludwig. Die Wirtschaftlichkeit der Energiespeicherung fur Elektrizitätswerke. Roy. 8vo. Pp. x + 142. (Berlin: Julius Springer, 1930.) 18 gold marks.

Norris, Earle B., and **Therkelsen, Eric.** Heat Power. Med. 8vo. Pp. 376. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 17*s*. 6*d*. net.

Petrol Engine, The: a Descriptive Handbook on the Principles and Construction of all types of Petrol Engines as used for Cars, Commercial Vehicles, Motor-cycles, Motor-boats, Aeroplanes, Electric Lighting and Portable Power Sets. Third edition, entirely revised. Cr. 8vo. Pp. 257. (London: The Temple Press, Ltd., 1930.) 3*s*. 6*d*. net.

Phillips, S. T., and **Tutt, G. T.** Modern Gasfitting in Theory and Practice. Vol. 1. Demy 8vo. Pp. xx + 394. (London: Ernest Benn, Ltd., 1930.) 15*s*. net.

Pilcher, R. Stuart. Road Transport Operation — Passenger. (Pitman's Transport Library.) Demy 8vo. Pp. 210. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 10*s*. 6*d*. net.

Pirani, M. Herausgegeben von. Elektrothermie: die elektrische Erzeugung und technische Verwendung hoher Temperaturen. 8vo. Pp. viii + 293. (Berlin: Julius Springer, 1930.) 36 gold marks.

Potter, Audrey A., and **Calderwood, James P.** Elements of Steam and Gas Power Engineering. Third edition. Demy 8vo. Pp. 363. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.

Schoof, Friedrich. Die Technik der elektrischen Installation. (Sammlung Goschen, Band 1023.) Pott 8vo. Pp. 114 + 25 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Seelye, Howard P. Electrical Distribution Engineering. Roy. 8vo. Pp. viii + 710. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 30s. net.

Sexton, F. Peake. Definitions and Formulæ for Students (Electrical Installation Work.) Demy 16mo. Pp. iv + 26. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6*d*. net.*

Southwell, R. V. The Place of Engineering Science in University Studies: an Inaugural Lecture delivered before the University of Oxford on June 7, 1930. Med. 8vo. Pp. 24. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 2*s*. net.

Taylor, F. Johnstone. Modern Bridge Construction: a Treatise setting forth the Elements of Bridge Design and illustrating Modern Methods of Construction. Demy 8vo. Pp. xii + 235. (London: Crosby Lockwood and Son, 1930.) 15*s*. net.*

Teago, F. J. The Commutator Motor. (Methuen's Monographs on Physical Subjects.) Fcp. 8vo. Pp. vii + 80. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.*

Vinal, George Wood. Storage Batteries. Second edition. Roy. 8vo. Pp. 427. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 25*s*. net.

Williams, C. C. Design of Masonry Structures and Foundations. Second edition. Med. 8vo. Pp. 603. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 25*s*. net.

Woolrich, W. R. Handbook of Refrigerating Engineering. Cr. 8vo. Pp. 332. (London: The Library Press, Ltd., 1930.) 20*s*. net.

Zeleny, Anthony. Elements of Electricity. Demy 8vo. Pp. 438. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 15*s*. net.

Chemistry: Chemical Industry

Alexander, Jerome. Colloid Chemistry: Principles and Applications. (Industrial Chemical Monographs.) Third edition. Roy. 8vo. Pp. 270. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

Biltz, Wilhelm. Ausführung qualitativer Analysen. Vierte vermehrte Auflage. 8vo. Pp. xi + 157. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 8.50 gold marks.

Briggs, William, and Stewart, R. W. Qualitative Analysis. Revised by D. R. Snellgrove. Second edition. Cr. 8vo. Pp. xii + 171. (London: University Tutorial Press, Ltd., 1930.) 4*s*.*

Brunold, Charles. Le problème de l'affinité chimique et l'atomistique: étude du rapprochement actuel de la physique et de la chimie. Roy. 8vo. Pp. x + 118. (Paris: Masson et Cie, 1930.) 20 francs.*

Chen, K. K., and Schmidt, Carl F. Ephedrine and Related Substances. Roy. 8vo. Pp. 121. (London: Baillière, Tindall and Cox, 1930.) 11*s*. 6*d*. net.

Constable, Frederick Hurn. A Condensed Outline of Modern Physical Chemistry. Demy 8vo. Pp. 157. (London: Ernest Benn, Ltd., 1930.) 10*s*. 6*d*. net.*

Delange, Raymond. Essences naturelles et parfums. (Collection Armand Colin: Section de chimie, No. 115.) Gl. 8vo. Pp. 222. (Paris: Armand Colin, 1930.) 10.50 francs.*

Deming, Horace G. In the Realm of Carbon: a Story of Organic Chemistry. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

Department of Scientific and Industrial Research: Building Research. Special Report No. 15: The Corrosion of Steel by Breeze and Clinker Concretes. By F. L. Brady. Roy. 8vo. Pp. iv + 15 + 2 plates. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 25: The Reactivity of Coke. 3: The Influence of Iron Compounds. By J. H. Jones, J. G. King and F. S. Sinnatt. Roy. 8vo. Pp. viii + 42. (London: H.M. Stationery Office, 1930.) 9*d*. net.*

Department of Scientific and Industrial Research: Building Research. Bulletin No. 7: Hot Cement. By N. Davey. Roy. 8vo. Pp. iii + 9. (London: H.M. Stationery Office, 1930.) 4*d*. net.*

Gmelins Handbuch der anorganischen Chemie. Herausgegeben von der Deutschen Chemischen Gesellschaft. Achte Auflage. System-Nummer 59: Eisen. Teil B, Lieferung 3. Sup. Roy. 8vo. Pp. 513-656. (Berlin: Verlag Chemie G.m.b.H., 1930.) 24 gold marks.*

Grant, Julius. The Measurement of Hydrogen Ion Concentration. Demy 8vo. Pp. viii + 159 + 2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 9*s*. net.*

Holmyard, E. J. Chemistry for Beginners. (Dent's Modern Science Series.) Gl. 8vo. Pp. xi + 223 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s*. 6*d*.*

Klein, A. St. Chemie und Papierfabrikation. 8vo. Pp. 47. (Berlin: Otto Elsner Verlagsgesellschaft m.b.H., 1930.) 1.50 gold marks.

Kopaczewski, W. Traité de biocolloïdologie. Tome 1: Pratique des colloïdes. Deuxième édition entièrement remaniée et mise à jour. Fascicule 3: Mesures capillaires et électriques. Roy. 8vo. Pp. 361-527 + viii. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.*

Kruyt, H. R., and Van Klooster, H. S. Colloids: a Textbook. Second edition. Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s*. 6*d*. net.

Kuhn, Robert. Mineralöltechnik. 8vo. Pp. 168. (Berlin: Allgemeine Industrie-Verlag, 1930.) 8 gold marks.

Langmuir, I. Electrochemical Interactions of Tungsten, Thorium, Cæsium and Oxygen. Roy. 8vo. Pp. 17. (New York: Columbia University Press; London: Oxford University Press, 1930.) 2*s*. 6*d*. net.

Mellor, J. W. A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Roy. 8vo. Vol. 10: S, Se. Pp. x + 958. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 63*s*. net.*

Ministry of Health. Reports on Public Health and Medical Subjects, No. 57: A Report on the Determination of Sucrose, Lactose and Invert Sugar in Sweetened Condensed Milk. By G. W. Monier-Williams. Roy. 8vo. Pp. 22. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Poucher, William A. Perfumes, Cosmetics and Soaps: with Especial Reference to Synthetics. Vol. 1: Being a Dictionary of Raw Materials, together with an Account of the Nomenclature of Synthetics. Third edition. Demy 8vo. Pp. ix + 394. (London: Chapman and Hall, Ltd., 1930.) 21*s*. net.*

Rabinowitsch, E. Grundbegriffe der Chemie. (Sammlung Göschen, Band 804.) Pott 8vo. Pp. 151. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.*

Rassow, B., und Loesche, A. Jahresbericht über die Leistungen der chemischen Technologie 1929. Roy. 8vo. Abteilung 1: Unorganischer Teil. Pp. 731. (Leipzig: Johann Ambrosius Barth, 1930.)

Richmond, Henry Droop. Dairy Chemistry: a Practical Handbook. Third edition, revised. Demy 8vo. Pp. 490. (London: Charles Griffin and Co., Ltd., 1930.) 25*s*. net.

Robinson, Clark S. Elements of Fractional Distillation. Second edition. Demy 8vo. Pp. 255. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 15*s*. net.

Rüdorff, Fr. Grundriss der Chemie für den Unterricht an höheren Lehranstalten. Ausgabe B. Neunzehnte Auflage. Bearbeitet von Hermann Petzold. (München: H. W. Müller, 1930.) 5.30 gold marks.

Stevens, H. B., and Lucas, C. E. L. First Lines in Dispensing. Third edition. Ex. Cr. 8vo. Pp. 190. (London: J. and A. Churchill, 1930.) 7*s*. 6*d*. net.

Stumper, R. Die physikalische Chemie der Kesselsteinbildung und ihre Verhütung. (Sammlung chemischer und chemisch-technischer Vorträge.) Pp. 51. (Stuttgart: Ferdinand Enke, 1930.) 4.80 gold marks.

Thoms, H. Handbuch der praktischen und wissenschaftlichen Pharmazie. Roy. 8vo. Lieferung 29, Band 5, Hälfte 2. Pp. 981-1172. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 10 gold marks.

Walther, C. Schmiermittel. (Technische Fortschrittsberichte: Fortschritte der chemisch-Technologie in Einzeldarstellungen, herausgegeben von B. Rassow, Band 23.) Roy. 8vo. Pp. x + 144. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 11 gold marks.

Wittig, Georg. Stereochemie. Med. 8vo. Pp. xi + 388. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 25 gold marks.*

Technology

Beery, Pauline G. Stuff: the Story of Materials in the Service of Man. Demy 8vo. Pp. 504. (New York and London: D. Appleton and Co., 1930.) 21s. net.

Bell, H. S. American Petroleum Refining. Second edition. Med. 8vo. Pp. xiii + 631. (London: Constable and Co., Ltd., 1930.) 31s. 6d. net.

Brannt, William T., and **Gray, J. B.,** Edited by. Practical Dry Cleaner, Scourer and Garment Dyer. Sixth corrected edition. Cr. 8vo. Pp. xviii + 378. (London: Crosby Lockwood and Son, 1930.) 12s. net.*

Chenoweth, W. W. Food Preservation. Roy. 8vo. Pp. 344. (New York: John Wiley and Sons, Inc.: London: Chapman and Hall, Ltd., 1930.) 15s. net.

Department of Scientific and Industrial Research: Fuel Research. Physical and Chemical Survey of the National Coal Resources. No. 15: A Survey of Scottish Coking and Furnace Coals. By Thomas Gray, assisted by T. H. P. Heriot and W. J. Skilling. Roy. 8vo. Pp. vi + 160 + 4 plates. (London: H.M. Stationery Office, 1930.) 4s. net.*

Duncan, Capt. Richard. Stunt Flying. Ex. Cr. 8vo. Pp. xi + 183. (London: Crosby Lockwood and Son, 1930.) 7s. 6d. net.*

Edwards, Junius D., and Others. The Aluminium Industry. 2 vols. Med. 8vo. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 60s. net.

Hauff, Albert Müller, and **Stein, Karl.** Automobile Steels. Translated by H. Goldschmidt. Roy. 8vo. Pp. 219. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17s. 6d. net.

Hugershoff, R. Photogrammetrie und Luftbildwesen. (Handbuch der wissenschaftlichen und angewandten Photographie, herausgegeben von Alfred Hay, Band 7.) Roy. 8vo. Pp. vii + 269. (Wien: Julius Springer, 1930.) 28 gold marks.

Johnson, Robert. The Art of Retouching Photographic Negatives, and Practical Directions how to Finish and Colour Photographic Enlargements, etc. Twelfth edition, revised and rewritten by T. S. Bruce and Alfred Braithwaite. Revised and enlarged by Arthur Hammond. Demy 8vo. Pp. x + 154 + 16 plates. (London: Chapman and Hall, Ltd., 1930.) 12s. 6d. net.*

Manly, Lieut. G. B. Aviation from the Ground Up. Demy 8vo. Pp. 374. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15s. net.

Manser, Percy, Edited by. Plumbing and Gasfitting. Cr. 8vo. Vol. 7. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6s. net.

Matthews, E. C. Modern Illustration: a Practical Art Course. Imp. 8vo. Pp. 192. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15s. net.

Matthews, E. C. The Lacquer System of Sign Painting. Illustrated with New Alphabets and Designs. Cr. 4to. Pp. 136. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 12s. 6d. net.

Mines Department: Safety in Mines Research Board. Paper No. 59: The Effect of the Rate of Cooling on the Structure and Constitution of Steel. By J. M. Robertson. Roy. 8vo. Pp. 57 + 12 plates. (London: H.M. Stationery Office, 1930.) 2s. net.*

Moldenke, Richard. Principles of Iron Founding. Second edition. Med. 8vo. Pp. 654. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 30s. net.

Payman, W., and **Statham, I. C. F.** Mine Atmospheres. (Methuen's Monographs on Coal-Mining.) Cr. 8vo. Pp. xi + 336. (London: Methuen and Co., Ltd., 1930.) 10s. 6d. net.*

Rosenholtz, Joseph L. The Elements of Ferrous Metallurgy. Roy. 8vo. Pp. 248. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15s. net.

Sömme, Axel. La Lorraine métallurgique. Roy. 8vo. Pp. viii + 250 + 7 planches + 12 cartes. (Paris, Nancy et Strasbourg: Éditions Berger-Levrault, 1930.) 30 francs.*

Stern, Marc. Die-casting Practice. Demy 8vo. Pp. 270. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12s. 6d. net.

Sterner-Rainer, Ludwig. Edelmetallegierungen und Amalgame in der Zahnheilkunde. 8vo. Pp. 111. (Berlin: Herm. Meusser, 1930.) 10 gold marks.

Thomas, Capt. R. E. Stowage: the Properties and Stowage of Cargoes. Roy. 8vo. Pp. 408. (Glasgow: Brown, Son and Ferguson, Ltd., 1930.) 21s. net.

Walker, J. H., and **Crocker, Sabin.** Piping Handbook. Ex. Cr. 8vo. Pp. 763. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 25s. net.

Wheeler, Capt. Owen. Photographic Printing Processes. Cr. 8vo. Pp. xvi + 260 + 6 plates. (London: Chapman and Hall, Ltd., 1930.) 8s. 6d. net.*

Zarotschenzeff, M. T. Between Two Oceans: Rapid Chilling and Freezing Systems for Fish and Meat. (London: *The Cold Storage and Produce Review*, 1930.) 5s. net.

Astronomy

Antoniadi, E.-M. La planète Mars: étude basée sur les résultats obtenus avec la grande lunette de l'Observatoire de Meudon et exposé analytique de l'ensemble des travaux exécutés sur cet astre depuis 1659. Demy 4to. Pp. iv + 240 + 10 planches. (Paris: Hermann et Cie, 1930.) 80 francs.*

Couderc, Paul. L'architecture de l'univers. (Encyclopédie Gauthier-Villars.) Demy 8vo. Pp. xi + 168 + 8 planches. (Paris: Gauthier-Villars et Cie, 1930.) 20 francs.*

Luyten, Willem J. The Pageant of the Stars. Demy 8vo. Pp. xvii + 300. (London: Stanley Paul and Co., Ltd., 1930.) 7s. 6d. net.

Meteorology: Geophysics

Air Ministry: Meteorological Office. Professional Notes, No. 56: Auroral Observations at Lerwick Observatory, 1924–9. By A. W. Lee. (M.O. 273 p.) Published by the Authority of the Meteorological Committee. Roy. 8vo. Pp. 11. (London: H.M. Stationery Office, 1930.) 3d. net.*

Air Ministry: Meteorological Office. The Weather Map: an Introduction to Modern Meteorology. (M.O. 225i.) Second edition, entirely rewritten. Published by the Authority of the Meteorological Committee. Roy. 8vo. Pp. iv + 83 + 24 plates. (London: H.M. Stationery Office, 1930.) 3s. net.*

Chapman, S. A Theory of Upper-Atmospheric Ozone. (Memoirs of the Royal Meteorological Society, Vol. 3, No. 26.) Roy. 8vo. Pp. 103-125. (London: Edward Stanford, Ltd., 1930.) 2s. 6d.*

Hosmer, George L., Edited by. Geodesy: including Astronomical Observations. Second edition. Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22s. 6d. net.

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 2, No. 18 (July-December, 1929.) Roy. 8vo. Pp. 255-301. (London: Royal Meteorological Society, 1930.) 2s. 6d.*

Vernadsky, W. J. Geochemie in ausgewählten Kapiteln. Autorisierte Übersetzung aus dem Russischen von E. Kordes. Med. 8vo. Pp. xii + 370. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 25 gold marks.*

Geology: Mineralogy

Briquet, Abel. Le littoral du nord de la France et son évolution morphologique. Suivi d'un appendice: L'Évolution du rivage du nord de la France et l'activité de l'homme. Roy. 8vo. Pp. v + 439 + 45. (Paris: Armand Colin, 1930.) 60 francs.*

Corbin, Paul, et **Oulianoff, Nicolas.** Carte géologique du massif du Mont-Blanc (partie française) à l'échelle du 1: 20,000. Feuille: Vallorcine. 23 in. 18 in. Notice explicative. Ex. Cr. 8vo. Pp. 15. (Paris: Société française de Stéréotopographie, 1930.) Carte et notice, 20 francs.*

Dohm, Baptist. Die Kalkmulde von Gerolstein in der Eifel: eine Einführung in die Geologie. (Fischers naturwiss. Heimatführer, Band 2.) 8vo. Pp. 64. (Wittlich: G. Fischer, 1930.) 3.20 gold marks.

Geological Survey, England, Memoirs of the. Wells and Springs of Gloucestershire. By L. Richardson. Roy. 8vo. Pp. v+292+1 plate. (London: H.M. Stationery Office, 1930.) 5s. net.

Geological Survey, England and Wales, Memoirs of the. Wells and Springs of Worcestershire. By L. Richardson, with Contributions by Cecil Cooke Duncan and B. Brotherton. Roy. 8vo. Pp. v+219. 4s. net. Explanation of Sheet 6: The Geology of the Alnwick District. By R. G. Carruthers, G. A. Burnett and W. Anderson, with Contributions by C. H. Dinham and the late J. Maden. Roy. 8vo. Pp. vii+138+4 plates. 3s. net. (London: H.M. Stationery Office, 1930.)*

Kühn, Othmar. Das Danien der äusseren Klippenzone bei Wien. Mit Beiträgen von Martin F. Glaessner (Geologische Verhältnisse des Kreidevorkommens), Frau P. Lemoine (paläobotanischer Teil) und Yoshiaki Ozawa (paläozoologischer Teil). (Geologische und paläontologische Abhandlungen, herausgegeben von J. F. Pompeckj und Fr. Freih. von Huene, Neue Folge, Band 17 (Der ganzen Reihe Band 21), Schluss-Heft 5). 4to. Pp. 84+2 Tafeln. (Jena: Gustav Fischer, 1930.) 24 gold marks.

McMillan, R. The Origin of the World. (The World of Youth Series, No. 3.) Sixth impression. Cr. 8vo. Pp. xiii+142. (London: Watts and Co., 1930.) 1s. 6d. net.

Platt, John I., and Challinor, John. Simple Geological Structures: a Series of Notes and Map Exercises. Cr. 4to. Pp. 56. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1930.) 3s. 6d. net.*

Ver Wiebe, Walter A. Oil Fields in the United States. Med. 8vo. Pp. 629. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 30s. net.

Wood, M. McKinnon, Made by. Reports on Geological Collections from the Coastlands of Kenya Colony. With Introduction by J. W. Gregory, and Report on the Ammonites by L. F. Spath, Report on the other Mesozoic Mollusca and Brachiopods by J. Weir, Report on the Kainozoic Mollusca by L. R. Cox, Report on the Cheilostomata by H. D. Thomas, Report on the Echinoidea by Ethel D. Currie, Report on the Corals by J. W. Gregory, Report on the Ostracoda and Foraminifera by Mary H. Latham, Report on the Fossil Plants by S. Williams, Report on Igneous Rocks by Agnes Neilson, and on the Stratigraphy of the Kenya Coastlands and a List of Localities by Meta McKinnon Wood. (Monographs of the Geological Department of the Hunterian Museum, Glasgow University, 4.) Roy. 4to. Pp. xi+232+24 plates. (Glasgow: Jackson, Wylie and Co.; London: Simpkin Marshall, Ltd., 1930.)*

Geography: Travel

Akeley, Delia J. Jungle Portraits. Demy 8vo. Pp. x+251+32 plates. (New York: The Macmillan Co., 1930.) 15s. net.

Assher, Ben. A Nomad in Morocco: Travels across the Hinterland and Desert's Fringe, through Atlas Snows and Cities of the Plain. Demy 8vo. Pp. 324. (London: H. F. and G. Witherby, 1930.) 12s. 6d. net.

Baedeker, Karl. Belgien und Luxemburg: Handbuch für Reisende. 26 Auflage. Pott 8vo. Pp. lii+352. (Leipzig: Karl Baedeker, 1930.) 12 gold marks.

Baedeker, Karl. Southern Italy and Sicily: with Excursions to Sardinia, Malta, Tripoli and Corfu; Handbook for Travellers. Seventeenth revised edition. Fcap. 8vo. Pp. lxxx+552. (London: George Allen and Unwin, Ltd.; New York: Charles Scribner's Sons, 1930.) 16s. net.

Betts, Edward Chambers. Kaleidoscopics of other Peoples and Places. Demy 8vo. Pp. 143. (Boston, Mass.: The Christopher Publishing House, 1930.) 1.75 dollars.

Birrell, J. Hamilton. World Commerce. (Nelson's Geography Practice Series.) Cr. 8vo. Pp. 156. (Edinburgh and London: Thomas Nelson and Sons, Ltd., 1930.) 2s.

Bremer, Mountsteven. Memoirs of a Ceylon Planter's Travels, 1851–1921. Demy 8vo. Pp. 282. (London: Rivingtons, 1930.) 10s. 6d. net.

Brooks, Leonard, and Finch, Robert. The Southern Continents. (Columbus Regional Geographies, Senior Series, Book I.) Imp. 16mo. Pp. 256. (London: University of London Press, Ltd., 1930.) 2s. 9d.

Buchheim, Gustav. Thule: das Land von Feuer und Eis; Skizzen und Bilder aus dem modernen Island. Unter Mitarbeit von Helmuth Lotz. 8vo. Pp. 151. (Berlin: Verlag Staritz, 1930.) 6 gold marks.

Chapman, Olive Murray. Across Iceland: the Land of Frost and Fire. Med. 8vo. Pp. xiv+193. (London: John Lane, The Bodley Head, Ltd., 1930.) 15s. net.

Daughtry, E. I. Introductory Studies in Geography. Cr. 8vo. Pp. viii+203. (London: William Heinemann, Ltd., 1930.) 2s. 3d.

Domizlaff, Hans. Mit der Yacht *Dirk II.* in Norwegen: drei Fahrtenberichte. 4to. Pp. 263. (Berlin: Klasing und Co., G.m.b.H., 1930.) 12 gold marks.

Eberlein, Harold Donaldson. Little Known England: Rambles in the Welsh Borderland, the Cotswolds, the Chalk Hills and the Eastern Counties. Roy. 8vo. Pp. xii+132+47 plates. (London: B. T. Batsford, Ltd., 1930.) 12s. 6d. net.

Eberlein, Harold Donaldson, and others. Down the Tiber and up to Rome. 8vo. Pp. 207. (Philadelphia and London: J. B. Lippincott Co., 1930.) 15s. net.

Elias, E. L. Les explorations polaires (Pôle Nord, Pôle Sud). Traduction française de M. Beauvais. 8vo. (Paris, Genève et Lausanne: Payot et Cie, 1930.) 25 francs.

Escholier, Raymond. Paris. Roy. 8vo. Pp. 162. (London: Methuen and Co., Ltd., 1930.) 10s. 6d. net.

Eulenberg, Herbert. Palästina: eine Reise ins gelobte Land. 8vo. Pp. 205. (Berlin: Rembrandt-Verlag, 1929.) 7.50 gold marks.

Frisbie, Robert Dean. The Book of Puka-Puka. Demy 8vo. Pp. x+356. (London: John Murray, 1930.) 10s. 6d. net.

"Gilcraft". Exploring. (The "Gilcraft" Series, No. 9.) Cr. 8vo. Pp. 127. (London: C. Arthur Pearson, Ltd., 1930.) 1s. 6d.

Goldring, Douglas. Sardinia, the Island of the Nuraghi. Med. 8vo. Pp. 271. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 15s. net.

Gwynn, Stephen. Burgundy: with chapters on the Jura and Savoy. (Kitbag Travel Books.) Fcap. 8vo. Pp. 281. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7s. 6d. net.

Harrison, Marjorie. Go West—Go Wise! a Canadian Revelation. Cr. 8vo. Pp. xii+308+8 plates. (London: Edward Arnold and Co., 1930.) 7s. 6d. net.

Harvey, George. Belgium and Luxembourg. (Harvey's Guide Books.) Fcap. 8vo. Pp. 196. (London: The Richards Press, Ltd., 1930.) 3s. 6d. net.

Hebert, B. T. A Geography of the Americas: a Text-Book of Matriculation Standard for Public and Secondary Schools. Cr. 8vo. Pp. x+179. (London: William Heinemann, Ltd., 1930.) 3s.

Hermanns, Will. Der schöne deutsche Rhein: Landschaft, Kunst und Kultur. (Die Welt in Wort und Bild.) Roy. 8vo. Pp. 256+8 Tafeln. (Berlin: Voegels Verlag, 1930.) 3.85 gold marks.

Holland, Clive. Things Seen in Belgium: an Account of the Land, its People, Historic Cities, Beautiful Medieval Buildings, Art Treasures and the Picturesque Ardennes. (The Things Seen Series.) Fcap. 8vo. Pp. 158. (London: Seeley, Service and Co., Ltd., 1930.) 3s. 6d. net.

Howard, Harvey T. Zehn Wochen bei chinesischen Banditen. Aus dem Englischen von Lothar Tobias. (Reisen und Abenteuer, Band 50.) 8vo. Pp. 159. (Leipzig: F. A. Brockhaus, 1930.) 2.80 gold marks.

Hughes, M. V. America's England. Cr. 8vo. Pp. x+342. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 6s. net.

Johnstone, James. A Study of the Oceans. Second edition. Demy 8vo. Pp. viii+235. (London: Edward Arnold and Co., 1930.) 10s. 6d. net.*

Keelan, Alice Jeannetta. In the Land of Dohori. Cr. 8vo. Pp. xii+302. (Sydney: Angus and Robertson; London: The Australian Book Co., 1930.) 7s. 6d. net.

Köhler, Albert. Sonne über dem Balkan: ein Reisebuch zwischen Baedeker und Homer: durch Jugoslawien, Albanien, Hellas, Türkei und Ungarn. 8vo. Pp. 221. (Dresden: Carl Reissner, 1930.) 5.50 gold marks.

Laughlin, Clara E. So You're Going to Germany and Austria! Fcap. 8vo. Pp. xxiv + 546 + 24 plates. (London: Methuen and Co., Ltd., 1930.) 10*s*. 6*d*. net.

Löwe, Fritz. Unter der Sonne des Südens: eine Mittelmeer und Orientfahrt. 8vo. Pp. 127. (Berlin: Pons-Verlag, 1930.) 5 gold marks.

Luke, Harry Charles, and **Keith-Roach, Edward,** Edited by. The Handbook of Palestine and Trans-Jordan. Issued under the Authority of the Government of Palestine. Second edition. Cr. 8vo. Pp. xvi + 505. (London: Macmillan and Co., Ltd., 1930.) 16*s*. net.

Lunecke, Hermann. Das Ruhrgebiet (in Wort und Bild): ein Heimatbuch. 8vo. Pp. 240. (Dusseldorf: Verlag Bagel, 1930.) 4.50 gold marks.

MacQuarrie, Hector. We and the Baby. Cr. 8vo. Pp. ix + 284. (Sydney: Angus and Robertson; London: Australian Book Co., 1930.) 7*s*. 6*d*. net.

Meyer, Fritz Jürgen, und **Leyden, Friedrich,** Bearbeitet von. Landeskunde von Holland, Belgien und Luxemburg. Teil 3. 8vo Pp. v + 42 + 3 Tafeln. (Leipzig: E. A. Seemann, 1930.) 2 gold marks.

Meyers Reisebücher. Suditalien. Sizilien, Korfu, Malta. Zweite Auflage. Pott 8vo. Pp. xliv 372 + 24. (Leipzig: Bibliographisches Institut, 1930.) 15 gold marks.

Meyers Reisebücher. Das Mittelmeer. Madeira, Kanarische Inseln. Funfte Auflage. Pott 8vo. Pp. viii + xxxii + 368 + 32. (Leipzig: Bibliographisches Institut, 1930.) 15 gold marks.

Meyers, Reisebücher. Adria: Dalmatien, kroatische Kuste, Bosnien, italienische Adriakuste, Albanien, Korfu. Pott 8vo. Pp. xxiv + 288 + 32. (Leipzig: Bibliographisches Institut, 1930.) 8.50 gold marks.

Midgley, Cyril. Modern World Geographies. Book 2, Part 2: North America. Cr. 8vo. Pp. 380. (Exeter: A. Wheaton and Co., Ltd., 1930.) 2*s*. 6*d*.

Midgley, Cyril, and **Clowser, Cleeve E.** Individual Exercises in School Geography. Book 8: The British Empire. Demy 4to. Pp. 14. (Exeter: A. Wheaton and Co., Ltd., 1930.) 10*d*.

Muirhead, Findlay, Edited by. Northern Spain: with the Balearic Islands. (The Blue Guides.) Fcap. 8vo. Pp. cxix + 345 + 12. (London: Macmillan and Co., Ltd.; Paris: Libr. Hachette, 1930.) 18*s*. net.

Müller, Orrie. Norwegische Reise. 8vo. Pp. 108. (Bremen: Leuwer Verlag, 1930.) 3.50 gold marks.

Murphy, Alison Barstow. Every Which Way in Ireland. Demy 8vo. Pp. xii 232. (New York and London: G. P. Putnam's Sons, 1930.) 6*s*. net.

Napier, S. Elliott. Walks Abroad: being a Record of the Experiences of Two Australians in the Wilds of the United Kingdom. Cr. 8vo. Pp. 328. (Sydney: Angus and Robertson; London: The Australian Book Co., 1930.) 7*s*. 6*d*.

Newman, E. M. Seeing England and Scotland. Roy. 8vo. Pp. xviii + 409. (New York and London: Funk and Wagnalls Co., 1930.) 21*s*. net.

Newth, J. D. Austria. (Peeps at Many Lands Series.) Cr. 8vo. Pp. 90. (London: A. and C. Black, Ltd., 1930.) 2*s*. 6*d*. net.

Nightingale, Agnes. This Wonderful World a Practical Pictorial Introduction to Physical Geography (Visual Geography Series.) Gl. 4to. Pp. 48. (London A. and C. Black, Ltd., 1930.) 1*s*.

Palmer, W. T. The English Lakes. (Kitbag Travel Books.) Fcap. 8vo. Pp. 304. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7*s*. 6*d*. net.

Powell, Hickman. The Last Paradise. Med. 8vo. Pp. xix + 292. (London: Jonathan Cape, Ltd., 1930.) 18*s*. net.

Raabe, Harry E. Kannibalennächte: als Raubhändler bei den Wilden der Salomonen. Aus dem Englischen von Max Mezger. Zweite Auflage. 8vo. Pp. 296. (Leipzig: F. A. Brockhaus, 1930.) 4.50 gold marks.

Reischek, Andreas. Yesterdays in Maoriland: New Zealand in the Eighties. Translated and edited by H. E. L. Priday. Demy 8vo. Pp. 312. (London: Jonathan Cape, Ltd., 1930.) 12*s*. 6*d*. net.

Ross, Colin. Der unvollendete Kontinent. 8vo. Pp. 282. (Leipzig: F. A. Brockhaus, 1930.) 6.30 gold marks.

Roome, William J. W. Tramping through Africa: a Dozen Crossings of the Continent. Med. 8vo. Pp. 330. (London: A. and C. Black, Ltd., 1930.) 15*s*. net.

Rue, Sidney de la. Liberia: the Land of the Pepper Bird. Med. 8vo. Pp. xii + 330. (New York and London: G. P. Putnam's Sons, 1930.) 15*s*. net.

Sankey, H., and **Merrett, Edgar A.** Progressive Studies in Geography: for Use in Conjunction with the Human Geographies (Secondary Series.) Book I. Cr. 8vo. Pp. vi + 46. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1930.) 9*d*.

Scheer, Albert. Erdkundlicher Unterricht. (Handbuch für d. hohere Schulen.) 8vo. Pp. viii + 184. (Leipzig: Quelle und Meyer, 1930.) 5.60 gold marks.

Scheffler, Karl. Holland. 8vo. Pp. 266 + 100 Tafeln. (Leipzig: Insel-Verlag, 1930.) 18 gold marks.

Schmidt, Carl Walter. Italien: Landschaft, Kunst und Kultur. (Die Welt in Wort und Bild.) Roy. 8vo. Pp. 256 + 8 Tafeln. (Berlin: Voegels Verlag, 1930.) 3.85 gold marks.

Schneider, Manfred. Mittelmeer-Orient-Fahrt: Reise nach Griechenland, Syrien, Palastina, Ägypten und der Turkei. 8vo. Pp. 246. (Stuttgart: W. Hadecke, 1930.) 9.50 gold marks.

Sibour, Violette de. Flying Gypsi the Chronicle of a 10,000-mile Air Vagabondage. Demy 8vo Pp. ix + 306. (New York and London: G. P. Putnam's Sons, 1930.) 10*s*. 6*d*. net.

Sorge, Ernst. Die Trockengrenze Sudamerikas. Roy 8vo. Pp. 64. (Berlin: Verlag Ebering, 1930.) 2.40 gold marks.

Steinitzer, Wilfred. Dalmatien, das kroatische und montenegrinische Kustenland. (Monographien zur Erdkunde, Band 42.) 4to. Pp. vii + 46 + 6 + 4 Tafeln. (Bielefeld: Velhagen und Klasing, 1930.) 8 gold marks.

Stembridge, Jasper H. The World we Live In. (The World-Wide Geographies, Book 4.) Imp. 16mo. Pp. 160. (London: Oxford University Press, 1930.) 2*s*.

Tweedy, Owen. By Way of the Sahara: the African Odyssey of Three Men and a Grocer's Van. Demy 8vo. Pp. 247. (London: Gerald Duckworth and Co., Ltd., 1930.) 12*s*. 6*d*. net.

General Biology: Natural History Botany: Zoology

Bannerman, David Armitage. The Birds of Tropical West Africa: with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. Published under the Authority of the Secretary of State for the Colonies. Vol. I. Sup. Roy. 8vo. Pp. lxxv + 376 + 10 plates. (London: The Crown Agents for the Colonies, 1930.) 22*s*. 6*d*. net.*

Brambell, F. W. Rogers. The Development of Sex in Vertebrates. (Text-Books of Animal Biology.) Demy 8vo. Pp. xvi + 261 + 24 plates. (London: Sidgwick and Jackson, Ltd., 1930.) 12*s*. net.*

Brehm, V. Einführung in die Limnologie. (Biologischen Studienbucher, herausgegeben von Walther Schoenichen, Band 10.) Roy. 8vo. Pp. vi + 261. (Berlin: Julius Springer, 1930.) 18 gold marks.

Brieger, Friedrich. Selbststerilität und Kreuzungssterilitat im Pflanzenreich und Tierreich. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 21.) Demy 8vo. Pp. xi + 395. (Berlin: Julius Springer, 1930.) 32 gold marks.*

Bryk, Felix. Linné und Berlin. Berliner Festschrift zu Linné's Hundertfünfzigstem Todestage, 1778–1928. Roy. 8vo. Pp. xv + 59. (Neubrandenburg: Gustav Feller, 1930.)*

Carbone, D., e **Arnaudi, C.** L' immunità nelle piante. (Monografie dell' Istituto Sieroterapico Milanese.) Sup. Roy. 8vo. Pp. xii + 274 + 3 tavole. (Milano: Istituto Sieroterapico Milanese, 1930.) 25 lire.*

Chrystal, R. N. Studies of the Sirex Parasites: the Biology and Post Embryonic Development of *Ibalia leucospoides* Hochenw. (Hymenoptera-Cynipoidea.) (Oxford Forestry Memoirs, No. 11.) Imp. 8vo. Pp. 63 + 10 plates (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 5*s*. net.*

Cohen-Kysper, Adolf. Das Determinationsproblem in analytischer Darstellung. (Abhandlungen zur Theorie der organischen Entwicklung, Heft 5.) Roy. 8vo. Pp. x + 48. (Berlin: Julius Springer, 1930.) 4.80 gold marks.*

Cowdry, Edmund V., Edited by. Human Biology and Racial Welfare. Roy. 8vo. Pp. xviii + 612. (London: H. K. Lewis and Co., Ltd., 1930.) 28*s.* net.*

Crawshay, Richard. The Spore Ornamentation of the Russulas. Med. 8vo. Pp. 185 + 48 plates. (London: Baillière, Tindall and Cox, 1930.) 12*s.* 6*d.* net.*

Empire Marketing Board. The Biological Control of Insect and Plant Pests: a Report on the Organisation and Progress of the Work of Farnham House Laboratory. By W. R. Thompson. (E.M.B. 29.) Cr. 4to. Pp. 124 + 8 plates. (London: H.M. Stationery Office, 1930.) 1*s.* net.*

Engler, Adolf, und **Prantl, Karl,** Begründet von. Die natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen. Zweite stark vermehrte und verbesserte Auflage, herausgegeben von A. Engler. Band 15a: Angiospermae; Reihen Farinosae, Liliiflorae, Scitamineae. Redigiert von L. Diels. Roy. 8vo. Pp. iv + 707. 95 gold marks. Band 18a: Angiospermae, Reihe Podostemonales; Reihe Rosales, Unterreihe Saxifragineae. Redigiert von H. Harms. Roy. 8vo. Pp. iii + 492. 68 gold marks. (Leipzig: Wilhelm Engelmann, 1930.)

FitzSimons, F. W. Pythons and their Ways. Demy 8vo. Pp. 155 + 16 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7*s.* 6*d.* net.*

Goodrich, Edwin S. Studies on the Structure and Development of Vertebrates. Demy 8vo. Pp. xxx + 837. (London: Macmillan and Co., Ltd., 1930.) 36*s.* net.*

Holmyard, E. J. Biology for Beginners. (Dent's Modern Science Series.) Gl. 8vo. Pp. vii + 172 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s.*.*

Just, Günther, Herausgegeben von. Vererbung und Erziehung. Roy. 8vo. Pp. vi + 333. (Berlin: Julius Springer, 1930.) 12.80 gold marks.

Martin, W. The New Zealand Nature Book. Cr. 8vo. Vol. 1: The Fauna. Pp. xx + 235. Vol. 2: The Flora. Pp. viii + 187. (London, Auckland and Melbourne: Whitcombe and Tombs, Ltd., 1930.) 4*s.* 6*d.* net each.

Mitchell, Sir Peter Chalmers. Materialism and Vitalism in Biology: the Herbert Spencer Lecture delivered at Oxford, June 3, 1930. Demy 8vo. Pp. 30. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 2*s.* net.*

Pax, Ferdinand, und **Arndt, Walther,** Herausgegeben von. Die Rohstoffe der Tierreichs. Lieferung 4. Sup. Roy. 8vo. Pp. 161-320. (Berlin: Gebrüder Borntraeger, 1930.) 12.75 gold marks.*

Ponton, D. Baby Beasts. (Scientific Tales for Children.) Imp. 32mo. Pp. 36. (Poole: The Wessex Press, 1930.) 6*d.**

Schoenichen, Walther. Praktikum der Insektenkunde: nach biologisch-ökologischen Gesichtspunkten. Dritte, verbesserte Auflage. Roy. 8vo. Pp. x + 256. (Jena: Gustav Fischer, 1930.) 12 gold marks.

Step, Edward. Nature Rambles: an Introduction to Country-Lore. Spring to Summer. (The "Come-with-me" Books.) Fcap. 8vo. Pp. viii + 152 + 31 plates. (London and New York: Frederick Warne and Co., Ltd., 1930.) 2*s.* 6*d.* net.*

Wagner, Julius. Katalog der palaarktischen Aphanipteren. Roy. 8vo. Pp. 55. (Wien: Verlag Wagner, 1930.) 1.50 gold marks.

Warthin, Aldred Scott. The Creed of a Biologist: a Biologic Philosophy of Life. Cr. 8vo. Pp. viii + 62. (London: Constable and Co., Ltd., 1930.) 7*s.* 6*d.* net.*

Winkler, Hans. Die Konversion der Gene: eine vererbungstheoretische Untersuchung. Roy. 8vo. Pp. x + 186. (Jena: Gustav Fischer, 1930.) 10 gold marks.

Woodruff, Lorande Loss. Foundations of Biology. Fourth edition. Demy 8vo. Pp. xvi + 501. (New York: The Macmillan Co., 1930.) 3.50 dollars.*

Horticulture: Agriculture: Forestry

Bardswell, Frances A. The Herb-Garden. Second edition. Roy. 8vo. Pp. 174 + 16 plates. (London: A. and C. Black, Ltd., 1930.) 7*s.* 6*d.* net.

Blanck, E., Herausgegeben von. Handbuch der Bodenlehre. Band 6: Die physikalische Beschaffenheit des Bodens. Bearbeitet von Alfred Densch, Fritz Giesecke, Maximilian Helbig, u.a. Roy. 8vo. Pp. viii + 423. (Berlin: Julius Springer, 1930.) 43.60 gold marks.

Department of Scientific and Industrial Research: Forest Products Research. Bulletin No. 4: A Decay of Sitka Spruce Timber caused by *Trametes serialis*, Fr.; a Cultural Study of the Fungus. By K. St. G. Cartwright. Cr. 4to. Pp. vi + 26 + 6 plates. (London: H.M. Stationery Office, 1930.) 2*s.* net.*

Knapp, Arthur W. The Cocoa and Chocolate Industry: the Tree, the Bean, the Beverage. Second edition, revised and enlarged. Demy 8vo. Pp. 188. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 7*s.* 6*d.* net.

Little, W. B. Science in the Country. (Science in Everyday Life, Second Series.) Cr. 8vo. Pp. xii + 219. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.*

Sudell, Richard. The Town Garden. Cr. 8vo. Pp. 128. (London: Ward, Lock and Co., Ltd., 1930.) 2*s.* 6*d.* net.

Tempany, H. A., and **Mann, G. E.** Principles of Tropical Agriculture. Ex. Cr. 8vo. Pp. 328 + xxiii. (Kuala Lumpur: The Incorporated Society of Planters, Malaya, 1930.)*

Wilson, Ernest H. Aristocrats of the Trees. Med. 4to. Pp. xxi + 279. (Boston, Mass.: The Stratford Co., 1930.) 15 dollars.

Winkler, Willibald. Handbuch der Milchwirtschaft. Roy. 8vo. Band 1, Teil 1: Die Milch; Zusammensetzung, Eigenschaften, Veränderungen, Untersuchungen. Bearbeitet von Julius Bauer, Benno Bleyer, Karl J. Demeter, u.a. Pp. x + 413. 36 gold marks. Band 1, Teil 2: Die Milchproduktion; die Milchviehzucht, Fütterung, Haltung und Pflege der Milchtiere, Entstehung, Gewinnung und Behandlung der Milch. Pp. ix + 482. 46 gold marks. (Wien: Julius Springer, 1930.)

Anatomy: Physiology

Cheesman, J. E. Baillière's Synthetic Anatomy. 8vo. Part 7: The Thorax. (London: Baillière, Tindall and Cox, 1930.) 3*s.* net.

Ellis, Havelock. Man and Woman: a Study of Human Secondary Sexual Characters. Sixth edition. Demy 8vo. Pp. 564. (London: A. and C. Black, Ltd., 1930.) 10*s.* 6*d.* net.

Mallwitz, A., und **Rautmann, H.,** Herausgegeben von. Muskelarbeit und Energieverbrauch: Verhandlungsbericht über die 6 Tagung des Deutschen Ärztebundes zur Förderung der Leibesübungen in Frankfurt a.M. vom 6 bis 8 September 1929. Im Auftrage des Hauptvorstandes des Deutschen Ärztebundes zur Förderung der Leibesübungen. Roy. 8vo. Pp. vi + 137. (Jena: Gustav Fischer, 1930.) 7.20 gold marks.

Searth, G. W., and **Lloyd, F. E.** Elementary Course in General Physiology. Part 1: Principles and Theory, by G. W. Searth; Part 2: Laboratory Exercises, by F. E. Lloyd and G. W. Searth. Roy. 8vo. Pp. 258. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 13*s.* 6*d.* net.

Stöhr's Lehrbuch der Histologie und der mikroskopischen Anatomie des Menschen mit Einschluss der mikroskopischen Technik. Zweiundzwanzigste Auflage, von Wilhelm von Möllendorff. Roy. 8vo. Pp. xii + 522. (Jena: Gustav Fischer, 1930.) 19 gold marks.

Warthin, Aldred Scott. Old Age, the Major Involution: the Physiology and Pathology of the Ageing Process. Ex. Cr. 8vo. Pp. xvi + 199 (11 plates). (London: Constable and Co., Ltd., 1929.) 15*s.* net.*

Anthropology: Archæology

Carpenter, Rhys. The Sculpture of the Nike Temple Parapet. Sup. Roy. 8vo. Pp. 83. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 9*s.* net.

Harries, C. L. The Sacred Baboons of Lomondo. Cr. 8vo. Pp. 219. (London: Simpkin Marshall, Ltd., 1930.) 7*s.*

Krappe, Alexander Haggerty. The Science of Folk-Lore. Demy 8vo. Pp. xxii + 344. (London: Methuen and Co., Ltd., 1930.) 10s. 6d. net.*

Macnaughton, Duncan. A Scheme of Babylonian Chronology: from the Flood to the Fall of Nineveh; with Notes thereon, including Notes on Egyptian and Biblical Chronology. Cr. 8vo. Pp. xii + 189. (London: Luzac and Co., 1930.) 7s. 6d.*

Mylonas, George E. Excavations at Olynthus. Part 1: The Neolithic Settlement. Demy 4to. Pp. xvii + 108. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1930.) 34s. net.

Redfield, Robert. Tepoztlan, a Mexican Village: a Study of Folk Life. 8vo. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 13s. 6d. net.

Saller, K. Die Fehmaraner: eine anthropologische Untersuchung aus Ostholstein. (Deutsche Rassenkunde, Forschungen über Rassen und Stämme, Volkstum und Familien im Deutschen Volk, herausgegeben von Eugen Fischer. Band 4.) Roy. 8vo. Pp. vii + 236 + 48 Tafeln. (Jena: Gustav Fischer, 1930.) 26 gold marks.

Stibbe, E. P. An Introduction to Physical Anthropology. Demy 8vo. Pp. vii + 199. (London: Edward Arnold and Co., 1930.) 12s. 6d. net.*

Vulliamy, C. E. The Archaeology of Middlesex and London. (The County Archaeologies.) Cr. 8vo. Pp. xx + 308 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10s. 6d. net.*

Zammit, Sir Themistocles. Prehistoric Malta: the Tarxien Temples. Roy. 8vo. Pp. 143. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 12s. 6d. net.

Philosophy: Psychology

Allendy, R. Les rêves et leur interprétation psychoanalytique. (Bibliothèque de Philosophie contemporaine.) Nouvelle édition. Cr. 8vo. Pp. 166. (Paris: Félix Alcan, 1930.) 12 francs.

Bloor, Constance. The Process of Learning: some Psychological Aspects of Learning and Discipline in School. Cr. 8vo. Pp. xii + 284. (London: Kegan Paul and Co., Ltd., 1930.) 7s. 6d. net.*

Bradley, F. H. Appearance and Reality: a Metaphysical Essay. Ninth impression, authorised and corrected. Demy 8vo. Pp. xxii + 570. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 16s. net.*

D'Arcy, Rev. M. C. Thomas Aquinas. (Leaders of Philosophy Series.) Demy 8vo. Pp. ix + 292. (London: Ernest Benn, Ltd., 1930.) 12s. 6d. net.*

Dewey. John Dewey, the Man and his Philosophy: Addresses delivered in New York in celebration of his Seventieth Birthday. Cr. 8vo. Pp. vii + 181. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 10s. 6d. net.*

Dewey, John. Construction and Criticism. (The first Davies Memorial Lecture, delivered February 25, 1930, for the Institute of Arts and Sciences.) Roy. 8vo. Pp. 25. (New York: Columbia University Press; London: Oxford University Press, 1930.) 4s. net.

Driesch, Hans. Wirklichkeitslehre: ein metaphysischer Versuch. Dritte neubearbeitete und erweiterte Auflage. Roy. 8vo. Pp. xvi + 407. (Leipzig: E. Reinicke, 1930.) 14 gold marks.

Dubs, Homer H. Rational Induction: an Analysis of the Method of Science and Philosophy. Ex. Cr. 8vo. Pp. xv + 510. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 21s. net.*

Dumas, Georges. Nouveau traité de psychologie. Tome 1: Notions préliminaires, introduction, méthodologie. Avec la collaboration de C. Champy, A. Lalande, L. Lapicque, R. Perrier, P. Rivet, A. Tournay, H. Wallon. Roy. 8vo. Pp. vii + 425. (Paris: Félix Alcan, 1930.) 75 francs.*

Feuchtwanger, Erich. Amusie: Studien zur pathologischen Psychologie der akustischen Wahrnehmung und Vorstellung und ihrer Strukturgebiete besonders in Musik und Sprache. (Monographien aus dem Gesamtgebiete der Neurologie und Psychiatrie, herausgegeben von O. Foerster und K. Wilmanns, Band 57.) Roy. 8vo. Pp. v + 295. (Berlin: Julius Springer, 1930.) 26 gold marks.

Krutch, Joseph Wood. The Modern Temper: a Stud[y] and a Confession. Med. 8vo. Pp. xvi + 249. (London: Jonathan Cape, Ltd., 1930.) 12s. 6d. net.

Murchison, Carl, Edited by. Psychologies of 1930. By Alfred Adler, Madison Bentley, Edwin G. Boring, G. S. Brett, Harvey Carr, John Dewey, Knight Dunlap, J. C. Flugel, Walter S. Hunter, Pierre Janet, Truman L. Kelley, K. Koffka, Wolfgang Kohler, K. N. Kornilov, William McDougall, John Paul Nafe, I. P. Pavlov, Friedrich Sander, A. L. Schniermann, C. Spearman, Leonard T. Troland, Margaret F. Washburn, Albert P. Weiss, Robert S. Woodworth. (The International University Series in Psychology.) Med. 8vo. Pp. xix + 497. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1930.) 27s. net.*

Stout, G. F. Studies in Philosophy and Psychology. Demy 8vo. Pp. xiii + 408. (London: Macmillan and Co., Ltd., 1930.) 15s. net.*

Bacteriology: Hygiene

Currie, J. R. A Textbook of Hygiene. Demy 8vo. Pp. 844. (Edinburgh: E. and S. Livingstone, 1930.) 27s. net.

Kopeloff, Nicolas. Man vs. Microbes. Med. 8vo. Pp. xxiii + 311 + viii. (London and New York: Alfred A. Knopf, Ltd., 1930.) 21s.*

Laqueur, August. Licht, Luft und Wasser. (Bucher der Hygiene und Volksernahrung, Band 6.) Roy. 8vo. Pp. 88. (Berlin: Rothgiesser und Diesing A.-G., 1930.) 2.20 gold marks.

Medical Research Council. A System of Bacteriology in Relation to Medicine. Vol. 1. By F. W. Andrewes, J. A. Arkwright, J. E. Barnard, C. H. Browning, W. Bulloch, H. Chick, A. D. Gardner, A. Harden, H. McCombie, J. W. McLeod, E. K. Rideal, R. St. John-Brooks, A. Slator, H. G. Thornton. Sup. Roy. 8vo. Pp. 374 + 18 plates. Vol. 5. By W. Bulloch, S. L. Cummins, F. W. Eurich, J. T. Duncan, A. Fleming, S. R. Gloyne, W. Fletcher, A. Stanley Griffith, R. T. Hewlett, J. C. G. Ledingham, J. A. W. McCluskie, A. D. McEwen, J. McIntosh, F. C. Minett, E. Muir, C. C. Okell, R. St. John-Brooks, A. S. Stableforth, W. H. Tytler, L. E. H. Whitby. Sup. Roy. 8vo. Pp. 506. (London: H.M. Stationery Office, 1930.) 21s. net each.*

Stooke, J. J. A Second Year's Course in Hygiene. Cr. 8vo. Pp. 128. (Edinburgh and London: Oliver and Boyd, 1930.) 1s. 6d.

Williams, Jesse Feiring, and **Oberteuffer, Delbert.** Industrial Hygiene for Schools. (McGraw-Hill Vocational Texts.) Ex. Cr. 8vo. Pp. xiv + 280. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 10s. net.*

Miscellany

A Surgeon. Essays and Addresses: Sociological, Biological and Psychological. Demy 8vo. Pp. xiii + 2[..] (London: H. K. Lewis and Co., Ltd., 1930.) 10s. 6d. net.*

Grierson, Walter ("The Enquiring Layman"). The Conclusions of Modern Science: Plainly Told. (The Outline Library, No. 10.) Fcp. 8vo. Pp. xviii + 198. (London: George Newnes, Ltd., 1930.) 2s. 6d. net.*

Read. Sir Hercules Read, 1857–1929. (From the *Proceedings of the British Academy*, Vol. 15.) Roy. 8vo. Pp. 19. (London: Oxford University Press, 1930.) 1s. 6d. net.

Schiaparelli. Le opere di G. V. Schiaparelli. Pubblicat[e] per cura della Reale Specola di Brera. Imp. 8vo. Tomo [1]. Pp. x + 515 + 19 tavole. 220 lire. Tomo 2. Pp. iv + 486 + 30 tavole. 220 lire. (Milano: Ulrico Hoepli, 1929–1930.)

Swinton, Alan A. Campbell. Autobiographical [and] other Writings. Demy 8vo. Pp. ix + 181 + 18 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10s. 6d. net.*

Walker, M. E. M. Pioneers of Public Health: the Story of some Benefactors of the Human Race. Med. 8vo. Pp. xv + 270 + 23 plates. (Edinburgh and London: Oliver and Boyd, 1930.) 12s. 6d. net.*

Waugh, Arthur. A Hundred Years of Publishing: being the Story of Chapman and Hall, Ltd. Demy 8vo. Pp. xvii + 326 + 50 plates. (London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Recent Scientific and Technical Books.

*Volumes marked with an asterisk have been received at "*Nature*" Office.*

Mathematics: Mechanics: Physics

Andrews, P. E., and Lambert, H. G. Physics. Science Note Books for School Certificate.) Book 3: Light and Sound. Ex. Cr. 4to. (Exeter: A. Wheaton and Co., Ltd., 1930.) 1s. net.

Déjardin, Georges. Les quanta. (Collection Armand Colin: Section de physique, No. 121.) Gl. 8vo. Pp. 221. (Paris: Armand Colin, 1930.) 10.50 francs.*

Dirac, P. A. M. The Principles of Quantum Mechanics. The International Series of Monographs on Physics.) Roy. 8vo. Pp. x + 257. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 17s. 6d. net.*

Dresden, Arnold. Solid Analytical Geometry and Determinants. Demy 8vo. Pp. x + 310. (New York: John Wiley and Sons, Inc.: London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Durell, Clement V. A New Algebra for Schools. Parts 1 and 2. Cr. 8vo. Pp. ix + 328 + xxiv + xxiii + xv. London: G. Bell and Sons, Ltd., 1930.) Without Appendix: with Answers, 3s. 6d.; without Answers, 3s. With Appendix: with Answers, 4s. 6d.; without Answers, 4s.*

Garnier, René. Cours de mathématiques générales analyse et géométrie). (Cours de la Faculté des Sciences de Paris.) Tome 1: Calcul différentiel, géométrie. Roy. 8vo. Pp. xi + 463. (Paris: Gauthier-Villars et Cie, 1930.) 80 francs.*

Hewitt, W. H. School Certificate Light. Cr. 8vo. Pp. 218. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3s. 6d. net.

Higbee, F. G. The Essentials of Descriptive Geometry. Fourth edition, revised. 8vo. Pp. 311. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12s. 6d. net.

Leigh, Charles W., and Mangold, John F. Practical Mechanics and Strength of Materials. Second edition. Cr. 8vo. Pp. 120. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13s. 9d. net.

Loria, Gino. Curve piane speciali, algebriche e trascendenti; teoria e storia. Vol. 2: Curve trascendenti, curve dedotte da altre. Roy. 8vo. Pp. xi + 439. Milano: Ulrico Hoepli, 1930.) 70 lire.*

Martin, L. C. An Introduction to Applied Optics. The Specialists Series.) Vol. 1: General and Physiological. Demy 8vo. Pp. ix + 324. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 21s. net.*

Moir, John M. Mechanics. Cr. 8vo. Pp. vii + 96. (London: Edward Arnold and Co., 1930.) 1s. 6d.*

Moulton, Forest Ray. Differential Equations. Demy 8vo. Pp. xv + 395. (New York: The Macmillan Co., 1930.) 24s. net.*

Shackel, R. G. Heat and Light. Cr. 8vo. Pp. viii + 375. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 4s. 6d.*

Shackel, R. G. Heat, Light and Sound. Cr. 8vo. Pp. viii + 472. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 5s. 6d.*

Spease, Edward. Pharmaceutical Mathematics. Ex. Cr. 8vo. Pp. 126. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 8s. 9d. net.

Engineering

Caldwell, Frank C. Modern Lighting. (Engineering Science Series.) Demy 8vo. Pp. xi + 386. (New York: The Macmillan Co., 1930.) 18s. net.*

Engineering Index, The. 1929 edition. Imp. 8vo. Pp. 2000. (New York: The American Society of Mechanical Engineers, 1930.) 50 dollars.

Kyser, Herbert. Die elektrische Kraftübertragung. 8vo. Pp. x + 544. (Berlin: Julius Springer, 1930.) 36 gold marks.

Munzinger, F. La vapeur à très haute pression. Traduction d'après l'édition allemande, complétée et mise à jour pour l'auteur par A. Schubert. Roy. 8vo. Pp. xiv + 276. (Paris: Libr. Dunod, 1930.) 62 francs.

National Physical Laboratory. Notes on Screw Gauges. By the Gauge-Testing Staff of the Metrology Department. Third edition, revised and enlarged. Cr. 4to. Pp. 88. (London: H.M. Stationery Office, 1930.) 4s. net.*

Raubol, Nikolaus, und Effenberger, Wilh. Baumechanik der Hochbaukonstruktionen in elementarer Darstellung. (Leipzig und Wien: Franz Deuticke, 1930.) 14.60 gold marks.

Schuhler, Albert A. Electric Wiring: Applied Electricity for Vocational and Trade Schools. Ex. Cr. 8vo. Pp. 380. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12s. 6d. net.

Chemistry: Chemical Industry

Berl, Ernst; Herbert, W., und Wahlig, W. Nomographische Tafeln für die chemische Industrie. 4to. Pp. iv + 31 Tafeln. (Berlin: Julius Springer, 1930.) 12 gold marks.

Brooks, Arthur. A First Chemistry for Schools. Cr. 8vo. Pp. 160 + 4 plates. (London: University of London Press, Ltd., 1930.) 2s. 9d.

Findlay, Alexander. The Spirit of Chemistry: Introduction to Chemistry for Students of the Liberal Arts. Demy 8vo. Pp. xvi + 480. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10s. 6d.*

Houben, J. Fortschritte der Heilstoffchemie. 2 Abteilungen. 4to. Abteilung 2: Die Ergebnisse der wissenschaftlichen Literatur. Band 1: Die aliphatischen und hydrierten isocyklischen Verbindungen. Pp. xxxvii + 1488. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) Subskriptionspreis 240 gold marks.

Kruyt, H. R. Colloids: a Textbook. Translated from the Manuscript by H. S. van Klooster. Second edition, revised and enlarged. Med. 8vo. Pp. xiii + 286. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17s. 6d. net.*

Lobel, L., und Dubois, M. Handbuch der Sensitometrie. Übersetzt und bearbeitet von Leopold Kutzleb. (Photoh and-Bücherei, Band 17.) Pott 8vo. Pp. 189 + 2 Tafeln. (Berlin: Verlag Hackebeil, 1930.) 4.50 gold marks.

Pohlmann, Walther. Taschenbuch für Kälte Techniker. Neunte vollständig neubearbeitete Auflage. Begründet von Georg Gottsche. 8vo. Pp. 362. (Hamburg: Hanseatische Verlagsanstalt, 1930.) 8 gold marks.

Pozzi-Escot, Emm. Le pH: force d'acidité et d'alcalinité. Roy. 8vo. Pp. 61. (Paris: Libr. Dunod, 1930.) 10 francs.

Schultz, Gustav. Farbstofftabellen. Siebente Auflage, neu bearbeitet und erweitert. Band 1, Lieferung 9. 8vo. Pp. 337-384. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 8 gold marks.

Seeligmann, Franz, und Zieke, Emil. Handbuch der Lack- und Firnisindustrie: Lehrbuch der Fabrikation von Lacken und Firnissen, sowie Beschreibung und Untersuchung der dazu verwendeten Rohmaterialien. Vierte vollständig neubearbeitete Auflage. Herausgegeben von E. Zieke und Hans Wolff. Bearbeitet von Hans Wolff, Fritz Zimmer und Bernhard Scheifele. Roy. 8vo. Pp. 979. (Berlin: Union Deutsche Verlagsgesellschaft, 1930.) 45 gold marks.

Springer, Ludwig. Einführung in die Chemie der Glas-, Email- und Keram-Industrie. Zweite Auflage. 8vo. Pp. xix + 279. (Dresden: Verlag *Die Glashütte*, 1930.) 10 gold marks.

Taussig, Rudolf. Die Industrie des Calciumcarbides. (Monographien über angewandte Elektrochemie, Band 51.) Roy. 8vo. Pp. xvi + 519 + 22 Tafeln. (Halle a. S.: Wilhelm Knapp, 1930.) 60 gold marks.

Thürmer, Alfred. Die chemische Untersuchung der Rohstoffe des Emails und seine Prüfung. 8vo. Pp. iv + 113. (Dresden: Verlag *Die Glashütte*, 1930.) 6 gold marks.

Waeser, Bruno. Handbuch der Schwefelsaurefabrikation. 3 Bände. 8vo. Pp. 2036. (Braunschweig: Friedr. Vieweg und Sohn A.G., 1930.) 204 gold marks.

Zerr, Georg, und **Rübencamp, Robert.** Handbuch der Farbenfabrikation: Lehrbuch der Fabrikation, Untersuchung und Verwendung aller in der Praxis vorkommenden Körperfarben. Vierte neubearbeitete und vermehrte Auflage. Roy. 8vo. Pp. xv + 962. (Berlin: Union Deutsche Verlagsgesellschaft, 1930.) 45 gold marks.

Astronomy

Thomas, Oswald. The Heavens and the Universe. Translated by Bernard Miall. Cr. 8vo. Pp. 288 (London: George Allen and Unwin, Ltd., 1930.) 7*s*. 6*d*. net.*

Geology: Mineralogy

Ahrens, Wilhelm. Geologisches Wanderbuch durch das Vulkangebiet des Laacher Sees in der Eifel. 8vo. Pp. viii + 87. (Stuttgart: Ferdinand Enke, 1930.) 5.50 gold marks.

Geological Survey of England and Wales. Sheet 6: Alnwick. Scale of one Inch to one Statute Mile. Solid edition, colour printed. 26½ in. × 20½ in. 2*s*. net. Drift edition, colour printed. 26½ in. × 20½ in. 2*s*. net. (Southampton: Ordnance Survey Office; London: H.M. Stationery Office, 1930.)*

Krejci-Graf, Karl. Grundfragen der Ölgeologie. (Schriften aus dem Gebiet der Brennstoff-Geologie, Heft 4.) Roy. 8vo. Pp. viii + 182. (Stuttgart: Ferdinand Enke, 1930.) 20 gold marks.

Rohleder, Herbert P. T. Der tertiäre Vulkanismus in Nord-Irland. (Geologische Charakterbilder, herausgegeben von K. Andrée, Heft 37.) Roy. 4to. Pp. 32 + 13 Tafeln. (Berlin: Gebrüder Borntraeger, 1930.) 24 gold marks.*

General Biology: Natural History Zoology: Botany

Bateson, W. Mendel's Principles of Heredity. Fourth impression. Roy. 8vo. Pp. xvi + 414 + 6 plates. (Cambridge: At the University Press, 1930.) 15*s*. net.

Butcher, Roger W. Further Illustrations of British Plants. Drawings by Florence E. Strudwick. Forming with Fitch's Companion Volume to Bentham's Handbook a Collection of Illustrations of most of the Species in the British Flora. Cr. 8vo. Pp. vii + 476. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 12*s*. net.*

Copley, Hugh. The Letters of Two Fishermen: relating Angling Experiences in West Africa and on English Rivers, and giving much Useful Advice and Information of Fish and Fishing; with Appendix. Cr. 8vo. Pp. x + 150 + 12 plates. (London and New York: Frederick Warne and Co., Ltd., 1930.) 6*s*. net.*

Eltringham, H. Histological and Illustrative Methods for Entomologists. With a Chapter on Mounting Whole Insects, by H. Britten. Cr. 8vo. Pp. xi + 139. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 7*s*. 6*d*. net.*

Fishery Board for Scotland. Scientific Investigations, 1930, No. 1: Scottish Herring Shoals: Pre-spawning and Spawning Movements. By H. Wood. Imp. 8vo. Pp. 71. (Edinburgh and London: H.M. Stationery Office, 1930.) 3*s*. 6*d*. net.*

Friederichs, Karl, Bearbeitet von. Die Grundfragen und Gesetzmässigkeiten der land- und forstwirtschaftlichen Zoologie, insbesondere der Entomologie. Unter Mitwirkung von L. O. Howard, E. Martini und H. Prell. 2 Bände. Roy. 8vo. Band 1: Ökologischer Teil. Band 2: Wirtschaftlicher Teil. Pp. xvii + 875. (Berlin: Paul Parey, 1930.) 56 gold marks.

Frisch, Karl von; Goldschmidt, Richard; Ruhland, Wilhelm, und **Winterstein, Hans,** Herausgegeben von. Ergebnisse der Biologie. Redigiert von H. Winterstein. Band 6. Roy. 8vo. Pp. vi + 764. (Berlin: Julius Springer, 1930.) 76 gold marks.

Fulmer, Ellis I., and others. An Index to the Chemical Action of Micro-organisms on the Non-nitrogenous Organic Compounds. Roy. 8vo. Pp. 1981. (London: Baillière, Tindall and Cox, 1930.) 20*s*. net.

Gilbert-Carter, H. Our Catkin-bearing Plants: an Introduction. Gl. 8vo. Pp. xii + 61 + 17 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 4*s*. 6*d*. net.*

Hirsch, Nathaniel D. Mittron. Twins: Heredity and Environment. Demy 8vo. Pp. vii + 159. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 10*s*. net.

Kearton, Richard. At Home with Wild Nature. (New Readers' Library.) Cheaper edition. Fcap. 8vo. Pp. 176. (London: Gerald Duckworth and Co., Ltd., 1930.) 3*s*. 6*d*. net.

Kirkman, F. B., and **Jourdain, F. C. R.** British Birds. Cr. 4to. Pp. xvi + 184 + 202 plates. (London and Edinburgh: T. C. and E. C. Jack, Ltd., 1930.) 21*s*. net.*

Körner, Otto. Die homerische Tierwelt. Zweite, für Zoologen und Philologen neubearbeitete und ergänzte Auflage. Roy. 8vo. Pp. iv + 100. (München: J. F. Bergmann, 1930.) 6.60 gold marks.*

Lagerlöf, Nils. Untersuchungen über die Topographie der Bauchorgane beim Rinde und einige klinische Beobachtungen und Bemerkungen im Zusammenhang damit. Berechtigte Übersetzung von Eugen Bass. Roy. 8vo. Pp. viii + 96 + 80 Tafeln. (Jena: Gustav Fischer, 1930.) 9 gold marks.

Mace, Herbert. A Book ab[illegible] the Bee. Cheap edition. Cr. 8vo. Pp. 138. (L[illegible]: Hutchinson and Co., Ltd., 1930.) 2*s*. 6*d*. net.

Mace, Herbert. Adventures [illegible] Bees. Cr. 8vo. Pp. 114. (London: Hutchinson and Co., Ltd., 1930.) 2*s*. 6*d*. net.

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 11, No. 7, 1929: Investigations into the Age, Length and Maturity of the Herring of the Southern North Sea. Part 3: The Composition of the Catches from 1923 to 1928. By William C. Hodgson; with a section on the Hydrography of the Area by J. R. Lumby. Imp. 8vo. Pp. 75 + 8 charts. (London: H.M. Stationery Office, 1929.) 5*s*. net.*

Morgan, Ann Haven. Field Book of Ponds and Streams: an Introduction to the Life of Fresh Water. (Putnam's Nature Field Books.) Fcap. 8vo. Pp. xvi + 448 + 23 plates. (New York and London: G. P. Putnam's Sons, 1930.) 3.50 dollars.*

Rostand, Jean. La formation de l'ê[illegible] Cr. 8vo. Pp. 222. (Paris: Libr. Hachette, 1930.) 12 francs.

Saz, Rev. P. Eugenio. Costumbres de insectos observadas en plena naturaleza. Tomo 1. Pp. 104. 2 pesetas. Tomo 2. Pp. 96. 2 pesetas. (Barcelona: Revista *Ibérica*, 1930.)

Shumway, Waldo. Vertebrate Embryology. Second edition. 8vo. Pp. 311. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s*. 6*d*. net.

Stapf, O. Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies, being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns, compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries. Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew. Vol. 3. Roy. 4to. Pp. iv + 555. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 105*s*. net.*

Step, Edward. Nature Rambles: an Introduction to Country-lore. (The "Come-with-Me" Books.) Summer to Autumn. Fcap. 8vo. Pp. viii + 152 + 31 plates. Autumn to Winter. Fcap. 8vo. Pp. viii + 152 + 31 plates. (London and New York: Frederick Warne and Co., Ltd., 1930.) 2*s*. 6*d*. net each.*

Stephenson, Lieut.-Col. J., Edited by. The Fauna of British India: including Ceylon and Burma. Published under the Authority of the Secretary of State for India in Council. Cestoda. Vol. 1. By T. Southwell. Demy 8vo. Pp. xxxi + 391. (London: Taylor and Francis, 1930.) 22*s*. 6*d*.*

Thaysen, A. C., and **Galloway, L. D.** The Microbiology of Starch and Sugars. Demy 8vo. Pp. 336. (London: Oxford University Press, 1930.) 25*s.* net.

Thom, Burton Peter. Dust to Life: the Scientific Story of Creation. Demy 8vo. Pp. 410. (London: Ernest Benn, Ltd., 1930.) 21*s.* net.

Tothill, J. D., assisted by **Taylor, T. H. C.,** and **Paine, R. W.** The Coconut Moth in Fiji: a History of its Control by means of Parasites. Published for the Government of Fiji. Imp. 8vo. Pp. vii + 269. (London: The Imperial Bureau of Entomology, 1930.) *

Vogt, Walther Heinrich, und **Spethmann, Hans,** Herausgegeben von. Deutsche Islandforschung, 1930. Band 2: Natur. Herausgegeben von Hans Spethmann. (Veröffentlichungen der Schleswig-Holsteinischen Universitätsgesellschaft, Nr. 28, 2.) Sup. Roy. 8vo. Pp. viii + 175 + 16 Tafeln. (Breslau: Ferdinand Hirt, 1930.) 8 gold marks.*

Warming, Eug., und **Graebner, P.** Lehrbuch der ökologischen Pflanzengeographie. Vierte Auflage nach Warmings Tode bearbeitet von P. Graebner. Sup. Roy. 8vo. Lieferung 1. Pp. 240. (Berlin: Gebrüder Borntraeger, 1930.) 24 gold marks.*

Wieman, H. L. An Introduction to Vertebrate Embryology. (McGraw-Hill Publications in the Zoological Sciences.) Med. 8vo. Pp. xi + 411. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.*

Anatomy: Physiology

Bethe, Albrecht; Bergmann, Gustav von; Embden, Gustav, und **Ellinger, Alexander,** Herausgegeben von. Handbuch der normalen und pathologischen Physiologie: mit Berücksichtigung der experimentellen Pharmakologie. Band 15, Hälfte 1: Correlationen I/1. Bewegung und Gleichgewicht, Physiologie der körperlichen Arbeit I. 4to. Pp. xiii + 832. (Berlin: Julius Springer, 1930.) 86 gold marks.

Buslik, Alice. Histologie. Unter Mitarbeit von Elise Wolff. (Repetitorien für techn. Assistentinnen, Heft 1.) 8vo. Pp. 65. (Berlin: Pilger und Co., 1930.) 4.50 gold marks.

Camis, Mario. The Physiology of the Vestibular Apparatus. Translated and annotated by R. S. Creed. Roy. 8vo. Pp. xiv + 310 + 27 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 21*s.* net.*

Gerandel, Emile. The Mechanism of the Heart and its Anomalies. Translated by L. F. Bishop. Roy. 8vo. Pp. 266. (London: Baillière, Tindall and Cox, 1930.) 45*s.* net.

Goodall, Alexander. Aids to Histology. Third edition. Fcap. 8vo. Pp. 118. (London: Baillière, Tindall and Cox, 1930.) 3*s.* 6*d.* net.

Henke, Friedrich, und **Lubarsch, Otto,** Herausgegeben von. Handbuch der speziellen pathologischen Anatomie und Histologie. Band 3, Teil 2: Atmungswege und Lungen. Bearbeitet von Walter Berblinger, W. Ceelen, F. Danisch, u.a. Roy. 8vo. Pp. viii + 593. (Berlin: Julius Springer, 1930.) 114 gold marks.

Lyle, H. Willoughby, and **De Souza, David.** Manual of Physiology: for Students and Practitioners. (Oxford Medical Publications.) New (third) edition. Cr. 8vo. Pp. xvi + 820 + 3 plates. (London: Oxford University Press, 1930.) 16*s.* net.

Medical Research Council. Special Report Series, No. 146: The Antiscurvy Vitamin in Apples. By Mary F. Bracewell, E. Hoyle and S. S. Zilva. Roy. 8vo. Pp. 15. (London: H.M. Stationery Office, 1930.) 9*d.* net.*

Mohr, Leo, und **Staehelin, Rudolf,** Begründet von. Handbuch der inneren Medizin. Zweite Auflage, herausgegeben von Gustav von Bergmann und R. Staehelin. Band 2: Zirkulationsorgane, Mediastinum, Zwerchfell, Luftwege, Lungen, Pleura. Teil 2. Roy. 8vo. Pp. x + 981-1988. (Berlin: Julius Springer, 1930.) 88 gold marks.

Möllendorff, Wilhelm von, Herausgegeben von. Handbuch der mikroskopischen Anatomie des Menschen. Band 6: Blutgefass- und Lymphgefassapparat, Atmungsapparat und innersekretorische Drüsen. Teil 1. 4to. Pp. viii + 584. (Berlin: Julius Springer, 1930.) 148 gold marks.

Schenck, Friedrich, und **Gürber, August.** Leitfaden der Physiologie des Menschen: für Studierende der Medizin und der Zahnheilkunde. Fünfundzwanzigste Auflage. 8vo. Pp. xii + 309. (Stuttgart: Ferdinand Enke, 1930.) 11 gold marks.

Sieglbauer, Felix. Lehrbuch der normalen Anatomie des Menschen. Zweite, vollständig umgearbeitete Auflage. 4to. Pp. xx + 880. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 25 gold marks.

Anthropology: Archaeology

Brown, G. Baldwin. The Arts in Early England. Vol. 6, Part 1: Completion of the Study of the Monuments of the Great Period of the Art of Anglian Northumbria. Roy. 8vo. Pp. xi + 91 + 23 plates. (London: John Murray, 1930.) 15*s.* net.

Cowan, James. The Maori, Yesterday and To-day. Demy 8vo. Pp. 266. (London, Auckland and Melbourne: Whitcombe and Tombs, Ltd., 1930.) 12*s.* 6*d.* net.

Günther, Hans F. R. Rassenkunde des jüdischen Volkes. Roy. 8vo. Pp. 352. (München: J. F. Lehmann, 1930.) 11 gold marks.

Obermaier, Hugo, and **Kühn, Herbert.** Bushman Art: Rock Paintings of South-West Africa, based on the Photographic Material collected by Reinhard Maack. Gl. folio. Pp. xii + 70 + 39 plates. (London: Oxford University Press, 1930.) 84*s.* net.*

O'Neill, J. G. Ancient Corinth: with a Topographical Sketch of the Corinthia. Part 1: From the Earliest Times to 404 B.C. 8vo. Pp. 279. (Baltimore, Md.: Johns Hopkins University Press; London: Oxford University Press, 1930.) 22*s.* 6*d.* net.

Osten, H. H. von der. Explorations in Hittite Asia Minor, 1929. Roy. 8vo. Pp. 196. (Cambridge: At the University Press, 1930.) 9*s.* net.

Rattray, Capt. R. S., Collected and translated by. Akan-Ashanti Folk-Tales. Fcap. 4to. Pp. xx + 276 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 21*s.* net.*

Schapera, I. The Khoisan Peoples of South Africa: Bushmen and Hottentots. (The Ethnology of Africa, edited by J. H. Driberg and I. Schapera.) Roy. 8vo. Pp. xi + 450 + 16 plates. (London: George Routledge and Sons, Ltd., 1930.) 31*s.* 6*d.* net.*

Sieveking, Johannes. Bronzen, Terrakotten, Vasen der Sammlung Loeb. 4to. Pp. xi + 65 + 53 Tafeln. (München: A. Buchholz, 1930.) 100 gold marks.

Winbolt, S. E., and **Herbert, George.** The Roman Villa at Bignor, Sussex. New edition. Demy 8vo. Pp. 18. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 1*s.* net.

Philosophy: Psychology

Aaron, R. I. The Nature of Knowing. Demy 8vo. Pp. 151. (London: Williams and Norgate, Ltd., 1930.) 7*s.* 6*d.* net.

Adam, J., Selected and arranged by. Texts to illustrate a Course of Elementary Lectures on Greek Philosophy after Aristotle. Demy 8vo. Pp. viii + 70. (London: Macmillan and Co., Ltd., 1930.) 6*s.* net.

Adler, Alfred. Praxis und Theorie der Individualpsychologie: Vorträge zur Einführung in der Psychotherapie für Ärzte, Psychologen und Lehrer. Vierte Auflage. 4to. Pp. vii + 245. (München: J. F. Bergmann, 1930.) 12.80 gold marks.

Boas, George. The Adventures of Human Thought: the Major Traditions of European Philosophy. Demy 8vo. Pp. 497. (New York and London: Harper and Bros., 1930.) 15*s.* net.

Bonar, James. Moral Sense. (Library of Philosophy.) Demy 8vo. Pp. 304. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1930.) 12*s.* 6*d.* net.

Bühler, Karl. The Mental Development of the Child: a Summary of Modern Psychological Theory. Translated from the fifth German edition by Oscar Oeser. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. xi + 170 + 3 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1930.) 8*s.* 6*d.* net.*

Bluemel, C. S. Mental Aspects of Stammering. Cr. 8vo. Pp. 152. (London: Baillière, Tindall and Cox, 1930.) 11*s.* 6*d.* net.

Cattell, R. B. The Subjective Character of Cognition: and the Pre-sensational Development of Perception. A Thesis approved for the Degree of Doctor of Philosophy in the University of London. (*The British Journal of Psychology* Monograph Supplements, 14.) Sup. Roy. 8vo. Pp. viii + 166. (Cambridge: At the University Press, 1930.) 12*s.* 6*d.* net.*

Driesch, Hans. Relativitätstheorie und Weltanschauung. Zweite umgearbeitete Auflage. 8vo. Pp. viii + 106. (Leipzig: Quelle und Meyer, 1930.) 3 gold marks.

Fernkorn, Carl Maria. Denken und Erkennen: eine grundwissenschaftliche Untersuchung zur scholastische Logik und Erkenntnistheorie. (Beihefte der "Grundwissenschaft", Nr. 6.) Roy. 8vo. Pp. 71. (Greifswald: Verlag Bamberg, 1930.) 3 gold marks.

Fisher, Raymond Anderson. The Psychology of Desire, or A Measure for Men. Med. 8vo. Pp. 158. (Saskatoon, Sask.: The Elliott Printing Co., 1930.) 2.70 dollars.

Flournoy, Theodor. Die Philosophie von William James. Übersetzt von Helene Baumgarten. Roy. 8vo. Pp. xix + 126. (Tübingen: J. C. B. Mohr, 1930.) 7.60 gold marks.

Freud, Sigmund. Civilization and its Discontents. Translated by J. Rivière. (International Psycho-analytical Library.) Roy. 8vo. Pp. 144. (London: The Hogarth Press, 1930.) 8*s.* 6*d.* net.

Furfey, Paul Hanly. The Growing Boy: Case Studies of Developmental Age. Cr. 8vo. Pp. x + 192. (New York: The Macmillan Co., 1930.) 8*s.* 6*d.* net.

Geiger, Moritz. Die Wirklichkeit der Wissenschaften und die Metaphysik. Roy. 8vo. Pp. viii + 183. (Bonn a. Rh.: Friedrich Cohen, 1930.) 8 gold marks.

Grunicke, Lucia. Der Begriff der Tatsache in der positivistischen Philosophie des 19 Jahrhunderts. 8vo. Pp. 199. (Halle a. S.: Verlag Niemeyer, 1930.) 8 gold marks.

Hart, Bernard. Psychopathology: its Development and its Place in Medicine. Second edition. Demy 8vo. Pp. vii + 178. (Cambridge: At the University Press, 1929.) 8*s.* 6*d.* net.*

Hart, Bernard. The Psychology of Insanity. (The Cambridge Manuals of Science and Literature.) Fourth edition. Roy. 16mo. Pp. xxxv + 176. (Cambridge: At the University Press, 1930.) 3*s.* net.*

Hegel, Georg Wilhelm Friedrich. Sämtliche Werke. Jubiläumsausgaben in 20 Bänden. Auf Grund der von Ludwig Boumann, Friedrich Förster, Eduard Gans u.a. besonderer Original-Druckes Faksimileverfahren herausgegeben von Hermann Glockner. Band 20: Vermischte Schriften aus der Berliner Zeit. 8vo. Pp. xxiii + 544. (Stuttgart: Verlag Frommann, 1930.) 8.90 gold marks.

Jodl, Friedrich. Geschichte der Ethik als philosophischer Wissenschaft. Band 1: Bis zum Schlusse des Zeitalters der Aufklärung. Vierte verbesserte Auflage. Roy. 8vo. Pp. xii + 687. (Stuttgart: Verlag Cotta, 1930.) 20 gold marks.

Kant, Immanuel. Grundlegung zur Metaphysik der Sitten. Neu herausgegeben von Rudolf Otto. 8vo. Pp. 213. (Gotha: Verlag Klotz, 1930.) 7 gold marks.

Levy-Suhl, Max. Die seelischen Heilmethoden des Ärztes: eine Lehre vom neurotischen Menschen. Roy. 8vo. Pp. xxi + 280. (Stuttgart: Ferdinand Enke, 1930.) 15 gold marks.

Lovejoy, Arthur O. The Revolt against Dualism: an Inquiry concerning the Existence of Ideas. (Published on the Foundation established in memory of Paul Carus, Editor of *The Open Court* and *The Monist*, 1888–1919.) Med. 8vo. Pp. xii + 325. (London: George Allen and Unwin, Ltd., 1930.) 15*s.* net.*

Lutosławski, Wincenty. The Knowledge of Reality. Cr. 8vo. Pp. xvii + 203. (Cambridge: At the University Press, 1930.) 7*s.* 6*d.* net.*

Morgan, C. Lloyd. Mind at the Crossways. Demy 8vo. Pp. xi + 275. (London: Williams and Norgate, Ltd. 1930.) 10*s.* 6*d.* net.

Petronievics, Branislav. Hauptsätze der Metaphysik. (Beiträge zur Philosophie, 17.) Med. 8vo. Pp. iii + 82. (Heidelberg: Carl Winter's Universitätsbuchhandlung, 1930.) 5 gold marks.*

Pringle-Pattison, A. Seth. Studies in the Philosophy of Religion. Partly based on the Gifford Lectures, 1923. Med. 8vo. Pp. 254. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 12*s.* 6*d.* net.

Santayana, George. The Realm of Matter. Book second of The Realm of Being. Demy 8vo. Pp. xv + 209. (London: Constable and Co., Ltd., 1930.) 12*s.* net.

Sinclair, Upton. Mental Radio: Does it Work, and How? Demy 8vo. Pp. 241. (London: T. Werner Laurie Ltd., 1930.) 8*s.* 6*d.*

Spencer, W. Wylie. Our Knowledge of Other Minds: a Study in Mental Nature, Existence and Intercourse. (Published on the Mary Cady Tew Fund.) Ex. Cr. 8vo. Pp. vi + 146. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1930.) 9*s.* net.*

Strang, Ruth. An Introduction to Child Study. Cr. 8vo. Pp. xiii + 550 + 8 plates. (New York: The Macmillan Co., 1930.) 12*s.* net.

Waterhouse, Rev. E. S. Psychology and Religion: a Series of Broadcast Talks. Cr. 8vo. Pp. xxii + 232. (London: Elkin Mathews and Marrot, Ltd., 1930.) 6*s.* net.

Weinberg, Siegfried. Erkenntnistheorie, eine Untersuchung ihrer Aufgabe und ihrer Problematik. 8vo. Pp. viii + 134. (Berlin: Carl Heymann, 1930.) 6 gold marks.

Wittels, Fritz. Critique of Love. De[illegible] P. 317. (London: George Allen and Unwin, Ltd., 1930.) 12*s.* 6*d.* net.

Ziehen, Theodor. Die Stellung der Philosophie zu den grossen Ereignissen der Geschichte. (Hallische Universitätsreden, Heft 46.) 8vo. Pp. 42. (Halle a. S.: Verlag Niemeyer, 1930.)

Miscellany

Dingwall, E. J. Ghosts and Spirits in the Ancient World. (Psyche Miniatures: General Series No. 28.) Pott 8vo. Pp. 121. (London: Kegan Paul and Co., Ltd., 1930.) 2*s.* 6*d.* net.*

Havemeyer, Loomis (Editor). **Roush, Gar A., Newell, Frederick H., Graves, Henry S., Wehrwein, George S., Redington, Paul G.,** and **Higgins, Elmer.** Conservation of our Natural Resources. Based on Van Hise's "The Conservation of Natural Resources in the United States". Demy 8vo. Pp. xxii + 551. (New York: The Macmillan Co., 1930.) 17*s.* net.*

Janssen, Jules. Œuvres scientifiques. Recueillies et publiées par Henri Dehérain. Roy. 8vo. Tome 2. Pp. 648. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1930.)*

Philip, Alexander. The Essentials of Calendar Reform. Demy 8vo. Pp. 21. (London: Ge[illegible] Routledge and Sons, Ltd., 1930.) 1*s.* 6*d.* net.*

Plarr's Lives of the Fellows of the Royal College of Surgeons of England. (Thelwall Thomas Memorial.) Revised by Sir D'Arcy Power, with the assistance of W. G. Spencer and G. E. Gask. 2 volumes. Roy. 8vo. Vol. 1. Pp. xxvi + 752. Vol. 2. Pp. 596. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1930.) Cloth, 42*s.* net; half-bound, 57*s.* 6*d.* net.*

Price, Harry. Rudi Schneider: a Scientific Examination of his Mediumship. Demy 8vo. Pp. xv + 239 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.*

Salter, Mary. The Point Theory of Creation. Cr. 8vo. Pp. 95. (London: Rider and Co., 1930.) 3*s.* net.*

Santalov, A. A., and **Segal, Louis,** Compiled and edited by. Soviet Union Year-Book, 1930. Cr. 8vo. Pp. viii + 670. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.*

Ward, Ernest. General Practice (Some further Experiences). Cr. 8vo. Pp. iv + 108. (London: John Bale, Sons and Danielsson, Ltd., 1930.) 3*s.* 6*d.* net.*

Weir, Helen B. Institutional Cookery and Dietetics. Cr. 8vo. Pp. viii + 141. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 3*s.* 6*d.**

White, William. Furness Folk and Facts. Demy 8vo. Pp. viii + 122 + 5 plates. (Kendal: Titus Wilson and Son, 1930.) 6*s.* net.

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" Office.

Mathematics: Mechanics: Physics

Barnard, George P. The Selenium Cell: its Properties and Applications. Roy. 8vo. Pp. xxix + 331. (London: Constable and Co., Ltd., 1930.) 35*s.* net.*

Borchardt, W. G. Geometry Test Papers. Pott 8vo. Pp. 88 + viii. (London: Rivingtons, 1930.) 1*s.* 3*d.*

Bowes, P. K., Compiled by. Definitions and Formulæ for Students (Light and Sound). Demy 16mo. Pp. iv + 36. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6*d.* net.

Cary, C. Descriptive Geometry for Engineers. Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12*s.* 6*d.* net.

Craig, J. I. The Elements of Analytical Geometry. Vol. 1: Straight Line and Circle. Cr. 8vo. Pp. xiv + 415. (London: Macmillan and Co., Ltd., 1930.) 12*s.* 6*d.**

Dreyer, Georg. Elemente der Graphostatik: Lehrbuch für höheren technischen Lehranstalten und für d. Selbstunterricht mit vielen Anwendungen auf Maschinenbau, Eisenhoch- und Brückenbau. (Dreyer: Statik und Festigkeit, Band 1.) Zehnte ergänzte Auflage. 4to. Pp. viii + 165 + 5 Tafeln. (Leipzig: Max Jänecke, 1930.) 6.60 gold marks.

Faraday Society. Optical Rotatory Power: a General Discussion held by the Faraday Society, April 1930. Roy. 8vo. Pp. iv + 265-461. (London: The Faraday Society, 1930.) 10*s.* 6*d.**

Fawdry, R. C., and **Beaven, H. C.** Elementary Algebra for Schools. Part 2. Cr. 8vo. Pp. viii + 217-423. (London: A. and C. Black, Ltd., 1930.) Without Answers, 3*s.*; with Answers, 3*s.* 6*d.*

Föppl, Ludwig. Aufgaben aus technischer Mechanik: Statik, Festigkeitslehre, Dynamik. Roy. 8vo. Pp. viii + 188. (München und Berlin: R. Oldenbourg, 1930.) 13 gold marks.

Fort, Tomlinson. Infinite Series. Med. 8vo. Pp. 253. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 20*s.* net.

Franklin, Wm. S., and **Grantham, G. E.** General Physics. Med. 8vo. Pp. xvi + 705. (Lancaster, Penn.: Franklin and Charles, 1930.) 4 dollars.*

Graham, Frederick B., and **Loftus, John J.** Modern City Arithmetic. Eighth Year, Second Half. Cr. 8vo. Pp. 170. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 2*s.* 6*d.* net.

Haas, Arthur. La mécanique ondulatoire et les nouvelles théories quantiques. Traduit de l'allemand par A. Bogros et F. Esclangon. Cr. 8vo. Pp. vii + 198. (Paris: Gauthier-Villars et Cie, 1930.) 30 francs.*

Haldane, J. S. The Theory of Heat Engines: including the Action of Muscles. Cr. 8vo. Pp. xv + 120. (Edinburgh and London: Oliver and Boyd, 1930.) 6*s.* net.*

Harrop, P. F. Practical Geometry and Graphics. Cr. 8vo. Pp. iv + 134. (London: Oxford University Press, 1930.) 3*s.* 6*d.*

Houstoun, R. A. Intermediate Physics. Ex. Cr. 8vo. Pp. xviii + 638. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s.* 6*d.**

Jones, A. Clement, and **Newton, H. F.** A New Trigonometry. Vol. 1: Numerical. Cr. 8vo. Pp. vii + 164. (London: A. and C. Black, Ltd., 1930.) 1*s.* 9*d.*

MacMillan, William Duncan. Theoretical Mechanics: The Theory of the Potential. Med. 8vo. Pp. xiii + 469. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 25*s.* net.*

Molony, Rev. B. C. A Numerical Trigonometry. Cr. 8vo. Pp. 215. (London: Edward Arnold and Co., 1930.) 3*s.**

Papelier, G. Éléments de trigonométrie sphérique. 8vo. Pp. 165. (Paris: Libr. Vuibert, 1930.) 20 francs.

Pöschl, Theodor. Lehrbuch der technischen Mechanik: für Ingenieure und Physiker: zum Gebrauch bei Vorlesungen und zum Selbststudium. Zweite vollständig umgearbeitete Auflage. Roy. 8vo. Pp. viii + 318. (Berlin: Julius Springer, 1930.) 17.50 gold marks.

Reidemeister, Kurt. Vorlesungen über Grundlagen der Geometrie. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 32.) Roy. 8vo. Pp. x + 147. (Berlin: Julius Springer, 1930.) 11 gold marks.*

Rogosinski, Werner. Fouriersche Reihen. (Sammlung Göschen, Band 1022.) Pott 8vo. Pp. 135. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Shearcroft, W. F. F., and **Lewis, C. N.** School Certificate Mechanics and Hydrostatics. Cr. 8vo. Pp. vii + 375. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 4*s.* 6*d.*

Spriggs, G. W. School Certificate Algebra. (Pitman's School Certificate Series.) Cr. 8vo. Pp. xviii + 326. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 4*s.*

Spriggs, G. W. Introductory School Algebra. Cr. 8vo. Pp. x + 135. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.*

Tweedy, A. E. Senior Geometry. Part 2. Cr. 8vo. Pp. ix + 180. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) Without Answers, 2*s.* 3*d.*; with Answers, 2*s.* 9*d.*

Walton, J. J. School Certificate Trigonometry (with Mensuration). Cr. 8vo. Pp. vii + 195. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) Without Answers, 3*s.* 6*d.*; with Answers, 4*s.*

Watson, F. R. Acoustics of Buildings: including Acoustics of Auditoriums and Soundproofing of Rooms. Second edition, revised. Med. 8vo. Pp. x + 155. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.*

Wells, J. H. Thirty Tests in Elementary Mathematics: including Arithmetic, Algebra, Geometry and Trigonometry. Cr. 8vo. Pp. 43. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 8*d.*

Wolkowitsch, D. Applications de la géométrie à la stabilité des constructions. Tome 2. Cr. 8vo. Pp. 270. (Paris: Gaston Doin et Cie, 1930.) 35 francs.

Zworykin, V. K., and **Wilson, E. D.** Photocells and their Application. Ex. Cr. 8vo. Pp. xi + 209. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12*s.* 6*d.* net.*

Engineering

Ardenne, Manfred von. Der Bau von Anoden- und Heizstrom-Netzanschlussgeräten. Fünfte umgearbeitete und erweiterte Auflage. 8vo. Pp. 78. (Berlin: Rothgiesser und Diesing, 1930.) 1.70 gold marks.

Ardenne, Manfred von. Die physikalischen Grundlagen der Rundfunk-Anlagen. Zweite völlig umgearbeitete Auflage von "Die Wirkungsweise der Rundfunk-Empfänger". Roy. 8vo. Pp. 115. (Berlin: Rothgiesser und Diesing, 1930.) 3.50 gold marks.

Baker, Donald M., and **Conkling, Harold.** Water Supply and Utilization. 8vo. Pp. 495. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 30*s.* net.

Betz, Louis. Spezial-Lastautomobile. 4 Bände. Band 2: Kraftomnibusse. 4to. Pp. viii + 549. (Berlin: Schmidt und Co., 1930.) 30 gold marks.

Bushnell, C. Diesel Engine Operation. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

David, Pierre. Manuel de réception radio-électrique. 8vo. Pp. 308. (Paris: Masson et Cie, 1930.) 36 francs.

Dawson, J., jun. Belting and its Application: the Construction and Use of the many Types of Belting; including a Chapter on V-shaped Ropes. Demy 8vo. Pp. 194. (London: Chapman and Hall, Ltd., 1930.) 10*s.* 6*d.* net.

Diederichs, Herman, and **Andrae, William C.** Experimental Mechanical Engineering: for Engineers and for Students in Engineering Laboratories. Vol. 1: Engineering Instruments. Med. 8vo. Pp. viii + 1082. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 40*s.* net.*

Emperger, F., Herausgegeben von. Handbuch für Eisenbetonbau. Vierte neubearbeitete Auflage. In 14 Bänden. Band 1: Geschichtliche Entwicklung, Versuche, Theorie. Bearbeitet von M. Foerster, O. Graf und O. Domke. 4to. Pp. xxiv+585. (Berlin: Wilhelm Ernst und Sohn, 1930.) 44 gold marks.

Fitze, Walther H. Elementar-Handbuch des Rundfunk-Hörers: Gemeinverständliche Übersicht des Rundfunks mit genauer Bedienungsanleitung d. Empfangsgeräte, Erl. d. wichtigsten Schaltungen und der elektr. Schallplattenwiedergabe. Vierte völlig umgearbeitete und wesentlich erweiterte Auflage. Roy. 8vo. Pp. 108. (Berlin: Rothgiesser und Diesing, 1930.) 1.50 gold marks.

Fleming, Robins. Wind Stresses in Buildings: with a Chapter on Earthquakes and Earthquake Resistance. Med. 8vo. Pp. xi+193. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.*

Gibson, Charles R. How We Harness Electricity. (Rambles in Science Series.) Cr. 8vo. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* 6*d.* net.

Gibson, Charles R. Telephones and Gramophones. (Rambles in Science Series.) Cr. 8vo. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* 6*d.* net.

Gregor, Alfred. Der praktische Eisenhochbau. 3 Bände. Band 1: Entwurf der Stahlbauten, Berechnung und Ausführung der Dach- und Hallenbauten. Fünfte neubearbeitete Auflage. 4to. Pp. xii+285. (Berlin: Hermann Meusser, 1930.) 48 gold marks.

Henrich, Hubert, Herausgegeben von. Der neuzeitliche Strassenbau. Teil 2: Konstruktion und Ausführung. Bearbeitet von Franz Knipping. Roy 8vo. Pp. viii+166. (Halle a.S.: Wilhelm Knapp, 1930.) 9.80 gold marks.

Hofman, August Clemens. Der Schirmgitter Netz-Vierer "Prases" für Wechselstrom-Vollnetz-, Gleichstrom-Vollnetz- oder Batteriebetrieb. (Dt. Radio-Bücherei, Band 7.) Zweite verbesserte und erweiterte Auflage. 8vo. Pp. 20. (Berlin: Verlag Schneider, 1930.) 1.50 gold marks.

Jahr, Willy, und **Knechtel, Paul.** Grundzüge der Getriebelehre: auf Anregung d. Ausschusses für wirtschaftliche Fertigung dargestellt. Band 1: Allgemeine Grundlagen, Schraubentriebe, Kurbeltriebe. (Bibliothek der gesamte Technik, Band 384.) 8vo. Pp. xvi+402. (Leipzig: Max Janecke, 1930.) 18 gold marks.

Kaufmann, Walther. Statik der Tragwerke. (Handbibliothek der Bauingenieure, Teil 4, Band 1.) Zweite ergänzte und verbesserte Auflage. 4to. Pp. viii+322. (Berlin: Julius Springer, 1930.) 19.50 gold marks.

Kempe, H. R., and **Smith, W. Hanneford,** Originally compiled by. Engineer's Year Book of Formulae, Rules, Tables, Data and Memoranda for 1930: a Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Compiled by Experts under the direction of the Editor of *The Engineer*. 37th Annual edition. Cr. 8vo. Pp. 3000. (London: Crosby Lockwood and Son, 1930.) 31*s.* 6*d.* net.

Kennedy, R. W. Electrical Housecraft: a Complete, Popular Guide to the Multi-uses of Electricity in the Home. Cr. 8vo. Pp. x+108. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.* net.

Klose, Georg. Asphalt und Asphaltmaschinen im Strassenbau. Roy. 8vo. Pp. 437. (Berlin: Allgemeine Industrie-Verlag, 1930.) 15 gold marks.

Philp, Charles G. Television for All: a Simple Explanation. Cr. 8vo. Pp. 82. (London: Percival Marshall and Co., 1930.) 1*s.* net.

Schmidt-Stölting, Hans. Das Problem des Ausbaues der deutschen Wasserkräfte. 8vo. Pp. 79. (Berlin: Georg Stilke, 1930.) 2 gold marks.

Soeser, Maximilian. Allgemeine Baubetriebslehre. Roy. 8vo. Pp. v+277. (Berlin: Julius Springer, 1930.) 18.60 gold marks.

Wilkins, Roy, and **Crellin, E. A.** High Voltage Oil Circuit Breakers. Med. 8vo. Pp. ix+301. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.

Chemistry: Chemical Industry

Arendt-Doermer. Leitfaden für den Unterricht in d. Chemie und Mineralogie an höheren Lehranstalten. Siebzehnte Auflage. 8vo. Pp. 144. (Leipzig: Leopold Voss, 1930.) 2.40 gold marks.

Beilstein, Friedrich Konrad. Handbuch der organischen Chemie. Vierte Auflage. Die Literatur bis 1 Januar 1910 umfassend. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von Bernhard Prager, Paul Jacobson, Paul Schmidt und Dora Stern. Band 13: Isocyclische Reihe, Polyamine, Oxy-Amine. Roy. 8vo. Pp. x+903. (Berlin: Julius Springer, 1930.) 190 gold marks.

Bertelsmann, Wilhelm, und **Schuster, Fritz.** Einführung in die technische Behandlung gasförmiger Stoffe. Roy. 8vo. Pp. x+411. (Berlin: Julius Springer, 1930.) 38 gold marks.

Bodansky, Meyer. Introduction to Physiological Chemistry. Second edition, rewritten and reset. Med. 8vo. Pp. ix+542. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 20*s.* net.*

Chemical Engineering Catalog, Compiled and edited by the Editorial Staff of the. Condensed Chemical Dictionary. Second edition, completely revised and enlarged. Med. 8vo. Pp. 551. (New York: The Chemical Catalog Co., Inc., 1930.) 10 dollars.

Curtis, C. A. Artificial Organic Pigments and their Applications. Translated from the German "Künstliche Organische Pigmentfarben" by Ernest Fyleman. Demy 8vo. Pp. viii+291. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 21*s.* net.

Deming, Horace G. In the Realm of Carbon: the Story of Organic Chemistry. Med. 8vo. Pp. x+365. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.*

Department of Scientific and Industrial Research: Building Research. Technical Paper No. 9: The Estimation of Free Calcium Hydroxide in Set Cements: a Calorimetric Method. By G. E. Bessey. Roy. 8vo. Pp. iv+25. (London: H.M. Stationery Office, 1930.) 6*d.* net.*

Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 26. The Influence of Size of Coal during Gas Manufacture. Roy. 8vo. Pp. vi+55+2 plates. (London: H.M. Stationery Office, 1930.) 1*s.* 3*d.* net.*

Doelter, C., und **Leitmeier, H.** Handbuch der Mineralchemie. Band 4. Pp. 321-480. (Dresden: Theodor Steinkopff, 1930.) 8 gold marks.

Fajans, Kasimir. Radioaktivität und die neueste Entwicklung der Lehre von den chemischen Elementen. Durchgesehen Abdruck der vierte Auflage. (Sammlung Vieweg, Heft 45.) 8vo. Pp. xi+137. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 5 gold marks.

Fischer, Emil. Anleitung zur Darstellung organischer Präparate. Herausgegeben von Burckhardt Helferich. Elfte durchgesehene Auflage. Pott 8vo. Pp. xii+107. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 2.50 gold marks.

Gibson, Charles R. About Coal and Oil. (Rambles in Science Series.) Cr. 8vo. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* 6*d.* net.

Gibson, Charles R. Discoveries in Chemistry. (Rambles in Science Series.) Cr. 8vo. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* 6*d.* net.

Gibson, Charles R. How Photography came About. (Rambles in Science Series.) Cr. 8vo. Pp. 80. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* 6*d.* net.

Grohmann, Hans. Über die Aufspeicherung von Acetylen. Pp. 22. (Berlin: Julius Springer, 1930.) 2 gold marks.

Herz, Walter. Physikalische Chemie als Grundlage der analytischen Chemie. Unter Mitarbeit von L. Lorenz. (Die chemische Analyse, Band 3.) Dritte vollständig umgearbeitete Auflage. Roy. 8vo. Pp. viii+310. (Stuttgart: Ferdinand Enke, 1930.) 17 gold marks.

Holleman, Arnold Frederik. Lehrbuch der organischen Chemie. Neunzehnte umgearbeitete und vermehrte Auflage, von Friedrich Richter. Roy. 8vo. Pp. x+530. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 20 gold marks.

Huntress, Ernest Hamlin. A Brief Introduction to the use of Beilstein's Handbuch der organischen Chemie. Med. 8vo. Pp. viii + 35. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 5s. net.*

Jacobson, Kurt. Theorie und Praxis der Hypersensibilisierung. (Photographische Bibliothek.) 8vo. Pp. 97. (Berlin: Deutsche Verlagsgesellschaft m.b.H., 1930.) 6 gold marks.

Johnson, Charles Morris. Rapid Methods for the Chemical Analysis of Special Steels, Steel making Alloys, their Ores, Graphites and Bearing Metals. Fourth edition. Med. 8vo. Pp. xix + 729. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 37s. 6d. net.*

Jung, Hermann. Die physikalische Chemie in ihrer Anwendung auf Probleme der Mineralogie, Petrographie und Geologie. Zweite Auflage des Vorlesungen über die chemische Gleichgewichtslehre von Robert Marc, neubearbeitet. Roy. 8vo. Pp. viii + 214. (Jena: Gustav Fischer, 1930.) 10 gold marks.

Kauffmann, Hugo. Allgemeine und physikalische Chemie. (Sammlung Göschen.) Teil 2. Vierte verbesserte Auflage. Pott 8vo. Pp. 148. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Kränzlein, Georg. Aluminiumchlorid in der organischen Chemie (Systematische Übersicht) Vortrag, gehalten anlässlich der Tagung der Hauptversammlung des Vereins deutscher Chemiker, e.V., Frankfurt a.M., vom 10 bis 14 Juni. (Berlin: Verlag Chemie G.m.b.H., 1930.) 3 gold marks.

Martin, Geoffrey. Volumes and Weights of Industrial Gases: Chemical Engineering Tables. Roy. 8vo. Pp. 64. (London: Crosby Lockwood and Son, 1930.) 10s 6d. net.

Mitchell, C. Ainsworth, Editor. Recent Advances in Analytical Chemistry. Vol. 1: Organic Chemistry. Contributors: C. L. Hinton, E. J. Parry, D. Jordan Lloyd, H. Chick, D. W. Kent-Jones, G. D. Elsdon, W. Dickson, J. G. King, R. A. Acton-Taylor, H. R. Ambler. Ex. Cr. 8vo. Pp. x + 421 + 6 plates. (London: J. and A. Churchill, 1930.) 12s. 6d.*

Sadtler, Samuel S. Chemistry of Familiar Things. Sixth edition, revised and enlarged. 8vo. Pp. 342. (Philadelphia and London: J. B. Lippincott Co., 1930.) 15s. net.

Technology

Chenoweth, W. W. Food Preservation: a Textbook for Student, Teacher, Home-maker and Home Factory Operator. (The Wiley Agricultural Series.) Med. 8vo. Pp. vii + 344. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Cronshaw, H. B., and others. Edited by. Rubber Information: an Industrial and Commercial Compendium. 8vo. Pp. 237. (London: Leonard Hill, Ltd., 1930.) 10s. net.

Department of Scientific and Industrial Research: Food Investigation. Special Report No. 38: Wastage in Imported Fruit; its Nature, Extent and Prevention. By J. Barker. Roy. 8vo. Pp. vi + 62 + 9 plates. (London: H.M. Stationery Office, 1930.) 1s. 6d. net.*

Frazer, Samuel W., and **Stine, George F.** A Treatise on the Air Brush: with Progressive Lessons. Sup. Roy. 8vo. Pp. x + 203. (London: Chapman and Hall, Ltd., 1930.) 12s. 6d. net.*

Rosenholtz, Joseph L. The Elements of Ferrous Metallurgy. Med. 8vo. Pp. vii + 248. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Meteorology: Geophysics

Air Ministry: Meteorological Office. Réseau Mondial 1923: Monthly and Annual Summaries of Pressure, Temperature and Precipitation, based on a World-wide Network of Observing Stations. (M.O. 322.) Published by the Authority of the Meteorological Committee. Roy. 4to. Pp. xv + 115. (London: H.M. Stationery Office, 1930.) 25s. net.*

Air Ministry: Meteorological Office. The Weekly Weather Report for the Period March 3, 1929, to March 1, 1930. Fifty-second Year. Vol. 46. New Series: Particulars of Temperature, Rainfall and Bright Sunshine for each Week. (M.O. 311.) Published by the Authority of the Meteorological Committee. Roy. 4to. Pp. 72. (London: H.M. Stationery Office, 1930.) 15s. net.*

Air Ministry: Meteorological Office. Geophysical Memoirs No. 50: Practical Examples of Polar-Front Analysis over the British Isles in 1925 6. By J. Bjerknes. (M.O. 307j.) Published by the Authority of the Meteorological Committee. Roy. 4to. Pp. 21 + 28 plates. 3s. net. Geophysical Memoirs No. 51: A Study of Visibility and Fog at Malta. By J. Wadsworth. (M.O. 331a.) Published by the Authority of the Meteorological Committee. Roy. 4to. Pp. 23 + 1 plate. 1s. 6d. net. (London: H.M. Stationery Office, 1930).*

Air Ministry: Meteorological Office. Professional Notes, No. 57: The Effect of Variation in relative Wind Force on the Readings of the Wet and Dry Bulb Thermometers in a Portable Screen on Board Ship. By E. G. Bilham and J. E. Belasco. (M.O. 273q.) Published by the Authority of the Meteorological Committee. Roy. 8vo. Pp. 10 + 2 plates. 3d. net. Professional Notes, No. 58: A new Relation between Atmospheric Electricity and Terrestrial Magnetism. By A. W. Lee. (M.O. 273r.) Published by the Authority of the Meteorological Committee. Roy. 8vo Pp. 8 + 3 plates. 3d. net. (London: H.M. Stationery Office, 1930.)*

Gregg, Willis Ray, with the collaboration of C. G. Andrus, R. N. Covert, H. M. Hightman, V. E. Jakl, D. M. Little, F. W. Reichelderfer, J. A. Riley and R. H. Weightman. Aeronautical Meteorology. Second edition, revised and enlarged. Demy 8vo. Pp. xvi + 405. (New York: The Ronald Press Co., 1930.) 4.50 dollars.*

Hosmer, George L. Geodesy: including Astronomical Observations, Gravity Measurements and Method of Least Squares. Second edition, revised and enlarged. Med. 8vo. Pp. xiv + 461. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22s. 6d. net.*

Thost, Ernst. Das Klima des nordlichen Wurttemberg. Roy. 8vo. Pp. viii + 138. (Stuttgart: Fleischhauer und Spohn, 1930.) 5 gold marks.

Geology: Mineralogy

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 334. Abt. 10: Methoden der Geologie, Mineralogie, Paläobiologie, Geographie, Heft 8 (Schluss). Die Erforschung des Erdinnern, von August Sieberg; Die mechanische Phasenanalyse, von Ferdinand v. Wolff und Wilhelm Jager. Sup. Roy. 8vo. Pp. 883 1048 + xvi. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 10.50 gold marks.*

Cushman, Joseph A., and **Valentine, William W.** Shallow-water Foraminifera from the Channel Islands of Southern California. (Contributions from the Department of Geology of Stanford University, Vol. 1, No. 1.) Sup. Roy. 8vo. Pp. 51 + 10 plates. (Stanford University, Calif. Stanford University Press; London: Oxford University Press, 1930.) 4s. 6d. net.*

Longwell, Chester R. Outlines of Physical Geology. Prepared from the third edition of Part I. of "A Textbook of Geology" by the late Louis V. Pirsson and Charles Schuchert. Med. 8vo. Pp. v + 376. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Sander, Bruno. Gefugekunde der Gesteine: mit besonderer Berücksichtigung der Tektonite. Sup. Roy. 8vo. Pp. vi + 352. (Wien: Julius Springer, 1930.) 39.60 gold marks.*

Torgasheff, Boris P. The Mineral Industry of the Far East. 8vo. Pp 520 + 14 maps. (Shanghai: The Chali Co., Ltd., 1930.) 40s.

Geography: Travel

Baedeker, Karl. Die Schweiz: Chamonix, die Oberitalienischen Seen; Handbuch fur Reisende. 38 Auflage. Pott 8vo. Pp. lxii + 614. (Leipzig: Karl Baedeker, 1930.) 14 gold marks.

Belloc, Hilaire. Many Cities. New edition. Feap. 4to. Pp. xi + 262. (London: Constable and Co., Ltd., 1930.) 10*s*. 6*d*. net.

Blache, P. Vidal de la, et Gallois, M. Géographie universelle. Tome 10: Océanie, par P. Privat-Deschanel; Régions polaires Australes, par M. Zimmermann. Sup. Roy. 8vo. Pp. 368. (Paris: Armand Colin, 1930.) 90 francs.

Brunies, Stefan. Streifzuge durch den schweizerischen Nationalpark. Zweite Auflage. 8vo. Pp. 108. (Basel: Benno Schwabe und Co., 1930.) 2.40 gold marks.

Chalfant, W. A. Death Valley: the Facts. Med. 8vo. Pp. ix + 155 + 16 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1930.) 16*s*. net.*

Clowser, C. E., and Midgley, C. The British Empire (not including the British Isles). (Modern World Geographies, Book IIa.) Cr. 8vo. Pp. 347. (Exeter: A. Wheaton and Co. Ltd., 1930.) 3*s*. 6*d*. net.

Crockett, Rev. W. S. The Scott Country. Sixth edition, thoroughly revised and entirely reset. Demy 8vo. Pp. xii + 244. (London: A. and C. Black, Ltd., 1930.) 7*s*. 6*d*. net.

Crockett, William Day, and Crockett, Sarah Gates. A Satchel Guide to Spain and Portugal. Feap. 8vo. Pp. xlix + 350. (London: George Allen and Unwin, Ltd., 1930.) 16*s*. net.

Currey, Muriel. Dalmatia. Feap 8vo. Pp. 168. (London: Philip Allan and Co., Ltd., 1930.) 5*s*. net.

Davies, W. Watkin. A Wayfarer in Wales. Cr. 8vo. Pp. x + 212. (London: Methuen and Co., Ltd., 1930.) 7*s*. 6*d*. net.

Elliott, S. J., and Goadby, T. S., Compiled by. Geographical Statistics: a Notebook for Students. Feap. 4to. Pp. 56. (London: The Gregg Publishing Co., Ltd., 1930.) 1*s*. 6*d*. net.

Elston, Roy. Travels in Normandy. Cr. 8vo. Pp. ix + 332. (London: G. Bell and Sons, Ltd., 1930.) 7*s*. 6*d*. net.

Elston, Roy. The Traveller's Handbook to Normandy and Brittany. Feap. 8vo. Pp. 540. (London: Simpkin Marshall, Ltd., 1930.) 8*s*. 6*d*. net.

Eriksen, Sigurd. Norge: Scharen, Fjorde und Sonne; ein Fuhrer fur Schiffsreisende durch Norwegen, Island und Spitzbergen. Pott 8vo. Pp. 214. (Hamburg: Verlag Stilke, 1930.) 4.50 gold marks.

Fagg, C. C., and Hutchings, G. E. An Introduction to Regional Surveying. Demy 8vo. Pp. xi + 150. (Cambridge: At the University Press, 1930.) 7*s*. 6*d*. net.*

Finch, Robert. North America. (Individual Geographies.) Cr. 8vo. Pp. vi + 122. (London: A. and C. Black, Ltd., 1930.) 1*s*. 6*d*.

Franck, Harry A. A Scandinavian Summer: Five Months in Denmark, Finland, Sweden, Norway and Iceland. Demy 8vo. Pp. 398. (London: Methuen and Co., Ltd., 1930.) 12*s*. 6*d*. net.

Fry, G. C. A Textbook of Geography. Seventh edition. Cr. 8vo. Pp. xxii + 516. (London: University Tutorial Press, Ltd., 1930.) 6*s*. 6*d*.

Gibbons, John. Afoot in Italy. Cr. 8vo. Pp. 248. (London: George Newnes, Ltd., 1930.) 7*s*. 6*d*. net.

Horner, Alfred. Kärnten. (Monographien zur Erdkunde, Band 41.) 4to. Pp. 46 + 48 + 8. (Bielefeld: Velhagen und Klasing, 1930.) 7 gold marks.

James, M. R. Suffolk and Norfolk: a Perambulation of the Two Counties, with Notices of their History and their Ancient Buildings. Cr. 4to. Pp. 240. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 5*s*. net.

Lüders, E. Unter indischer Sonne. 8vo. Pp. 151. (Leipzig: Quelle und Meyer, 1930.) 8 gold marks.

Miles, Hamish. Fair Perthshire. Sup. Roy. 8vo. Pp. xiii + 184. (London: John Lane, The Bodley Head, Ltd., 1930.) 15*s*. net.

Moeschlin, Felix. Amerika vom Auto aus: 20,000 km. U.S.A. Roy. 8vo. Pp. 187 + 128 Tafeln. (Erlenbach-Zürich und Munchen: Eugen Rentsch, 1930.) 12 gold marks.

Muirhead, Findlay, Edited by. Switzerland: with Chamonix and the Italian Lakes. (The Blue Guides.) Second edition. Feap. 8vo. Pp. lxii + 508. (London: Macmillan and Co., Ltd.; Paris: Libr. Hachette, 1930.) 15*s*. net.

Muirhead, Findlay, Edited by. 70 Miles around London. (The Blue Guides.) Feap. 8vo. Pp. xvi + 306 + 48. (London: Macmillan and Co., Ltd.; Paris: Libr. Hachette, 1930.) 7*s*. 6*d*. net.

Muirhead, Findlay, Edited by. Great Britain. (The Blue Guides.) Feap. 8vo. Pp. liv + 683. (London: Macmillan and Co., Ltd.; Paris: Libr. Hachette, 1930.) 15*s*. net.

Mulley, J. T. The Americas. (The Living World Geographies, Book 4.) Cr. 8vo. Pp. 144. (London: Edward Arnold and Co., 1930.) Paper, 1*s*. 6*d*.; limp cloth, 1*s*. 9*d*.

Nobile, Umberto. With the *Italia* to the North Pole. English translation by Frank Fleetwood. Demy 8vo. Pp. 358 + 8 plates. (London: George Allen and Unwin, Ltd., 1930.) 15*s*. net.

Perckhammer, Heinz von. Von China und Chinesen. (Schaubucher, Band 28.) 8vo. Pp. 16 + 64 Tafeln. (Zurich: Orell Füssli, 1930.) 2.40 gold marks.

Ramsay, Gertrude M. N. The Road Home: a Journey of Exploration. Cr. 8vo. Pp. 226. (London: John Murray, 1930.) 6*s*. net.

Roome, William J. W. Tramping Through Africa: a Dozen Crossings of the Continent. Med. 8vo. Pp. xii + 330. (London: A. and C. Black, Ltd., 1930.) 15*s*. net.

Sankey, H., and Merrett, Edgar A. Progressive Studies in Geography: for Use in conjunction with the Human Geographies (Secondary Series). Cr. 8vo. Book 2: The Atlantic Hemisphere. Pp. vi + 56. Paper, 10*d*.; limp cloth, 1*s*. 1*d*. Book 3: Euro-Asia. Pp. vi + 42. Paper, 9*d*.; limp cloth, 1*s*. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1930.)

Sargent, A. J. Seaways of the Empire: Notes on the Geography of Transport. Second edition, revised and entirely reset. Cr. 8vo. Pp. xii + 145. (London: A. and C. Black, Ltd., 1930.) 6*s*. net.

Sloane, Roscoe C., and Montz, John M. Elements of Topographic Drawing. Med. 8vo. Pp. 188. (New York: McGraw Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.

Sölch, Johann. Die Ostalpen. (Jedermanns Bucherei, Abteilung: Erdkunde.) 8vo. Pp. 116 + 20. (Breslau: Ferdinand Hirt, 1930.) 3.50 gold marks.

Spada, Friedel. Mit Flote und Lippenstift: Asienfahrt. Roy. 8vo. Pp. 132. (Munchen: Knorr und Hirth, 1930.) 4.80 gold marks.

Spary, V. C. New Regional Map Books. Book 3: Africa and Europe. Cr. 4to. Pp. 32. (London: University of London Press, Ltd., 1930.) 1*s*.

Stamp, L. Dudley. A Regional Geography: for Higher Certificate and Intermediate Courses. Demy 8vo. Part 1: The Americas. Pp. viii + 177. 3*s*. 6*d*. Part 3: Australia and New Zealand. Pp. viii + 101. 3*s*. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.)

Stamp, L. Dudley. Real Life Geography. (The Key to Commerce Series.) Cr. 8vo. Pp. viii + 140. (London: George Gill and Sons, Ltd., 1930.) 1*s*. 6*d*.

Stamp, L. Dudley, and Stamp, Elsa A. At Home. (Longmans' New Age Geographies, Junior Series, Book 1.) Urban edition, for Town Schools. Cr. 8vo. Pp. iv + 92 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 1*s*. 6*d*.

Stamp, L. Dudley, and Stamp, Elsa C. Far Away. (Longmans' New Age Geographies, Junior Series, Book 2.) Cr. 8vo. Pp. vi + 122 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 1*s*. 8*d*.

Stöckl, Hans. Du schones Osterreich! Wanderungen und Reisen. 8vo. Pp. 188. (Wien und Leipzig: Österreichischer Bundesverlag für Unterricht, Wissenschaft und Kunst, 1930.) 2.80 gold marks.

Stuart-Watt, Eva. Africa's Dome of Mystery: comprising the first Descriptive History of the Wachagga People of Kilimanjaro, their Evangelization and a Girl's Pioneer Climb to the Crater of their 19,000 feet Snow Shrine. Sup. Roy. 8vo. Pp. 214. (London: Marshall, Morgan and Scott, Ltd., 1930.) 10*s*. 6*d*. net.

Sutton, Richard L. The Long Trek: Around the World with Camera and Rifle. Roy. 8vo. Pp. 348. (London: Henry Kimpton, 1930.) 21*s*. net.

Treatt, Stella Court. Sudan Sand: Filming the Baggara Arabs. Med. 8vo. Pp. 252. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 15s. net.

Tweedie, Mrs. Alec. (*née* Harley). Hyde Park: its History and Romance. Abridged revised edition. Cr 8vo. Pp. vii + 239 + 29 plates. (London: Besant and Co., Ltd., 1930.) 3s. 6d. net.*

Ule, Willi. Mecklenburg. (Monographien zur Erdkunde, Band 43.) 4to. Pp. 49 + 4 Tafeln. (Bielefeld: Velhagen und Klasing, 1930.) 7 gold marks.

Untermeyer, Louis. Blue Rhine, Black Forest: a Hand-and-Day-Book. Demy 8vo. Pp. 256. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7s. 6d. net.

Wegener, Alfred. Mit Motorboot und Schlitten in Grönland. Mit Beitragen von Johannes Georgi, Fritz Loewe und Ernst Sorge. Demy 8vo. Pp. iv + 192. (Bielefeld: Velhagen und Klasing, 1930.) 7 gold marks.

Whitbeck, R. H., and Finch, V. C. Economic Geography. Second edition. Med. 8vo. Pp. 565. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 17s. 6d. net.

Williams, Leonard. The Waistcoat-pocket Guide to Paris. Third edition. 32mo. Pp. 251. (London: The Richards Press, Ltd., 1930.) 2s. 6d. net.

Wilson, Lieut.-Col. Sir Arnold. A Bibliography of Persia. Roy. 8vo. Pp. x + 253. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 20s. net.*

Wilstach, Paul. An Italian Holiday. Roy 8vo. Pp. 382. (New York and London: Harper and Bros., 1930.) 12s. 6d. net.

Winbolt, S. E. Kent. (Bell's Pocket Guides: English Counties.) Feap. 8vo. Pp. xxxvi + 324 + 50 plates. (London: G. Bell and Sons, Ltd., 1930.) 6s. net.

Wundt, Theodor. Zermatt und seine Berge. 4to. Pp. xii + 140. (Zurich: Orell Fussli, 1930.) 12.40 gold marks.

General Biology: Natural History: Botany: Zoology

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 333. Abt. 9: Methoden der Erforschung der Leistungen des tierischen Organismus, Teil 5, Heft 5. Methoden der Meerwasserbiologie. Die Kultur der Auster. Von Rudolf Kandler. Sup. Roy. 8vo. Pp. 599-716. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 7 gold marks.*

Abrams, Leroy. An Illustrated Flora of the Pacific States: Washington, Oregon and California. In 3 volumes. Imp. 8vo. Vol. 1: Ophioglossaceae to Aristolochiaceae, Ferns to Birthworts. Pp. xi + 557. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1923.) 40s. net.*

Australasian Antarctic Expedition, 1911-1914. Scientific Reports, Series C: Zoology and Botany. Vol. 6, Part 7: Marine Free-living Nemas. By N. A. Cobb. Roy. 4to. Pp. 28. (Sydney, N.S.W.: Alfred James Kent, 1930.) 5s.*

Bodenheimer, F. S. Die Schadlingsfauna Palastinas: unter besonderer Berucksichtigung der Grossschadlinge des Mittelmeergebietes. (Monographien zur angewandten Entomologie: Beihefte zur Zeitschrift fur angewandte Entomologie, herausgegeben von K. Escherich, Nr. 10.) Sup. Roy. 8vo. Pp. xv (Berlin: Paul Pa 1930.) 42 gold marks.*

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report: Zoology. Vol. 8, No. 4: Crustacea, Part 11: Amphipoda. By K. H. Barnard. Roy. 4to. Pp. 307-454. 12s. 6d. Vol. 4, No. 5: Birds. By P. R. Lowe and N. B. Kinnear. Roy. 4to. Pp. 103-193 + 16 plates. 20s. (London: British Museum (Natural History), 1930.)*

British Museum (Natural History). Diptera of Patagonia and South Chile: based mainly on Material in the British Museum (Natural History). Part 5, Fascicule 2: Stratiomyiidae, by D. Aubertin; Tabanidae, by O. Krober; Bombyliidae, Nemestrinidae, Cyrtidae, by F. W. Edwards. Demy 8vo. Pp. 93-197 + plates 4-5. (London: British Museum (Natural History), 1930.) 5s.*

British Museum (Natural History). Insects of Samoa and other Samoan Terrestrial Arthropoda. Part 2: Hemiptera. Fascicule 3: Heteroptera. By W. E. China. Cr. 4to. Pp. 81-162. (London: British Museum (Natural History), 1930.) 5s.*

Browning, Gareth H. The Children's Book of Wild-Flowers, and the Story of their Names. Second series. Pott 4to. Pp. 245 + 50 plates. (London and Edinburgh: W. and R. Chambers, Ltd., 1930.) 10s. 6d. net.

Elton, Charles. Animal Ecology and Evolution. Cr. 8vo. Pp. 96. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 4s. 6d. net.*

Fischer, Albert. Gewebezuchtung: Handbuch der Biologie d. Gewebezelle *in vitro*. Dritte vermehrte Auflage. 4to. Pp. xvi + 661. (Munchen: Muller und Steinicke, 1930.) 79 gold marks.

Fishery Board for Scotland. Salmon Fisheries, 1930, No. 1: The Identification of Bacillus Salmonicida by the Complement Fixation Test: a Further Contribution to the Study of Furunculosis of the Salmonidae. By Isobel Blake (I. J. F. Williamson) and Eleanor J. M. Anderson. Imp. 8vo. Pp. 10. (Edinburgh and London: H.M. Stationery Office, 1930.) 9d. net.*

Hogben, Lancelot T. Principles of Animal Biology. Cr. 8vo. Pp. xxiv + 332. (London: Christophers, 1930.) 8s. 6d. net.*

Jost, Ludwig. Die Entstehung der groszen Entdeckungen in der Botanik: Rede zur Reichsgrundungsfeier am 18 Januar 1930. (Heidelberger Universitatsreden, Heft 9.) Roy. 8vo. Pp. 29. (Heidelberg: Carl Winter, 1930.) 1 gold mark.

Krause, Kurt. Bluten und Insekten. (Bucher der Naturwissenschaften, Band 33: Reclams Universal-Bibliothek, Nr. 7067-69.) Pott 8vo. Pp. 188. (Leipzig: Reclam Verlag, 1930.) 1.20 gold marks.

Kükenthal, Willy, Gegrundet von. Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Herausgegeben von Thilo Krumbach. Band 4: Progoneata, Chilopoda, Insecta. Lieferung 8. Demy 4to. Pp. 801-892. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 12 gold marks.*

La Touche, J. D. D. A Handbook of the Birds of Eastern China (Chihli, Shantung, Kiangsu, Anhwei, Kiangsi, Chekiang, Fohkien and Kwangtung Provinces). Part 5: Containing Families Motacillidae, Alaudidae, Zosteropidae, Nectariniidae, Dicaeidae, Pittidae and Eurylaimidae. Roy 8vo. Pp. 399-500 + xx + 2 plates. (London: Taylor and Francis, 1930). 7s. 6d. net.*

Loeske, Leopold. Monographie der europaischen Grimmiaceen. (Bibliotheca Botanica, Heft 101.) 4to. Pp. ix + 236. (Stuttgart: E. Schweizerbart, 1930.) 66 gold marks.

Lowson's Text Book of Botany. (Indian edition.) Revised and adapted by Birbal Sahni. Fourth edition, revised by L. C. Fox. Cr. 8vo. Pp. x + 655. (London: University Tutorial Press, Ltd., 1930.) 9s. 6d.

Pax, Ferdinand, und Arndt, Walther, Herausgegeben von. Die Rohstoffe des Tierreichs. Sup. Roy 8vo. Lieferung 5, Band 1. Pp. 321-448. (Berlin: Gebruder Borntraeger, 1930.) 12 gold marks.*

Ridley, Henry N. The Dispersal of Plants throughout the World. Roy 8vo. Pp. xx + 744 + 22 plates. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 63s. net.*

Strasburger's Text-Book of Botany. Rewritten by Hans Fitting, Hermann Sierp, Richard Harder and George Karsten. Sixth English edition, translated from the seven- German edition by W. H. Lang. Demy 8vo. Pp. xii + 818. (London: Macmillan and Co., Ltd., 1930.) 31s. 6d. net.*

Verne, Jean. Couleurs et pigments des êtres vivants. (Collection Armand Colin: Section de biologie, No. 123). Feap. 8vo. Pp. 219. (Paris: Armand Colin, 1930.) 10.50 francs.*

Ward, F. Kingdon. Plant Hunting on the Edge of the World. Demy 8vo. Pp. 383 + 16 plates. (London: Victor Gollancz, Ltd., 1930.) 21s. net.*

Wauton, Charles A. N. Troutfishers' Entomology: an Elementary Treatise on Natural Flies. Feap. 8vo. Pp. 72. (London: The *Fishing Gazette*, 1930.) 5s. net.

Williams, Edward H. Animal Autobiographies. Cr. 8vo. Pp. 123. (London: Baillière, Tindall and Cox, 1930.) 4s. 6d.

Horticulture: Agriculture: Forestry

Billings, William A. Live-Stock and Poultry Diseases. (Rural Science Series.) Cr. 8vo. Pp. xvi + 504. (New York: The Macmillan Co., 1930.) 15*s*. net.

Brown, Sir Edward. British Poultry Husbandry: its Evolution and History. Demy 8vo. Pp. 350 + 32 plates. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.*

Burgess, C., and **Graves, P. E.** Sugar Beet in the Eastern Counties, 1929: being the Final Report on an Investigation into the Financial Results of Sugar Beet Growing, and the Principal Factors influencing them, during the Three Seasons 1927, 1928 and 1929, with particular reference to the Latter Year. (University of Cambridge: Department of Agriculture, Farm Economics Branch, Report No. 16.) Cr. 4to. Pp. ix + 70. (Cambridge: W. Heffer and Sons, Ltd., 1930.) 2*s*. 6*d*. net.*

Cohen, Ruth L. Factors Affecting the Price of Potatoes in Great Britain. (University of Cambridge: Department of Agriculture, Farm Economics Branch, Report No. 15.) Cr. 4to. Pp. iv + 55. (Cambridge: W. Heffer and Sons, Ltd., 1930.) 2*s*. 6*d*. net.*

Correvon, Henry. Rock Garden and Alpine Plants. Edited by Leonard Barron. Demy 8vo. Pp. xv + 544 + 16 plates. (London: Macmillan and Co., Ltd., 1930.) 25*s*. net.

Costenoble, H. V. Der Reis (*Oryza sativa*). (Die Tropenreihe, Nr. 18.) 8vo. Pp. 28. (Hamburg: Verlag Thaden, 1930.) 3 gold marks.

Cox, Joseph F. Crop Production and Management. (The Wiley Farm Series.) Second edition, revised. Ex. Cr. 8vo. Pp. xii + 469. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 13*s*. 6*d*. net.*

Department of Scientific and Industrial Research: Food Investigation. Special Report No. 39: The Prevention of Wastage in New Zealand Apples. By J. Barker. Roy. 8vo. Pp. v + 26. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Department of Scientific and Industrial Research: Forest Products Research. Bulletin No. 6: The Timber of Corsican Pine (*Pinus Laricio* Poiret). Cr. 4to. Pp. vii + 40 + 4 plates. (London: H.M. Stationery Office, 1930.) 2*s*. 6*d*. net.*

Empire Marketing Board. The Production of Tung Oil in the Empire: Memorandum prepared by the Imperial Institute with the co-operation of the Tung Oil Sub-Committee of its Advisory Committee on Oils and Oilseeds, and issued by the Empire Marketing Board. (E.M.B. 31.) Cr. 4to. Pp. 20 + 8 plates. 1*s*. net. Report on the Cultivation, Treatment and Prospects of Rice in British Guiana. By Charles E. Douglas. (E.M.B. 32.) Cr. 4to. Pp. 63 + 13 plates. 1*s*. net. (London: H.M. Stationery Office, 1930.) *

Ettling, Carl. Die wichtigsten tropischen Gewürzpflanzen. 2 Teile. Teil 1: Die Pfefferstaude (*Piper nigrum*), Kultur und Ernte. (Die Tropenreihe, Nr. 24.) 8vo. Pp. 32. 2.50 gold marks. Teil 2: Die Muskatnuss, Muskatnussblüte, Gewürznelken, Kanehl. (Die Tropenreihe, Nr. 25.) 8vo. Pp. 36. 3 gold marks. (Hamburg: Verlag Thaden, 1930.)

Ettling, Carl. Tropische Nebenkulturen: Batate, Erdnuss, Rizinusstaude, Sesam, Cassave (Manihot), Taro, Yam, Arrowroot, Kapok, u.a. (Die Tropenreihe, Nr. 22.) 8vo. Pp. 64. (Hamburg: Verlag Thaden, 1930.) 4 gold marks.

Ettling, Carl. Der Obstbau in den Tropen. (Die Tropenreihe, Nr. 23.) 8vo. Pp. 56. (Hamburg: Verlag Thaden, 1930.) 3.50 gold marks.

Hoffmann, Willy. Die Kultur der Kokospalme und die Verwertung ihrer Produkte. (Die Tropenreihe, Nr. 19.) 8vo. Pp. 70. (Hamburg: Verlag Thaden, 1930.) 4 gold marks.

Howes, Herbert. Management of Farm Poultry: with a View to Profit. Demy 8vo. Pp. xvi + 180 + 50 plates. (London: Chapman and Hall, Ltd., 1930.) 10*s*. 6*d*. net.*

Hultz, Fred S. Range Beef Production in the Seventeen Western States. Ex. Cr. 8vo. Pp. xv + 208. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s*. 6*d*. net.*

Husain, Zakir. Die Agrarverfassung von Britisch Indien. (Berichte uber Landwirtschaft, Sonderheft 25.) 4to. Pp. v + 138. (Berlin: Paul Parey, 1930.) 7.50 gold marks.

Kirkpatrick, W. H. The Seasonal Distribution of Farm Labour Requirements. (University of Cambridge Department of Agriculture, Farm Economics Branch, Report No. 14.) Cr. 4to. Pp. iv + 44. (Cambridge: W. Heffer and Sons, Ltd., 1930.) 2*s*. net.*

McDowell, John C., and **Field, Albert M.** Dairy Enterprises. (Farm Enterprise Series.) Demy 8vo. Pp. vii + 471. (Philadelphia and London: J. B. Lippincott Co., 1930.) 10*s*. 6*d*. net.

Ministry of Agriculture and Fisheries. Bulletin No. 1: Some Diseases of Farm Animals. Roy. 8vo. Pp. v + 137 + 4 plates. 1*s*. 6*d*. net. Bulletin No. 3: The Improvement of Grass Land. (Formerly Miscellaneous Publications, No. 24.) Roy. 8vo. Pp. vi + 51. 8*d*. net. Bulletin No. 6: Some Diseases of Poultry. Roy. 8vo. Pp. v + 46 + 9 plates. 8*d*. net. Bulletin No. 7: The Scientific Principles of Poultry Feeding. By E. T. Halnan. Roy. 8vo. Pp. vii + 26. 8*d*. net. Bulletin No. 8: Poultry Keeping on the General Farm. Roy. 8vo. Pp. viii + 34 + 3 plates. 8*d*. net. Bulletin No. 17: County Egg Laying Trials in England. Roy. 8vo. Pp. 64. 1*s*. 6*d*. net. Bulletin No. 18: Table Poultry Production; Report on the Experiments conducted under the National Poultry Institute Scheme at the South-Eastern Agricultural College, Wye, Kent. Roy. 8vo. Pp. v + 46 + 5 plates. 1*s*. 6*d*. net. Bulletin No. 19: Poultry Breeding for Egg Production; The Effects of In-Breeding. Roy. 8vo. Pp. v + 24. 6*d*. net. (London: Ministry of Agriculture and Fisheries, 1930.) *

Passmore, J. B. The English Plough. Med. 8vo. Pp. 84. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 7*s*. 6*d*. net.

Rice, James E., and **Botsford, Harold E.** Practical Poultry Management. (The Wiley Farm Series.) Second edition, extensively revised. Ex. Cr. 8vo. Pp. xvii + 540. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 13*s*. 6*d*. net.*

Smith, Clarence Beaman, and **Wilson, M. C.** The Agricultural Extension System of the United States. 8vo. Pp. 402. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s*. 6*d*. net.

Snapp, Roscoe R. Beef Cattle: their Feeding and Management in the Corn Belt States. (The Wiley Agricultural Series.) Second edition, entirely revised. Med. 8vo. Pp. viii + 494. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 20*s*. net.*

Snyder, Harry. Bread: a Collection of Popular Papers on Wheat, Flour and Bread. With Biographical Sketch by Andrew L. Winton. Ex. Cr. 8vo. Pp. x + 2[illegible] + 20 plates. (New York: The Macmillan Co., 1930.) 10*s*. 6*d*. net.*

Soares, José Carlos de Macedo. Rubber: an Economic and Statistical Study. Preface to the Brazilian edition by Antonio Carlos Ribeiro de Andrada, and Preface to the English edition by Philip Schidrowitz. Demy 8vo. Pp. xii + 93. (London: Constable and Co., Ltd., 1930.) 6*s*. net.*

Stewart, Rolland M., and **Getmar, Arthur K.** Teaching Agricultural Vocations. Second edition. 8vo. Pp. 377. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

Swanson, W. W., and **Armstrong, P. C.** Wheat. Demy 8vo. Pp. xiii + 320. (Toronto: The Macmillan Co. of Canada, Ltd., 1930.) 12*s*. 6*d*. net.

Winters, Laurence M. Animal Breeding. (The Wiley Agricultural Series.) Second edition, rewritten and reset. Med. 8vo. Pp. x + 389. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s*. 6*d*. net.*

Yapp, William Wodin, and **Nevens, William Barbour.** Dairy Cattle: Selection, Feeding and Management. (The Wiley Farm Series.) Second edition. Ex. Cr. 8vo. Pp. xx + 390. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12*s*. 6*d*. net.*

Anatomy: Physiology

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 331. Abt. 9: Methoden der Erforschung der Leistungen der tierischen Organismus, Teil 4, Heft 4 (Schluss). Methoden und Technik der vergleichenden Stoffwechselphysiologie bei Wirbellosen. Von H. P. Wolvekamp. Sup. Roy. 8vo. Pp. 439-524 + xiv. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 5.50 gold marks.*

Drennan, M. R. A Short Course on the Mechanism of Voice and Speech. Cr. 8vo. Pp. xi + 67 + 21 plates. (Cape Town: The Mercantile Press, 1929.) 5*s*. 6*d*.

Harris, J. A.; Jackson, C. M.; Paterson, D. G.; and **Scammon, R. E.** The Measurement of Man. Med. 8vo. Pp. vii + 215. (Minneapolis, Minn.: University of Minnesota Press, 1930.) 2.50 dollars.*

Jones, Daniel. The Organs of Speech. Wall Chart for Class Use. Second impression. (Cambridge: At the University Press, 1930.) Paper, folded in envelope, 3*s*. 6*d*. net; canvas, folded, 7*s*. 6*d*. net.

Laroche, Guy; Richet fils, Charles; and **Saint-Girons, François.** Alimentary Anaphylaxis (Gastro-intestinal Food Allergy). Translated by Mildred P. Rowe and Albert H. Rowe. Cr. 8vo. Pp. ix + 139. (Berkeley, Calif.: University of California Press: London: Cambridge University Press, 1930.) 2 dollars.*

Ministry of Health. Reports on Public Health and Medical Subjects, No. 59: Report on Cancer of the Lip, Tongue and Skin; an Analysis of the Literature, from a Statistical Standpoint, with special reference to the Results of Treatment. By Janet E. Lane Claypon. Roy. 8vo. Pp. 121. (London: H.M. Stationery Office, 1930.) 2*s*. net.*

Scarth, G. W., and **Lloyd, F. E.** An Elementary Course in General Physiology Part 1: Principles and Theory, by G. W. Scarth; Part 2: Laboratory Exercises, by F. E. Lloyd and G. W. Scarth. Med. 8vo. Pp. xxi + 258. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 13*s*. 6*d*. net.*

Shumway, Waldo. Vertebrate Embryology: a Textbook for Colleges and Universities. Second edition, thoroughly revised. Med. 8vo. Pp. x + 311. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s*. 6*d*. net.*

Todd, T. Wingate. Behaviour Patterns of the Alimentary Tract. 8vo. Pp. 79. (London: Baillière, Tindall and Cox, 1930.) 4*s*. 6*d*. net.

Warburg, Otto, Edited by. The Metabolism of Tumours: Investigations from the Kaiser Wilhelm Institute for Biology, Berlin-Dahlem. Translated from the German edition, with Accounts of Additional Recent Researches, by Frank Dickens. Demy 8vo. Pp. xxix + 327 + 5 plates (London: Constable and Co., Ltd., 1930.) 40*s*. net.*

Anthropology: Archaeology

Burn, A. R. Minoans, Philistines and Greeks, B.C. 1400-900. (The History of Civilization Series.) Roy. 8vo. Pp. xv + 273 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 15*s*. net.*

Clarke, the late **Somers,** and **Engelbach, R.** Ancient Egyptian Masonry: The Building Craft. Sup. Roy. 8vo. Pp. xvi + 242. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 63*s*. net.

Danzel, Theodor Wilhelm. Gefüge und Fundamente der Kultur vom Standpunkte der Ethnologie (Prolegomena). 4to. Pp. vii + 48. (Hamburg: L. Friederichsen und Co., 1930.) 3.50 gold marks.

Duncan, J. Garrow. Corpus of Dated Palestinian Pottery. Including Pottery of Gerar and Beth-Pelet, dated and arranged by Sir Flinders Petrie, and Beads of Beth-Pelet, dated and arranged by J. L. Starkey. Roy. 4to. Pp. 21 + 83 plates. (London: British School of Archaeology in Egypt; Bernard Quaritch, 1930.) 30*s*.*

Evans, Sir Arthur. The Palace of Minos: a Comparative Account of the Successive Stages of the Early Cretan Civilization as illustrated by the Discoveries at Knossus. Vol. 3: The Great Transitional Age in the Northern and Eastern Sections of the Palace; the most Brilliant Records of Minoan Art and the Evidences of an Advanced Religion. Cr. 4to. Pp. xxiv + 525 + 24 plates. (London: Macmillan and Co., Ltd., 1930.) 105*s*. net.

Haury, Jakob. Über babylonisch-assyrische Namen und Namensbildungen bei den Etruskern, Kleinasiaten, Ägyptern, usw. Roy. 8vo. Pp. 147. (Munchen: Selbstverlag, 1930.) 8 gold marks.

Li, Fang-Kuei. Mattole: an Athabaskan Language. Demy 8vo. Pp. 152. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 13*s*. 6*d*. net.

Meyer, Johann Jakob. Sexual Life in Ancient India: a Study in the Comparative History of Indian Culture. (The Broadway Oriental Library.) Demy 8vo. Vol. 1. Pp. xi + 275. Vol. 2. Pp. ix + 277-591. (London: George Routledge and Sons, Ltd., 1930.) 36*s*. net.*

Nordenskiöld, Erland. L'Archeologie du bassin de l'Amazone. (Collection Ars Americana.) Sup. Roy. 4to. Pp. 80 + 56 planches. (Paris: Les editions G. Van Oest, 1930.) 350 francs.

Peet, T. Eric. The Great Tomb-Robberies of the Twentieth Egyptian Dynasty: Being a Critical Study, with Translations and Commentaries, of the Papyri in which these are recorded. In 2 volumes. Vol. 1: Text. Sup. Roy. 8vo. Pp. xii + 188. Vol. 2: Plates. Roy folio. 39 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 63*s*. net

Petrie, Sir Flinders. Beth-Pelet I. (Tell Fara). With a Chapter by Olga Tufnell. Roy 4to Pp. vii + 26 + 72 plates. (London: British School of Archaeology in Egypt; Bernard Quaritch, 1930.) 50*s*.*

Robinson, David M. Excavations at Olynthus. Part 2: Architecture and Sculpture; Houses and other Buildings. 4to. Pp. 155 + plates. (Baltimore, Md.: Johns Hopkins University Press; London: Oxford University Press, 1930.) 90*s*. net.

Philosophy: Psychology

Angell, James Rowland. Psychology: an Introductory Study of the Structure and Function of Human Consciousness. Fourth edition revised. Cr. 8vo. Pp. 468. (London: Constable and Co., Ltd., 1930.) 10*s* net.

Freund, Ludwig. Am Ende der Philosophie: ein kritisches Wort an die Zeit und ihre Philosophen. Roy. 8vo. Pp. 179. (Munchen: Ernst Reinhardt, 1930.)

Hartshorne, Hugh; May, Mark A., and **Maller, Julius B.** Studies in Service and Self-Control. Book 1: Studies in Service; Book 2: Studies in Self-Control. (Studies in the Nature of Character. By the Character Education Inquiry, Teachers' College, Columbia University, in Co-operation with the Institute of Social and Religious Research, Vol. 2.) Ex. Cr. 8vo. Pp. xxiii + 559. (New York: The Macmillan Co., 1930.) 12*s*. net.

Hoffmann, Walter. Die Reifezeit: Grundfragen der Jugendpsychologie und Sozialpadagogik. Dritte neubearbeitete und erweiterte Auflage. Roy. 8vo. Pp. xv + 366. (Leipzig: Quelle und Meyer, 1930.) 10 gold marks.

Jaensch, E. R. Eidetic Imagery and Typological Methods of Investigation: their Importance for the Psychology of Childhood, the Theory of Education, General Psychology, and the Psycho-Physiology of Human Personality. Translated from the second edition by Oscar Oeser. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. vi + 136. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1930.) 7*s*. 6*d*. net.*

Juhos, Béla von. Das Problem der mathematischen Wahrscheinlichkeit. Roy. 8vo. Pp. 83. (München: Ernst Reinhardt, 1930.) 5 gold marks.

Kynast, Reinhard. Logie und Erkenntnistheorie der Gegenwart. (Philosophische Forschungsberichte, Heft 5.) Roy. 8vo. Pp. v + 58. (Berlin: Junker und Dunnhaupt, 1930.) 2.50 gold marks.

Lighthall, W. D. The Person of Evolution: the Outer Consciousness, the Outer Knowledge, the Directive Power; Studies of Instinct as Contributions to a Philosophy of Evolution. Cr. 8vo. Pp. 216. (Montreal: H. A. Kennedy and Co., 1930.)*

Lippmann, Walter. Die sittliche Lebensform des modernen Menschen. (A Preface to Morals.) Aus dem Amerikanischen übersetzt von Paul Sakmann. 8vo. Pp. xv + 358. (Stuttgart: Deutsche Verlags-Anstalt, 1930.) 9 gold marks.

Manheim, Ernst. Zur Logik des konkreten Begriffs. Roy. 8vo. Pp. xi + 157. (München: C. H. Beck, 1930.) 8 gold marks.

Margoliouth, D. S. On 'The Book of Religion and Empire', by 'Alī B. Rabban al-Tabarī. (From the *Proceedings of the British Academy*, Vol. 16.) Roy. 8vo. Pp. 20. (London: Oxford University Press, 1930.) 1*s.* 6*d.* net.*

Murchison, Carl, Edited by. A History of Psychology in Autobiography. (The International University Series in Psychology.) Vol. 1. By James Mark Baldwin, Mary Whiton Calkins, Édouard Claparède, Raymond Dodge, Pierre Janet, Joseph Jastrow, F. Kiesow, William McDougall, Carl Emil Seashore, C. Spearman, William Stern, Carl Stumpf, Howard C. Warren, Theodor Ziehan, H. Zwaardemaker. Med. 8vo. Pp. xvii + 516. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1930.) 22*s.* 6*d.* net.*

Sheen, Fulton J. God and Intelligence in Modern Philosophy: a Critical Study in the Light of the Philosophy of Saint Thomas. Demy 8vo. Pp. 295. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 15*s.* net.

Stettner, Leo. Das philosophische System Shaftesburys und Wielands Agathon. Roy. 8vo. Pp. xx + 189. (Halle a.S.: Verlag Niemeyer, 1930.)

Strong, C. A. Essays on the Natural Origin of the Mind. Demy 8vo. Pp. vii + 304. (London: Macmillan and Co., Ltd., 1930.) 12*s.* net.*

Webb, C. C. J. Our Knowledge of One Another. (Annual Philosophical Lecture, Henriette Hertz Trust, British Academy, 1930. From the *Proceedings of the British Academy*, Vol. 16.) Sup. Roy. 8vo. Pp. 18. (London: Oxford University Press, 1930.) 1*s.* 6*d.**

Zimmermann, Heinz. Der Befreier: eine Begegnung mit Kant. Roy. 8vo. Pp. 289. (München: Duncker und Humblot, 1930.) 11 gold marks.

Bacteriology: Hygiene

Buchanan, R. E., and **Fulmer, Ellis I.** Physiology and Biochemistry of Bacteria. Vol. 2: Effects of Environment upon Microorganisms. Roy. 8vo. Pp. xvii + 709. 34*s.* net. Vol. 3: Effects of Microorganisms upon Environment. Fermentative and other Changes Produced. Roy. 8vo. Pp. xv + 575. 34*s.* net. (London: Baillière, Tindall and Cox, 1930.)*

Fishbein, Morris. An Hour on Health. (The One Hour Series.) Feap. 8vo. Pp. 158. (Philadelphia and London: J. B. Lippincott Co., 1929.) 4*s.* 6*d.* net.

Grotjahn, Alfred; Langstein, Leo, und **Rott, Fritz,** Herausgegeben von. Ergebnisse der sozialen Hygiene und Gesundheitsfürsorge. Band 2. 4to. Pp. iii + 497. (Leipzig: Georg Thieme, 1930.) 36 gold marks.

Ministry of Health. Reports on Public Health and Medical Subjects. No. 58: Report on a Study of the Nasopharyngeal Bacterial Flora of a Group of the Manchester Population during the Period July 1925 to September 1927. Roy. 8vo. Pp. 29. (London: H.M. Stationery Office, 1930.) 6*d.* net.*

Seitz, Arthur. Bakteriologie für Zahnärzte: Einführung in der Mikrobiologie und Infektionskrankheiten. Zweite Auflage. Roy. 8vo. Pp. v + 237 + 7 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 10 gold marks.

Miscellany

Baker, Ernest A., Edited by. The Uses of Libraries. New and revised edition. Demy 8vo. Pp. viii + 338. (London: University of London Press, Ltd., 1930.) 10*s.* 6*d.* net.

Besterman, Theodore. Some Modern Mediums. Cr. 8vo. Pp. xi + 189 + 4 plates. (London: Methuen and Co., Ltd., 1930.) 7*s.* 6*d.* net.*

British Association. The Advancement of Science, 1930: Addresses delivered at the Annual Meeting of the British Association for the Advancement of Science (100th Year), Bristol, September 3–10, 1930. Demy 8vo. Pp. 15 + 24 + 20 + 27 + 10 + 14 + 15 + 19 + 24 + 17 + 16 + 29 + 11 + 16. (London: British Association, 1930.) 5*s.**

British Museum (Natural History): General Library Place-Numbers of the Societies and other Corporate Bodies issuing Serial Publications, and of the Independent Periodical Publications, with Alphabetical Indexes. Second edition. Gl. 4to. Pp. v + 175. (London: British Museum (Natural History), 1930.) 5*s.**

Bunzel, Madeleine, Told and drawn by. A Picture Book of a Big City. Cr. 4to. Pp. 30. (London and New York: Alfred A. Knopf, Ltd., 1930.) 5*s.**

France, Le Vicomte Henry de. The Modern Dowser: a Guide to the Use of the Divining Rod and Pendulum. Translated by A. H. Bell. Cr. 8vo. Pp. xv + 135. (London: G. Bell and Sons, Ltd., 1930.) 3*s.* 6*d.* net.*

Harnack, Edwin P., Edited by. All about Ships and Shipping: a Handbook of Popular Nautical Information. Fourth edition, revised and brought up to date. Cr. 16mo. Pp. xii + 526 + 10 plates. (London: Alexander Moring, Ltd., 1930.) 7*s.* 6*d.* net.*

Hodgman, C. D., and **Lange, N. A.** Handbook of Chemistry and Physics. Fourteenth edition. 8vo. Pp. xii + 1386. (Cleveland, Ohio: The Chemical Rubber Publishing Co., 1930.) 5 dollars.

Knight, Edgar W., Edited by. Reports on European Education. By John Griscom, Victor Cousin, Calvin E. Stowe. (McGraw-Hill Education Classics.) Cr. 8vo. Pp. vii + 319. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 11*s.* 3*d.* net.*

Little, W. B. Science in the City. (Science in Every-day Life: Second Series.) Cr. 8vo. Pp. xii + 239. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.*

Meldrum, Andrew Norman. The Eighteenth Century Revolution in Science: The First Phase. Roy. 8vo. Pp. vii + 60. (London, New York, Toronto and Bombay: Longmans, Green and Co., Ltd., 1930.) 4*s.* 6*d.**

Pearson, Hesketh. Doctor Darwin. Demy 8vo. Pp. xi + 242 + 12 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 10*s.* 6*d.* net.*

Pearson, Karl. The Life, Letters and Labours of Francis Galton. Imp. 8vo. Vol. 3 A: Correlation, Personal Identification and Eugenics. Pp. xiv + 440 + 44 plates. Vol. 3 B: Characterisation, especially by Letters, Index. Pp. vi + 441–673 + 18 plates. (Cambridge: At the University Press, 1930.) 69*s.* net.*

Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom. Vol. 8 (1929): Being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1929. Roy. 8vo. Pp. 316. (London: H.M. Stationery Office, 1930.) 1*s.* net.*

Ross, Colin. The World in the Balance: an Analysis of World-Problems after Twenty Years' Travel about the World. Ex. Cr. 8vo. Pp. xiv + 214. (London: George Routledge and Sons, Ltd., 1930.) 10*s.* 6*d.* net.*

Sandemann, F. and **G.** Practical Community. ("The Woodcraft Way" Series, No. 16.) Demy 8vo. Pp. v + 50. (Salisbury: The Order of Woodcraft Chivalry, Godshill, 1930.) 1*s.**

Struck, F. Theodore. Foundations of Industrial Education. Ex. Cr. 8vo. Pp. xiii + 492. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.*

Thomasz, Charles Mathew. How to Control Malaria. Gl. 8vo. Pp. 181. (Colombo: The *Ceylon Morning Leader* Co., Ltd., 1929.) 4.50 rupees.*

Thomson, Sir StClair, and **Colledge, Lionel.** Cancer of the Larynx. (The Anglo-French Library of Medical and Biological Science.) Demy 8vo. Pp. xxi + 244 + 60 plates. (London: Kegan Paul and Co., Ltd., 1930.) 25*s.* net.*

Trevelyan, George Macaulay. Blenheim. (England under Queen Anne.) Demy 8vo. Pp. xii + 477. (London, New York and Toronto: Longmans, Green and Co. Ltd., 1930.) 21*s.* net.*

Vaughan, Agnes Carr. Lucian Goes A-Voyaging. Cr. 8vo. Pp. ix + 139. (London and New York: Alfred A. Knopf, Ltd., 1930.) 6*s.**

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "Nature" Office.

Mathematics: Mechanics: Physics

Aryabhata. The Aryabhatiya of Aryabhata: an Ancient Indian Work on Mathematics and Astronomy. Translated with Notes by Walter Eugene Clark. Ex. Cr. 8vo. Pp. xxix + 90. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 11s. 6d. net.

Babini, J. Arimética práctica: el cálculo con números exactos y el cálculo numérico aproximado. (Bibliotoca Scientia, 4.) Cr. 8vo. Pp. viii + 200. (Toledo: A. Medina, 1930.)

Barlow's Tables of Squares, Cubes, Square Roots, Cube Roots and Reciprocals of all Integer Numbers up to 10,000. Revised and enlarged by L. J. Comrie. Third edition. Demy 8vo. Pp. 220. (London: E. and F. N. Spon, Ltd., 1930.) 7s. 6d. net.

Berek, M. Grundlagen der praktischen Optik: Analyse und Synthese optischer Systeme. Roy. 8vo. Pp. vii + 152. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 13 gold marks.*

Berthold, Rudolf. Grundlagen der technischen Röntgendurchstrahlung. Roy. 8vo. Pp. vii + 109. (Leipzig: Johann Ambrosius Barth, 1930.) 9 gold marks.

Bragg, W. L. The Structure of Silicates. Med. 8vo. Pp. 69. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 5 gold marks.*

Cohen-Kysper, Adolf. Das Determinationsproblem in analytischer Darstellung. (Abhandlungen zur Theorie der organischen Entwicklung, Heft 5.) Roy. 8vo. Pp. vi + 48. (Berlin: Julius Springer, 1930.) 4.80 gold marks.

Department of Scientific and Industrial Research: Building Research. Bulletin No. 8: Ultra-violet Window Glazing. By H. E. Beckett. Roy 8vo. Pp. iv + 13. (London: H.M. Stationery Office, 1930.) 4d. net.*

Eddington, A. S. Étoiles et atomes. Traduction J. Rossignol. Demy 8vo. Pp. x + 188 + 6 planches. (Paris: Hermann et Cie, 1930.) 35 francs.*

Ewald, Waldemar. Die optische Werkstatt: Handbuch der Arbeitsverfahren und Prufmethoden fur d. Fertigung von Optik. Unter Mitarbeit von Hans Schulz und Franz Weidert. Roy. 8vo. Pp. viii + 277. (Berlin: Gebrüder Borntraeger, 1930.) 20 gold marks.

Forder, H. G. A School Geometry. Cr. 8vo. Pp. ix + 260. (Cambridge: At the University Press, 1930.) 4s 6d.*

Goldstein, E. Canalstrahlen. Herausgegeben von E. Gehrcke. (Ostwald's Klassiker der exakten Wissenschaften, Nr. 231.) Cr. 8vo. Pp. iv + 86. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 4.80 gold marks.*

Hassler, Jasper O., and **Smith, Rolland R.** The Teaching of Secondary Mathematics. Edited by Earle Raymond Hedrick. Cr. 8vo. Pp. xi + 405. (New York: The Macmillan Co., 1930.) 10s. 6d. net.

Haussner, Robert. Sammlung von Aufgaben und Beispielen zur analytischen Geometrie der Ebene mit den vollständig Losungen. (Sammlung Goschen, Band 256.) Pott 8vo. Pp. 139. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Hodgson, T. Applied Mathematics for Engineers. Vol. 1: Graphical Statics. Demy 8vo. Pp. vii + 183. 9s. 6d. net. Vol. 2: Dynamics, with an Introduction to the Differential and Integral Calculus. Demy 8vo. Pp. vii + 293. 13s. 6d. net. (London: Chapman and Hall, Ltd., 1930.)*

Jasse, E. Die Elektromagnete: Grundlagen fur die Berechnung des magnetischen Feldes und der darin wirksamen Kräfte insbesondere an Eisenkorpern. 8vo. Pp. vi + 198. (Berlin: Julius Springer, 1930.) 21 gold marks.

Kronig, R. de L. Band Spectra and Molecular Structure. Demy 8vo. Pp. x + 164. (Cambridge: At the University Press, 1930.) 10s. 6d. net.*

Lietzmann, Walther. Lustiges und Merkwurdiges von Zahlen und Formen, Allerlei Unterhaltungsmathematik, von den Zahlen, von den geometrischen Formen. Vierte durchgesehene und erganzte Auflage. 8vo. Pp. vi + 307 + 20 Tafeln. (Breslau: Ferdinand Hirt, 1930.) 9.50 gold marks.

Macdonald, Marion E. Practical Statistics for Teachers. (A Text and Work Book.) Demy 4to. Pp. ix + 176. (New York: The Macmillan Co., 1930.) 7s. net.

Marshall, V. M., and **Barrat, E. M.** Arithmetic for Girls. Edited by H. E. J. Curzon. Imp. 16mo Pp. 190. 2s. 9d. Part 1. Pp. 64. 1s. 3d. Part 2. Pp. 65-128. 1s. 3d. Part 3. Pp. 129-190. 1s. 3d. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1930.)

Meyer, Heinrich. Eine Rechenmethode fur deutschen Schulen, als Probe angewandter Logik. 8vo. Pp. 358. (Oldenburg: Verlag Stalling, 1930.) 5.80 gold marks.

Mindt, Walter, und **Weiss, Edmund.** Grundlagen der Refraktionsbestimmung und Brillenanpassung. Herausgegeben von Walter Mindt. Roy. 8vo. Pp. xvi + 368. (Berlin: Verlag Mindt, 1930.) 29 gold marks.

Muir, Sir Thomas. Contributions to the History of Determinants, 1900-1920. Demy 8vo. Pp. xxiv + 408. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 30s. net.*

Peters, Jean. Sechsstellige trigonometrische Tafel für neue Teilung: die Werte der 6 trigonometrischen Funktionen fur jede Minute des in 100 Grade geteilten Quadranten. 4to. Pp. vii + 170. (Berlin: Verlag Wichmann, 1930.) 18 gold marks.

Peters, Jean. Multiplikations- und Interpolationstafeln fur alle ein- bis dreistelligen Zahlen. 4to. Pp. 23. (Berlin: Verlag Wichmann, 1930.) 1.75 gold marks.

Pohl, R. W. Physical Principles of Electricity and Magnetism. Authorised translation by Winifred M. Deans. Med. 8vo. Pp. xi + 356. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 17s. 6d. net.*

Rosenbach, R. B., and **Whitman, G. A.** Plane Trigonometry: with Five Place Tables. Cr. 8vo. Pp. 96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12s. 6d. net.

Saurin, C. W. The Wide Outlook Arithmetics. Book 2. Cr. 8vo. Pp. 80. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1s.

Schleicher, Ferdinand. Statik. Teil 1: Die Grundlagen der Statik starrer Korper. (Sammlung Goschen, Band 178.) Pott 8vo. Pp. 143. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Sharp, M. A., and **Sharp, W. M.** Principles of Farm Mechanics. Ex. Cr. 8vo. Pp. xx + 269. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15s. net.*

Upmark, Aug. Eine Korpuskulartheorie des Lichts auf energetischen Grunde. Demy 8vo. Pp. 97. (Lund: A.-B. Ph. Lindstedts Univ.-Bokhandel, 1930.)*

Volterra, Vito. Theory of Functionals and of Integral and Integro-Differential Equations. Edited by Luigi Fantappie. Authorised translation by Miss M. Long. Demy 8vo. Pp. xiv + 226. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 25s. net.*

Watts, W. Marshall, the late. Index of Spectra. Index of Authors and Index Indicus (1st edition (1872) to Appendix Y (1921) inclusive). Compiled by T. M. F. Tamblyn-Watts. Demy 8vo. Pp. 16. (Westcliff-on-Sea: T. M. F. Tamblyn-Watts, "Ismailia", Clatterfield Gardens, 1930.) 2s.*

Weil, Hugo. Praxis und Theorie zum Rechen- und Raumlehreunterricht der oberen Jahrgänge der Volksschule. Roy. 8vo. Pp. 134. (Langensalza: Verlag Beltz, 1930.) 4 gold marks.

Westphal, Wilhelm H. Physik: ein Lehrbuch für Studierende an den Universitaten und technischen Hochschulen Zweite Auflage. Roy. 8vo. Pp. xvi + 571. (Berlin: Julius Springer, 1930.) 19.80 gold marks.*

Wood, Alexander. Sound Waves and their Uses: Six Lectures delivered before a "Juvenile Auditory" under the auspices of the Royal Institution, Christmas 1928. Med. 8vo. Pp. x + 152. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 7s. 6d. net.*

Zimmermann, H. Rechentafel nebst Sammlung häufig gebrauchter Zahlenwerte. Zehnte Auflage. Ausgabe B. Roy. 8vo. Pp. xxxiv + 204 + 20. (Berlin: Wilhelm Ernst und Sohn, 1930.) 9 gold marks.

Engineering

Allen, John Parnell. Practical Building Construction: a Handbook for Students preparing for Examinations, and a Book of Reference for Persons engaged in Building. Seventh edition. Med. 8vo. Pp. 520. (London: Crosby Lockwood and Son, 1930.) 8*s.* 6*d.* net.

Bangay, R. D. The Elementary Principles of Wireless Telegraphy and Telephony. Third edition, revised by O. F. Brown. Demy 8vo. Pp. xii + 268. (London: Iliffe and Sons, Ltd., 1930.) 10*s.* 6*d.* net.*

Dannatt, C., and Dalgleish, J. W. Electrical Power Transmission and Interconnection. (The Specialists' Series.) Demy 8vo. Pp. xi + 424. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 30*s.* net.*

Defeld, Raymond. A Practical Treatise on Single and Multi-Stage Centrifugal Pumps. Translated by C. W. Olliver. Demy 8vo. Pp. x + 221 + 42 plates. (London: Chapman and Hall, Ltd., 1930.) 21*s.* net.*

Department of Scientific and Industrial Research: Building Research. Bulletin No. 9: Bonding New Concrete to Old. By Norman Davey. Roy. 8vo. Pp. iii + 4 + 2 plates. (London: H.M. Stationery Office, 1930.) 3*d.* net.*

Dowsett, H. M. Handbook of Technical Instruction for Wireless Telegraphists. Fourth edition, revised and enlarged. Demy 8vo. Pp. xix + 487. (London: Iliffe and Sons, Ltd., 1930.) 25*s.* net.*

Engelhardt, August. Fernkabel-Telephonie: ihre theoretischen Grundlagen in gemeinverständliche Darstellungen. Zweite Auflage. Roy. 8vo. Pp. ii + 278. (Berlin: Verlag Tetzlaff, 1930.) 17 gold marks.

Fleming, Sir Ambrose, Edited by. Pitman's Electrical Educator. Second edition. To be completed in about 28 fortnightly Parts. Cr. 4to. Part 1. Pp. ii + 48. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 1*s.* 3*d.* net each Part.*

Foerster, Ernst, Bearbeitet und herausgegeben von. Praktischer Stahlschiffbau: ein Hilfsbuch fur Werft, Reederei und Lehrstatte. 4to. Pp. ix + 601. (Berlin: Julius Springer, 1930.) 124 gold marks.

Garnett, A. Vectorial Solution of A.C. Circuits. Demy 8vo. Pp. 52. (London: The Draughtsman Publishing Co., Ltd., 1930.) 2*s.* net.*

Günther, Hanns. Automaten: die Befreiung des Menschen durch die Maschine. (Technische Bücher für Alle.) 8vo. Pp. 80. (Stuttgart: Dieck und Co., 1930.) 1.80 gold marks.

Heinrich, K. Die theoretischen Grundlagen der Wechselstrommaschinen. 8vo. Pp. xii + 381. (Leipzig: Max Jänecke, 1930.) 18 gold marks.

Hobbs, Edward W. Domestic Electric Appliances. (*Amateur Mechanic and Work* Handbooks.) Cr. 8vo. Pp. 150. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1930.) 1*s.* 6*d.* net.

Hutchison, Beatson. Valve and Reversing Gears. Demy 8vo. Pp. 56. (London: The Draughtsman Publishing Co., Ltd., 1930.) 2*s.* net.*

Jackson, G. Gibbard. Triumphs and Wonders of Modern Engineering. Demy 8vo. Pp. 246. (London: Sampson Low, Marston and Co., Ltd., 1930.) 6*s.* net.

Jahn, Gg. Radiotechnik, Band 7: Die Sender. (Sammlung Göschen, Band 1018.) Pott 8vo. Pp. 120 + 16 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Jolley, L. B. W., Waldram, J. M., and Wilson, G. H. The Theory and Design of Illuminating Engineering Equipment. Roy. 8vo. Pp. xxxi + 709 + 56 plates. (London: Chapman and Hall, Ltd., 1930.) 45*s.* net.*

Korn, Arthur. Elektrisches Fernsehen. (Math.-naturwiss.-techn. Bücherei, Band 26.) 8vo. Pp. viii + 103. (Berlin: O. Salle, 1930.) 3 gold marks.

Kraft, Ernest A. Die neuzeitliche Dampfturbine. Zweite erweiterte Auflage. 4to. Pp. viii + 214. (Berlin: V.D.I.-Verlag, 1930.) 20 gold marks.

Krukowski, Waldemar von. Grundzüge der Zählertechnik: ein Lehr- und Nachschlagebuch. Roy. 8vo. Pp. xi + 521. (Berlin: Julius Springer, 1930.) 34 gold marks.

Lamy, R. Réglage et essais des moteurs à explosion. (Paris: Libr. Dunod, 1930.) 65.45 francs.

Ludin, Adolf. Die nordischen Wasserkräfte: Ausbau und wirtschaftliche Ausnutzung. 4to. Pp. viii + 778 + [illegible] Tafeln. (Berlin: Julius Springer, 1930.) 160 gold marks.

Maercks, Josef. Bergbaumechanik: Lehrbuch für bergmänn. Lehranstalten; Handbuch für d. praktisch Bergbau. Roy. 8vo. Pp. ix + 451. (Berlin: Julius Springer, 1930.) 19.50 gold marks.

Mines Department: Safety in Mines Research Board Paper No. 61: The Support of Underground Workings in the Coalfields of the North of England (Durham, Northumberland and Cumberland). Roy. 8vo. Pp. 140. (London: H.M. Stationery Office, 1930.) 2*d.* net.*

Mitchell, Gen. William. Skyways: a Book of Modern Aeronautics. Demy 8vo. Pp. 314. (London: Ernest Benn, Ltd., 1930.) 21*s.* net.

Quantz, Ludwig. Kreiselpumpen: eine Einführung in Wesen, Bau und Berechnung von Kreisel- und Zentrifugalpumpen. Dritte umgeänderte und verbesserte Auflage. Roy. 8vo. Pp. v + 115. (Berlin: Julius Springer, 1930.) 5.50 gold marks.

Schmidt, H. Das Fernsprechwesen. Band 2: Fernsprechanlagen für Handbetrieb. (Sammlung Goschen, Band 773.) Pott 8vo. Pp. 123. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 1.80 gold marks.

Schoklitsch, Armin. Der Wasserbau: ein Handbuch für Studium und Praxis. 2 Bände. 4to. Pp. xi + 1199. (Wien: Julius Springer, 1930.) 130 gold marks.

Scott, Ernest A. Arrol's Reinforced Concrete Reference Book of Examples, General Formulæ, Model Regulation and Designing Tables as used by the Reinforced Concrete Department of Sir William Arrol and Co., Ltd., Glasgow. Demy 8vo. Pp. 292 + 5 plates. (London: E. and F. N. Spon, Ltd., 1930.) 16*s.* net.

Seufert, Franz. Bau und Berechnung der Verbrennungskraftmaschinen: eine Einfuhrung. Sechste verbesserte Auflage. 8vo. Pp. v + 145 + 2 Tafeln. (Berlin: Julius Springer, 1930.) 4.80 gold marks.

Waddicor, H. The Principles of Electric Power Transmission by Alternating Currents. Second edition, revised. Demy 8vo. Pp. xix + 419. (London: Chapman and Hall, Ltd., 1930.) 21*s.* net.*

Ward, William. Engineering Science: a Second Year Course. Cr. 8vo. Pp. 176. (London: Edward Arnold and Co., 1930.) 5*s.* net.

Weller, Cornel. Technologie der Textilmaschinen. Band 1: Die Baumwollspinnereimaschinen. 8vo. Pp. viii + 143. (Wien: A. Hartleben, 1930.) 6 gold marks.

Whyte, Adam Gowans. Forty Years of Electrical Progress: the Story of the G.E.C. Demy 8vo. Pp. 166. (London: Ernest Benn, Ltd., 1930.) 5*s.* net.

Zietemann, Constantin. Berechnung und Konstruktion der Dampfturbinen. Roy. 8vo. Pp. 452. (Berlin: Julius Springer, 1930.) 33 gold marks.

Zimmermann, H. Die Berechnung des Eisenbahnoberbaues. Zweite Auflage. Roy 8vo. Pp. xiv + 308 + 12 Tafeln. (Berlin: Wilhelm Ernst und Sohn, 1930.) 36 gold marks.

Chemistry: Chemical Industry

Cooper, John W. Pharmacy: General and Official. Cr. 8vo. Pp. 416. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

Deming, Horace G. General Chemistry: an Elementary Survey, emphasizing Industrial Applications of Fundamental Principles. Third edition, rewritten and revised. Demy 8vo. Pp. ix + 715. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.*

Drews, Kurt. Kältetechnik. (Monographien über chem.-techn. Fabrikations-Methoden, Band 46.) Roy. 8vo. Pp. viii + 212. (Halle a.S.: Wilhelm Knapp, 1930.) 16 gold marks.

Eder, Josef Maria. Ausführliches Handbuch der Photographie. Band 3: Die Photographie mit Bromsilbergelatine und Chlorsilbergelatine. Von Josef Maria Eder und Hinricus Lüppo-Cramer. Sechste völlig umgearbeitete und vermehrte Auflage. Teil 1: Die Fabrikation der photographischen Platten, Filme und Papiere und ihre maschinelle Verarbeitung. Neu bearbeitet von Fritz Wentzel. Roy. 8vo. Pp. xix + 595. (Halle a.S.: Wilhelm Knapp, 1930.) 48.50 gold marks.

Kunzmann, Th. Die Bedeutung der wissenschaftlichen Tätigkeit Friedrich Wohlers fur die Entwicklung der deutschen chemischen Industrie. Roy. 8vo. Pp. 30. (Berlin: Verlag Chemie G.m.b.H., 1930.) 4 gold marks.

Lindner, Paul. Mikroskopische und biologische Betriebskontrolle in den Gärungsgewerben: mit besonderer Berücksichtigung der Brauerei, zugleich eine Einfuhrung in die technische Biologie, Hefenreinkultur, Infektionslehre und allgemeine Gärungskunde; für technische Biologen, Chemiker, Mediziner, Studierende und Praktiker bearbeitet. (Parey's Bücherei für chemische Technologie, herausgegeben von F. Hayduck, Band 5.) Sechste neubearbeitete Auflage. Roy. 8vo. Pp. xvi + 692. (Berlin: Paul Parey, 1930.) 44 gold marks.

Litinsky, L. Prufanstalt fur feuerfeste Materialien. (Monographien zur Feuerungstechnik, Band 2.) 8vo. Pp. 126. (Leipzig: Otto Spamer, 1930.) 8.50 gold marks.

Meyer, Kurt H., und **Mark, H.** Der Aufbau der hochpolymeren organischen Naturstoffe: auf Grund molekular-morphologischer Betrachtungen. Demy 8vo. Pp. viii + 264. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 18 gold marks.*

Pregl, Fritz. Quantitative Organic Microanalysis. Second English edition. Translated from the third revised and enlarged German edition by E. Fyleman. Roy. 8vo. Pp. 238. (London: J. and A. Churchill, 1930.) 15*s*. net.

Rakshit, Jitendra Nath, Rai Shaheb. Association Theory of Solution and Inadequacy of Dissociation Theory. Cr. 8vo. Pp. v + 298. (Calcutta: S. C. Auddy and Co., 1930.)*

Schönfeld, Franz. Handbuch der Brauerei und Malzerei. Band 1: Roh- und Grundstoffe und ihre Wandlungen bei der Malz- und Bierbereitung. (Pareys Bucherei fur chemische Technologie, Band 4.) Roy. 8vo. Pp. xii + 492. (Berlin: Paul Parey, 1930.) 28 gold marks.

Simon, Oskar. Laboratoriumsbuch fur die Industrie der Riechstoffe. 8vo. Pp. 101. (Halle a.S.: Wilhelm Knapp, 1930.) 7.50 gold marks.

Wiechowski, Siegfried. Grundzuge der Chemie. Anorganische und organische Chemie in einem Bande. Zweite verbesserte Auflage. 8vo. Pp. 223. (Leipzig und Wien: Franz Deuticke, 1930.) 7.80 gold marks.

Technology

Alexander, Vera C. Passe-Partout. (Pitman's Craft for All Series.) Cr. 8vo. Pp. viii + 96. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s*. 6*d*. net.

Armfield, Maxwell. A Manual of Tempera-Painting. Cr. 8vo. Pp. 182. (London: George Allen and Unwin, Ltd., 1930.) 6*s*. net.

Bablik, Heinz. Grundlagen des Verzinkens: Feuerverzinken, galvan. Verzinken, Sherardisieren, Spritzverzinken. Roy. 8vo. Pp. vii + 255. (Berlin: Julius Springer, 1930.) 29.50 gold marks.

Bansen, Hugo. Warmewertigkeit, Warme- und Gasfluss: die physikalischen Grundlagen metallurgischer Verfahren. Roy. 8vo. Pp. 61. (Düsseldorf: Stahleisen Verlag m.b.H., 1930.) 10 gold marks.

Baumann, Ferd. S. Das Erdol in Deutschland. Roy. 8vo. Pp. iv + 76 + 4 Tafeln. (Berlin: Carl Heymann, 1930.) 10 gold marks.

Blum, William, and **Hogaboom, G. B.** Principles of Electroplating and Electroforming. Second edition. Med. 8vo. Pp. 424. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 22*s*. 6*d*. net.

Brenzinger, M., Janitzky, A., und **Wilhelmy, E.** Allgemeine Grundlagen, Physik und Technik des Rontgenverfahrens. (Sammlung Radiologische Praktika, Band 14.) Sup. Roy. 8vo. Pp. xi + 237. (Leipzig: Johann Ambrosius Barth, 1930.) 25.50 gold marks.

Capey, Reco. The Printing of Textiles. Demy 8vo. Pp. x + 138 + 29 plates. (London: Chapman and Hall, Ltd., 1930.) 13*s*. 6*d*. net.*

Clerc, L. P. Photography: Theory and Practice. English edition of "La technique photographique." Edited by George E. Brown. Sup. Roy. 8vo. Pp. 566. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 35*s*. net.

Corkhill, T., Edited by. Brickwork, Concrete and Masonry. To be completed in 26 weekly Parts. Cr. 8vo. Part 1. Pp. 64. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 1*s*. net each Part.

Crampton, Albert H. Leather Work: including Glove Making. (Warne's "Useful" Books.) Cr. 8vo. Pp. 63. (London and New York: Frederick Warne and Co., Ltd., 1930.) 6*d*. net.

Crampton, Albert H. Raffia Work and Basketry. (Warne's "Useful" Books.) Cr. 8vo. Pp. 64. (London and New York: Frederick Warne and Co., Ltd., 1930.) 6*d*. net.

Crampton, Albert H. Soft Toy Making and Nursery Novelties. (Warne's "Useful" Books.) Cr. 8vo. Pp. 64. (London and New York: Frederick Warne and Co., Ltd., 1930.) 6*d*. net.

Dews, H. C. The Metallurgy of Bronze. (The Specialists' Series.) Demy 8vo. Pp. ix + 147. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 12*s*. 6*d*. net.*

Eggert, John, und **Schiebold, Ernst,** Herausgegeben von. Die Rontgentechnik in der Materialprufung. (Ergebnisse der technischen Rontgenkunde, Band 1.) 8vo. Pp. vii + 206. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 16.80 gold marks.

Engler, Carl, und **Höfer, Hans,** Begrundet von. Das Erdöl: seine Physik, Chemie, Geologie, Technologie und sein Wirtschaftsbetrieb. Zweite vollig neubearbeitete Auflage. Herausgegeben von Jenoe Tausz. In 5 Banden. Band 4: Chemische, physikalische, geologische und geophysikalische Untersuchungsmethoden des Erdols und seiner Produkte. Redigiert von J. Tausz. 4to. Pp. xvi + 615. (Leipzig: S. Hirzel, 1930.) 68 gold marks.

Foster, J., and **Crossland, L. A.** A Woodwork Course for Beginners: compiled for the use of Boys who desire to become proficient in the Art of Working in Wood. Demy 8vo. Pp. 63. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) Paper, 8*d*.; cloth, 10*d*.

Gabriel, Leonard G. Bromoil and Transfer: for the Photographic Worker. Demy 8vo. Pp. 154. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 7*s*. 6*d*. net.

Guggenheim, Harry F. The Seven Skies. Demy 8vo. Pp. 216. (New York and London: G. P. Putnam's Sons, 1930.) 10*s*. 6*d*. net.

Hammond, Adam. Practical Bricklaying. Fourteenth edition, revised. Fourth impression. Cr. 8vo. Pp. 116. (London: Crosby Lockwood and Son, 1930.) 2*s*. 6*d*. net.

Hecht, Hermann. Lehrbuch der Keramik: eine Darstellung der keram. Erzeugnisse in ihrem techn. Aufbau. Zweite vollig durchgearbeitete vermehrte Auflage. 8vo. Pp. xii + 467. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 16.50 gold marks.

Hobbs, Edward W. House Building for Amateurs. (*Amateur Mechanic and Work* Handbooks.) Cr. 8vo. Pp. 150. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1930.) 1*s*. 6*d*. net.

Horth, A. C. Beaten Metal Work. (Pitman's Craft for All Series.) Cr. 8vo. Pp. x + 98. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s*. 6*d*. net.

Hubbard, Hesketh. Simple Colour Block Print Making from Linoleum Blocks. (Forest Press Publications No. 3A.) Demy 8vo. Pp. iv + 116. (London: The Forest Press, 1930.) 5*s*. net.

Janssen, F. Eisenguss in Dauerformen. 8vo. Pp. vi + 92. (Berlin: Julius Springer, 1930.) 10.50 gold marks.

Johnson, C. S. Painting and Enamelling: a Textbook for Craft Workers and Handymen. (Pitman's Craft for All Series.) Cr. 8vo. Pp. viii + 104. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s*. 6*d*. net.

Kirby, Richard Shelton. The Fundamentals of Mechanical Drawing. Third edition. Sup. Roy. 8vo. Pp. xi + 111. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 10*s*. net.*

Laatsch, W. Étude résumée des métaux précieux: extraction, récupération, séparation. Traduit de l'allemand par A. Schubert. Roy. 8vo. Pp. vi + 151. (Paris: Libr. Dunod, 1930.) 32 francs.

Lawrence, E. S. The Manufacture of Steel Sheets. 8vo. Pp. x + 233. (Cleveland, Ohio: The Penton Publishing Co., 1930.) 30*s*.

Norman, Ivy Evelyn, and **Smith, Paul I.** Leather Crafts Manual. (Lockwood's Manuals.) Cr. 8vo. Pp. vii + 88. (London: Crosby Lockwood and Son, 1930.) 2*s*. 6*d*. net.*

Orman, P. Handloom Weaving. (Pitman's Craft for All Series.) Cr. 8vo. Pp. x + 100. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s*. 6*d*. net.

Page, Eleanor. Lace Making: the Home Craft of all Ages. (Pitman's Craft for All Series.) Cr. 8vo. Pp. x + 94. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.* net.

Palmer, Bernard J. Hints and Tips for Commercial Artists. Cr. 8vo. Pp. 120. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 5*s.* net.

Phillips, M., and **Phillips, E. H.** Craftwork for Senior Schools. Demy 8vo. Pp. viii + 54. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3*s.* net.

Pukall, Wilhelm. Keramische Abhandlungen. 4to. Pp. vii + 355. (Coburg: Müller und Schmidt, 1930.) 19 gold marks.

Rietschel, Hermann. Leitfaden der Heiz- und Lüftungstechnik. Neunte verbesserte Auflage von Heinrich Grober. 4to. Pp. xv + 293. (Berlin: Julius Springer, 1930.) 36 gold marks.

St. Vincent, Isobel. Stencilling: with Whitewood Painting, Barbola Work and Painting on Glass. (Warne's "Useful" Books.) Cr. 8vo. Pp. 64. (London and New York: Frederick Warne and Co., Ltd., 1930.) 6*d.* net.

Schober, Joseph. Silk and the Silk Industry. Translated by R. Cuthill. Demy 8vo. Pp. xi + 375. (London: Constable and Co., Ltd., 1930.) 21*s.* net.*

Schöne, Otto. Grundlagen fur den Entwurf von Braunkohlenbrikettfabriken und Moglichkeiten zur Verbesserung ihrer Energieerzeugung, Wärmewirtschaft und Leistungsfahigkeit. Roy. 8vo. Pp. xii + 175. (Berlin: Julius Springer, 1930.) 25.50 gold marks.

Seiden, Rud. Konig Kautschuk: Kautschuk in Wissenschaft, Wirtschaft und Technik. Pp. 80. (Stuttgart: Dieck und Co., 1930.) 1.80 gold marks.

Smith, F. R. Pewter Work. (Pitman's Craft for All Series.) Cr. 8vo. Pp. xiii + 113. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.* net.

Smith, W. T. Sydney. Building Trade Facts: One Thousand Queries and Answers relating to all Sections of the Building Trade, including General Information; a Manual for Builders, House Owners and Investors. (Lockwood's Manuals.) Cr. 8vo. Pp. 127. (London: Crosby Lockwood and Son, 1930.) 2*s.* 6*d.* net.

Smithells, Colin J. Impurities in Metals: their Influence on Structure and Properties. Second edition, revised. Roy. 8vo. Pp. xiii + 190 + 26 plates. (London: Chapman and Hall, Ltd., 1930.) 18*s.* net.*

Sturt, George (George Bourne). The Wheelwright's Shop. Passages selected and edited by A. F. Collins. (Craftsman Series.) Cr. 8vo. Pp. xii + 116. (Cambridge: At the University Press, 1930.) 2*s.* 6*d.* net.

Taylor, Stewart, and **Snell, James E.** Craft Work (Stencil and Lino). (Practical Work for Senior Schools, First Year.) Cr. 8vo. Pp. 62. (London: Oxford University Press, 1930.) 1*s.* 9*d.*

Taylor, Stewart, and **Snell, James E.** Practical Drawing. (Practical Work for Senior Schools, First Year.) Cr. 8vo. Pp. 94. (London: Oxford University Press, 1930.) 1*s.* 9*d.*

Terrill, H. M., and **Ulrey, C. T.** X-Ray Technology: the Production, Measurement and Applications of X-Rays. Med. 8vo. Pp. viii + 256. (London: Chapman and Hall, Ltd., 1930.) 21*s.* net.*

Thews, Edmund Richard. Metallurgy of White Metal Scrap and Residues. Med. 8vo. Pp. xiv + 383. (London: Chapman and Hall, Ltd., 1930.) 25*s.* net.*

Wagner, Hans. Taschenbuch der Farbenkunde: fur Maler, Kunstler, Kunstgewerbler, Drogisten, Architekten, Fachlehrer, Farbenhandler und sonstige Farbenverbraucher. 8vo. Pp. 240. (Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H., 1930.) 6.50 gold marks.

Woldman, Norman E. Physical Metallurgy Laboratory Manual. Med. 8vo. Pp. v + 259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.*

Zimmermann, H. Lehre vom Knicken auf neuer Grundlage. 4to. Pp. viii + 91. (Berlin: Wilhelm Ernst und Sohn, 1930.) 12.50 gold marks.

Astronomy

Barlow, C. W. C., and **Bryan, G. H.** Elementary Mathematical Astronomy. Fourth edition, revised by A. C. D. Crommelin. Cr. 8vo. Pp. xvii + 415. (London: University Tutorial Press, Ltd., 1930.) 9*s.* 6*d.**

Meteorology: Geophysics

Air Ministry: Meteorological Office. Meteorological Observer's Handbook. Supplement No. 1: Instructions for Meteorological Telegraphy, embodying the New International Codes approved by the International Meteorological Conference at Copenhagen in September 1929 Second edition. (M.O.191/1, 1930.) Published by the Authority of the Meteorological Committee. Roy. 8vo Pp. 62 + 2 plates. (London: H.M. Stationery Office, 1930.) 2*s.* 6*d.* net.*

Brooks, C. E. P., and **Hunt, Theresa M.** The Zonal Distribution of Rainfall over the Earth. (Memoirs of the Royal Meteorological Society, Vol. 3, No. 28.) Roy. 8vo Pp. 139-158. (London: Edward Stanford, Ltd., 1930.) 2*s.* 6*d.**

Holdefleiss, Paul. Agrarmeteorologie: die Abhangigkeiten der Ernteertrage von Wetter und Klima. Roy. 8vo Pp. vii + 108. (Berlin: Paul Parey, 1930.) 7.50 gold marks.

Wishart, J. On the Secular Variation of Rainfall at Rothamsted. (Memoirs of the Royal Meteorological Society, Vol. 3, No. 27.) Roy. 8vo. Pp. 127-137. (London: Edward Stanford, Ltd., 1930.) 2*s.* 6*d.**

Geology: Mineralogy

Barker, T. V. The Study of Crystals: a General Introduction. Roy. 8vo. Pp. xvi + 137. (London: Thomas Murby and Co., 1930.) 8*s.* 6*d.* net.*

Bülow, Kurd von. Alluvium: Grundsatzliches und Programmatisches zur Geologie der jungsten erdgeschichtlichen Epoche. Roy. 8vo. Pp. viii + 178. (Berlin Gebruder Borntraeger, 1930.) 13.50 gold marks.*

Department of Scientific and Industrial Research Fuel Research. Physical and Chemical Survey of the National Coal Resources. No. 17: The Significance of Spores in the Correlation of Coal Seams. Part 1: The Parkgate Seam South Yorkshire Area. By L. Slater, Marjorie M. Evans and Gladys E. Eddy. Roy. 8vo. Pp vi + 28 + 7 plates. (London: H.M. Stationery Office, 1930.) 1*s.* 3*d.* net.*

Gadow, Hans. Jorullo: the History of the Volcano of Jorullo and the Reclamation of the Devastated District by Animals and Plants. Demy 8vo. Pp. xviii + 100 (Cambridge: At the University Press, 1930.) 7*s.* 6*d* net.

Geological Survey, England and Wales, Memoirs of the. Explanation of Sheet 77: The Geology of the Country around Huddersfield and Halifax. By D. A Wray, J. V. Stephens, W. N. Edwards and C. E. N. Bromehead. Roy. 8vo. Pp. vi + 221 + 5 plates. 4*s.* 6*d.* net Sheet 77: Huddersfield. Drift edition, Colour printed Scale of one Inch to one statute Mile. $26\frac{1}{2}$ in. $21\frac{1}{2}$ in 2*s.* net. (London: H.M. Stationery Office, Southampton Ordnance Survey Office, 1930.)*

Hesemann, Julius. Die Erzbezirke des Ramberges und von Tilkerode im Harz. (Archive fur Lagerstättenforschung, Heft 46.) Roy. 8vo. Pp. 92 + 6 Tafeln (Berlin: Preussischen Geologischen Landesanstalt, 1930.) 6 gold marks.

Joly, John. The Surface-History of the Earth. Second edition. Demy 8vo. Pp. xxi + 211 + 13 plates. (Oxford Clarendon Press; London: Oxford University Press, 1930.) 8*s.* 6*d.* net.*

Krejci-Graf, Karl. Geochemie der Erdollagerstätten erläutert an den rumänischen Vorkommen. (Abhandlungen zur praktischen Geologie und Bergwirtschaftslehre, Band 20.) Roy. 8vo. Pp. iv + 56. (Halle a.S.: Wilhelm Knapp, 1930.) 5.50 gold marks.

North, F. J. Limestones: their Origins, Distribution and Uses. Demy 8vo. Pp. xxiii + 467. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1930.) 16*s.* net.*

Pfeiffer, Wilhelm, und **Heubach, Karl.** Geologie von Heilbronn. (Erdgeschichtliche und landeskundliche Abhandlungen aus Schwaben und Franken, Heft 12.) Roy. 8vo. Pp. 151. (Oehringen: Hohenlohesche Buchhandlung, 1930.) 3.60 gold marks.

Geography: Travel

Adamovic, L. Italien. (Junks Naturführer, Band 9.) Pott 8vo. Pp. xiii+671. (Berlin: W. Junk, 1930.) 8 gold marks.

Baedeker, Karl. Nordbayern: Franken, Oberpfalz, Niederbayern, Bayerischer und Böhmer Wald, bohm. Grenzgebiet; Handbuch fur Reisende. Zweite Auflage Pott 8vo. Pp. xxxvi+340. (Leipzig: Karl Baedeker, 1930.) 7.50 gold marks.

Campbell, Dugald. Wanderings in Widest Africa. Med. 8vo. Pp. 223. (London: Religious Tract Society, 1930.) 7*s*. 6*d*. net.

Clowser, C. E., and others. Modern World Geographies. Book 4: Europe. Cr. 8vo. Pp. 518. (Exeter: A. Wheaton and Co., Ltd., 1930.) 5*s*. net.

Cole, Capt. D. H. Imperial Military Geography: General Characteristics of the Empire in relation to Defence. Sixth edition. Demy 8vo. Pp. 394. (London: Sifton Praed and Co., Ltd., 1930.) 10*s*.

Eddy, Clyde. Danger River: an Account of the only successful attempt to Navigate the Rapids of the World's Most Dangerous River (Colorado River). Roy. 8vo. Pp. 288. (London: Skeffington and Son, Ltd., 1930.) 18*s*. net.

Eddy, John W. Hunting the Alaska Brown Bear. Demy 8vo. Pp. 254. (New York and London: G. P. Putnam's Sons, 1930.) 15*s*. net.

Finnemore, John. Japan. (Peeps at Many Lands Series.) Third edition, thoroughly revised and entirely reset. Cr. 8vo. Pp. 90+8 plates. (London: A. and C. Black, Ltd., 1930.) 2*s*. 6*d*. net.

Fry, G. C. Principles of Physical Geography. From the seventh edition of "A Text Book of Geography." Cr. 8vo. Pp. 170. (London University Tutorial Press, Ltd., 1930.) 2*s*. 6*d*.

Grubb, Kenneth G. Amazon and Andes. Demy 8vo. Pp. xii+296. (London: Methuen and Co., Ltd., 1930.) 18*s*. net.

Guenther, Konrad. Von Kairo nach Bagdad und Stambul. Auf des Spuren Karl Mays durch d Orient. 8vo. Pp. 119. (Dresden: Karl-May-Verlag, 1930.) 1.50 gold marks.

Jackson, G. Gibbard. The Romance of Exploration. Demy 8vo. Pp. 240. (London: Sampson Low, Marston and Co., Ltd., 1930.) 6*s*. net.

Jaspert, Willem. Through Unknown Africa: the Record of the Jaspert African Exploration. Translated by Agnes Platt. Roy. 8vo. Pp. 287. (London: Jarrolds, Publishers (London), Ltd., 1930.) 12*s*. 6*d*. net.

Johnson, Norman M., and **Matheson, Charles.** Europe. (The Gateway Geographies.) Cr. 8vo. Pp. viii+184. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*.

Koch, Fritz, Herausgegeben von. Thuringen in Farbenphotographie. (Deutschland in Farbenphotographie, Band 13.) Folio. Pp. ix+92+40 Tafeln. (Berlin: Verlagsanstalt fur Farbenphotographie, 1930.) 44 gold marks.

Marlowe, Christopher. The Harz Mountains. Cr. 8vo. Pp. xii+226. (London: John Lane, The Bodley Head, Ltd., 1930.) 8*s*. 6*d*. net.

Maull, Otto. Vom Itatiaya zum Paraguay: Ergebnisse und Erlebnisse e. Forschungsreise durch Mittelbrasilien. 4to. Pp. xv+366+80 Tafeln. (Leipzig: Karl W. Hiersemann, 1930.) 60 gold marks.

Mawson, Sir Douglas. The Home of the Blizzard: being the Story of the Australasian Antarctic Expedition, 1911–1914. Abridged popular edition. Roy. 8vo. Pp. xxxi+438. (London: Hodder and Stoughton, Ltd., 1930.) 12*s*. 6*d*. net.

Miller, Francis Trevelyan. Byrd's Great Adventure: with the Complete Story of all Polar Explorations for One Thousand Years. Roy. 8vo. Pp. 383. (London: Stanley Paul and Co., Ltd., 1930.) 15*s*. net.

Narath, Rudolf. Die Union von Südafrika und ihre Bevolkerung. (Geographien Schriften, Band 6.) 8vo. Pp. vi+262. (Leipzig und Berlin: B. G. Teubner, 1930.) 12 gold marks.

Passarge, Siegfried. Vergleichende Landschaftskunde. Heft 5: Der Mensch im heissen Gurtel. 4to. Pp. viii+216. (Berlin: Dietrich Reimer, 1930.) 20 gold marks.

Penck, A. Das Tor von Mittenwald. (Sammlung geographischer Führer, Band 4.) 8vo. Pp. xii+216+2 Tafeln. (Berlin: Gebruder Borntraeger, 1930.) 9.40 gold marks.

Philips' Visual Contour Atlas. (Buckinghamshire edition.) Gl. 4to. Pp. 4+40+16. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1930.) 1*s*. 4*d*.

Sankey, H., and **Merrett, Edgar A.** Progressive Studies in Geography. Part 3: Euro-Asia. Cr. 8vo. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1930.) Paper, 9*d*.; limp cloth, 1*s*.

Schmithals, Hans. Die Alpen: das Gesamtgebiet in Bildern. Dritte Auflage. 4to. Pp. xxvi+336+16 Tafeln. (Berlin: Verlag Wasmuth, 1930.) 36 gold marks.

Schwerla, C. Borro. Kanada im Faltboot. 8vo. Pp. 196. (Berlin: A. Scherl, 1930.) 5 gold marks.

Spary, V. C. New Regional Map Books. Book 4: Regions of Britain and the World. Cr. 4to. Pp. 32. (London: University of London Press, Ltd., 1930.) 1*s*.

Storrs, Sir Ronald, and **O'Brien, Bryan Justin,** Edited by. The Handbook of Cyprus. Ninth (Jubilee) Issue. Cr. 8vo. Pp. xiv+368. (London: Christophers, 1930.) 7*s*. 6*d*. net.

Svensson, Jón Nonni. Aus Island: Erlebnisse und Erinnerungen. Pott 8vo. Pp. vii+83. (Freiburg i.Br.: Herder und Co., G.m.b.H., 1930.) 1.80 gold marks.

Swannell, Mildred. Animal Geography: a New Approach to Geography based on the Life Stories of Twelve Typical Animals. Roy. 4to. Pp. 32. (London: Evans Brothers, Ltd., 1930.) 3*s*. 6*d*. net.

Wilmore, Albert. Experimental and Open-air Geography. (Bell's Intermediate Geographies.) Fcap. 8vo. Pp. 198. (London: G. Bell and Sons, Ltd., 1930.) 1*s*. 9*d*.

Wood, Gordon L. The Pacific Basin Ex. Cr. 8vo. Pp. xii+340. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 10*s*. net.

General Biology: Natural History Zoology: Botany

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 338. Abt. 9: Methoden zur Erforschung der Leistungen des tierischen Organismus, Teil 2, Hälfte 2, Heft 4 Methoden der Susswasserbiologie. Die *p*H-Bestimmung mit dem Hydrionometer, von Ernst Bresslau; Haltung und Aufzucht von Susswasserschwammen, von Kurt Schroder; Fang, Pflege und Zucht der deutschen Susswasseregel, von Konrad Herter. Sup. Roy. 8vo. Pp. 1551–1618. (Berlin und Wien: Urban und Schwarzenberg, 1930.) 4 gold marks.*

Artschwager, Ernst. Dictionary of Biological Equivalents: German-English. Roy. 8vo. Pp. 239 (6 plates). (London: Baillière, Tindall and Cox, 1930.) 20*s*. net.*

Bower, F. O. Size and Form in Plants: with Special Reference to the Primary Conducting Tracts. Demy 8vo. Pp. xiv+232. (London: Macmillan and Co., Ltd., 1930.) 12*s*. 6*d*. net.*

Brandmeyer, Rudolf. Der Naturschwamm. Roy. 8vo. Pp. 38. (Bremen: Verlag Leuwer, 1930.)

Clark, Austin H. The New Evolution: Zoogenesis. Med. 8vo. Pp. xiv+297. (London: Baillière, Tindall and Cox, 1930.) 13*s*. 6*d*. net.*

Dahl, Friedrich, Begründet von. Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise. Teil 19: Eintagsfliegen oder Ephemeroptera. Von E. Schoenemund. Roy. 8vo. Pp iv+106. 7.50 gold marks. Teil 20: Zweiflügler oder Diptera. IV: Syrphidae–Conopidae. Schwebfliegen oder Syrphidae, von P. Sack; Blasenkopffliegen oder Conopidae, von O. Krober. Roy. 8vo. Pp. 142. 9 gold marks. (Jena: Gustav Fischer, 1930.)

Danish *Dana* Expeditions 1920–22 in the North Atlantic and the Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee. No. 7: Ornithological Observations in the North Atlantic Ocean. By P. Jespersen. Published at the cost of the Rask-Ørsted Fund. Roy. 4to. Pp. 36. (Copenhagen: Gyldendalske Boghandel; London: Wheldon and Wesley, Ltd., 1930.) 6*s*.*

Douglas, William F. Das Fischereiwesen Russlands. (Archive fur Hydrobiologie, Supplement-Band 10, Heft 1.) Roy. 8vo. Pp. 206. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele), G.m.b.H., 1930.)

Druce, George Claridge. The Flora of Northamptonshire: being a Topographical and Historical Account of the Flowering Plants and Ferns found in the County, with short Biographical Notices of the Botanists who have contributed to Northamptonshire Botany during the last Three Centuries. Demy 8vo. Pp. cxlii + 304. (Arbroath: T. Buncle and Co., 1930.) *

Duncan, F. Martin. Close Ups from Nature. Demy 8vo. Pp. 244. (London: Sampson Low, Marston and Co., Ltd., 1930.) 6*s.* net.

Duthie, Margaret A. A Study of the Origin and Development of the Embryo Sac of *Lilium candidum*. Cr. 4to. Pp. 16 + 4 plates. (Aberdeen: Privately printed at the University Press, 1930.) *

Elliott, Charlotte. Manual of Bacterial Plant Pathogens. Roy. 8vo. Pp. ix + 349. (London: Baillière, Tindall and Cox, 1930.) 22*s.* 6*d.* net.*

Fairchild, David. Exploring for Plants. From Notes of the Allison Vincent Armour Expeditions for the United States Department of Agriculture, 1925, 1926 and 1927. Med. 8vo. Pp. xx + 591. (New York: The Macmillan Co., 1930.) 21*s.* net.*

Gillespie, T. H. Zoo Ways and Whys. Cr. 8vo. Pp. 218 + 16 plates. (London: Herbert Jenkins, Ltd., 1930.) 3*s.* 6*d.* net.*

Golding, Harry. Our Animal Friends. Cr. 4to. Pp. 176 + 24 plates. (London: Ward, Lock and Co., Ltd., 1930.) 3*s.* 6*d.* net.

Groos, K. Die Spiele der Tiere. Dritte Auflage. Roy. 8vo. Pp. vi + 222. (Jena: Gustav Fischer, 1930.) 10 gold marks.

Gurwitsch, Alexander. Die histologischen Grundlagen der Biologie. Zugleich zweite Auflage der Morphologie und Biologie der Zelle. 8vo. Pp. vi + 310. (Jena: Gustav Fischer, 1930.) 18 gold marks.

Guyénot, Émile. La variation et l'évolution. Tome 2: L'Évolution. (Encyclopédie scientifique: Bibliothèque de biologie générale.) Gl. 8vo. Pp. 414. (Paris: Gaston Doin et Cie, 1930.) 32 francs.*

Hegner, Robert, and **Andrews, Justin,** Edited by. Problems and Methods of Research in Protozoölogy. Contributors: Justin Andrews, M. A. Barber, H. P. Barret, E. R. Becker, G. H. Boyd, Chas. F. Craig, Frank G. Haughwout, Robert Hegner, M. J. Hogue, Francis O. Holmes, T. S. Hsiung, John F. Kessel, Harold Kirby, Jr., Charles A. Kofoid, W. H. W. Komp, R. R. Kudo, M. S. MacDougall, Reginald D. Manwell, Maynard M. Metcalf, Herbert Ratcliffe, Lowell J. Reed, C. W. Rees, Bruce D. Reynolds, Nannie M. Smith, Lucy G. Taliaferro, W. H. Taliaferro, D. H. Wenrich. Demy 8vo. Pp. ix + 532. (New York: The Macmillan Co., 1930.) 21*s.* net.*

Henry, G. M. Coloured Plates of the Birds of Ceylon. With a Short Description of each Bird by W. E. Wait. Published by the Ceylon Government. Part 3. Roy. 4to. Pp. iii + 16 + 16 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd., 1930.) 30*s.**

Jaccottet, John. Die Pilze in der Natur. Deutsche bearbeitung von A. Knapp. 8vo. Pp. 250 + 76 Tafeln. (Bern: A. Francke, A.-G., 1930.) 28 gold marks.

Jennings, H. S. The Biological Basis of Human Nature. Med. 8vo. Pp. xviii + 384. (London: Faber and Faber, Ltd., 1930.) 15*s.* net.*

Junk, W., Ed. Tabulae Biologicae. Herausgegeben von C. Oppenheimer und L. Pincussen. Supplement 2 (Band 6): Zoologie; Protozoa, Mesozoa, Porifera, Coelenterata, Vermes, Mollusca, Echinodermata, Tunicata, Acrania, Pisces, Amphibia, Reptilia, Übersichten über Aves, Mammalia und Arthropoda. Sup. Roy. 8vo. Pp. vi + 969. (Berlin: W. Junk, 1930.) 110*s.**

Karsten, G., und **Schenck, H.,** Begründet von. Vegetationsbilder. Herausgegeben von G. Karsten. Reihe 21, Heft 3-4: Vegetationsbilder aus Portugal. Von Otto Cyrén. 8 gold marks. Reihe 21, Heft 5: Endemismen und Charakterpflanzen von Kreta. Von Th. Schmucker. 4 gold marks. (Jena: Gustav Fischer, 1930.)

Kleinschmidt, O. Die Singvögel der Heimat. Fünfte Auflage. 8vo. Pp. xii + 108 + 100 Tafeln. (Leipzig: Quelle und Meyer, 1930.) 7 gold marks.

Knapp, Edgar. Untersuchungen über die Hullorgane um Archegonien und Sporogonien der akrogynen Jungermaniaceen. (Botanische Abhandlungen, herausgegeben von K. Goebel, Heft 16.) Roy. 8vo. Pp. iv + 168. (Jena: Gustav Fischer, 1930.) 12 gold marks.

Kolle, W., und **Wassermann, A. von,** Begrundet von. Handbuch der pathogenen Mikroorganismen. Dritte, erweiterte Auflage. Mit Einschluss der Immunitätslehre und Epidemiologie sowie der mikrobiologischen Diagnostik und Technik. Herausgegeben von W. Kolle, R. Kraus und P. Uhlenhuth. Band 8, Teil 2. Roy. 8vo. Pp. viii + 780 + 10 Tafeln. (Jena: Gustav Fischer; Berlin und Wien: Urban und Schwarzenberg, 1930.) 78 gold marks.

Kükenthal, Willy, Gegründet von. Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Herausgegeben von Thilo Krumbach. Band 2: Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida. Lieferung 9, Teil 1. Med. 4to. Pp. 113-192. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 10 gold marks.*

Laubmann, Alfred. Vögel. (Wissenschaftlich Ergebnisse der deutschen Gran Chaco-Expedition, Band 1.) 4to. Pp. xv + 334. (Stuttgart: Strecker und Schroder, 1930.) 46 gold marks.

Lindau, Gustav. Die Algen. (Kryptogamenflora fur Anfänger, Band 4, Abteilung 2.) Zweite umgearbeitete und vermehrte Auflage, von Hans Melchior. 8vo. Pp. viii + 301 + 18 Tafeln. (Berlin: Julius Springer, 1930.) 27 gold marks.

Mace, Herbert. Some other Bees, Butterflies and Moths. Cr. 8vo. Pp. 160. (London: Hutchinson and Co., Ltd., 1930.) 2*s.* 6*d.* net.

Maiden, J. H. A Critical Revision of the Genus Eucalyptus. Published by Authority of the Government of the State of New South Wales. Vol. 8, Part 3 (Part 73 of the Complete Work). Roy. 4to. Pp. 113-180 + 4 plates. (Sydney, N.S.W.: Alfred James Kent, 1929.) 3*s.* 6*d.**

Meisenheimer, Johannes. Geschlecht und Geschlechter im Tierreiche. Band 2: Die allgemeinen Probleme. 8vo. Pp. x + 614. (Jena: Gustav Fischer, 1930.) 35 gold marks.

Mitton, G. E., and **Yoe, Shway.** The Life Story of an Elephant. (Life Stories of Animals Series.) Cr. 8vo. Pp. 216. (London: A. and C. Black, Ltd., 1930.) 2*s.* 6*d.* net.

Nienburg, Wilhelm. Die festsitzenden Pflanzen der nord-europaischen Meere. (Handbuch der Seefischerie Nordeuropas, Band 1, Heft 4.) 4to. Pp. iii + 54. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele), G.m.b.H., 1930.) 9 gold marks.

Patterson, Arthur Henry. A Norfolk Naturalist: Observations on Birds, Mammals and Fishes. Demy 8vo. Pp. xii + 209. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

Pax, Ferdinand Albert, und **Tischbierek, H.** Bibliographie der Schlesischen Zoologie. (Schlesische Bibliographie, Band 5.) 4to. Pp. xii + 520. (Breslau: Verlag Priebatsch, 1930.) 18 gold marks.

Prell, Heinrich. Die Pelztiere und ihre Zucht. (Aus: Die Grundfragen und Gesetzmässigkeiten der land- und forstw. Zoologie.) 4to. Pp. 30. (Berlin: Paul Parey, 1930.) 2.80 gold marks.

Rigg, George B. College Botany: with Special Reference to Liberal Education. Cr. 8vo. Pp. 442. (Philadelphia: Lea and Febiger, 1930.) 4 dollars net.*

Rübel, Eduard. Pflanzengesellschaften der Erde. Roy. 8vo. Pp. viii + 464. (Bern: Huber und Co., 1930.) 30 gold marks.

Schmiedeknecht, O., Herausgegeben von. Die Hymenopteren Nord- und Mitteleuropas mit Einschluss von England, Südschweiz, Südtirol und Ungarn. Zweite umgearbeitete Auflage. 4to. Pp. x + 1062. (Jena: Gustav Fischer, 1930.) 57.50 gold marks.

Seigne, J. W. A Bird Watcher's Note Book: Studies of Woodcock, Snipe and other Birds. Demy 8vo. Pp. x + 226 + 17 plates. (London: Philip Allan and Co., Ltd., 1930.) 12*s.* 6*d.* net.*

Smallwood, William Martin. A Text-Book of Biology: for Students in General, Medical and Technical Courses. Sixth edition, thoroughly revised. Med. 8vo. Pp. 470 + 4 plates. (Philadelphia: Lea and Febiger, 1930.) 4 dollars net.*

Smit, Jan. Die Gärungssarcinen: eine Monographie. (Pflanzenforschung, herausgegeben von R. Kolkwitz, Heft 14.) Roy. 8vo. Pp. viii + 59 + 6 Tafeln. (Jena: Gustav Fischer, 1930.) 9 gold marks.

Strauss, Ferdinand. Naturgeschichts-Skizzenbuch. Teil 2: Pflanzen. 4to. Heft 2: Freikronblättrige Pflanzen (Rosenreihe). 2.40 gold marks. Heft 6: Einblattkeimer. 2.40 gold marks. (Wien und Leipzig: Franz Deuticke, 1930.)

Tenenbaum, Joseph. The Riddle of Sex: the Medical and Social Aspects of Sex, Love and Marriage. Demy 8vo. Pp. xiv + 362. (London: George Routledge and Sons, Ltd., 1930.) 7*s*. 6*d*. net.*

Waltham, T. Ernest. Common British Wild Flowers Easily Named. Cr. 8vo. Pp. 194. (London: Oxford University Press, 1930.) 3*s*. 6*d*. net.

Zimmermann, Albrecht. Die Gerbrinden liefernden Akazien (Wattle-Baume): Kultur, Gewinnung, Verwendung und Handel. 4to. Pp. viii + 146. (Jena: Gustav Fischer, 1930.) 8 gold marks.

Agriculture: Horticulture: Forestry

Best, S. E. J. East Yorkshire: a Study in Agricultural Geography. Med. 8vo. Pp. xv + 189 + 8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 16*s*. net.*

Costenoble, H. V. Tropische Geflugelzucht. (Neues Handbuch der tropische Agrikultur, Lieferung 15-16.) 8vo. Pp. 96. (Hamburg: Verlag Thaden, 1930.)

Ettling, Carl. Chinarinde liefernde Baume und ihre Kultur. (Die Tropenreihe, Nr. 26.) 8vo Pp. 44. (Hamburg: Verlag Thaden, 1930.) 3 gold marks.

Ettling, Carl. Gerbstoff liefernde Pflanzen. (Die Tropenreihe, Nr. 27.) 8vo. Pp. 26. (Hamburg: Verlag Thaden, 1930.) 2.50 gold marks.

Fitschen, Jost, Herausgegeben von. Handbuch der Nadelholzkunde: Systematik, Beschreibung, Verwendung und Kultur d. Ginkgoaceen, Freiland-Koniferen und Gnetaceen; fur Gärtner, Forstbeamte und Botaniker. Dritte vollstandig neubearbeitete Auflage von Ludwig Beissners Nadelholzkunde. 4to. Pp. xv + 765. (Berlin: Paul Parey, 1930.) 42 gold marks.

Heale, Walter, and Reddaway, G. E. The Intensive System of Poultry Keeping. (Lockwood's Manuals.) Cr. 8vo. Pp. 88. (London: Crosby Lockwood and Son, 1930.) 2*s*. 6*d*. net.

Jull, Morley A. Poultry Husbandry. Med. 8vo Pp. ix + 639. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s*. net.*

Kronacher, Carl, und Lodemann, Georg. Technik der Haar- und Wolleuntersuchung. 8vo Pp. vi + 432. (Berlin und Wien: Urban und Schwarzenberg, 1930.)

Loew, Oscar. Das Calcium im Leben der Haustiere. Roy. 8vo. Pp. 65. (Munchen: Verlag Gmelin, 1930.) 2.40 gold marks.

Vageler, Paul. Grundriss der tropischen und subtropischen Bodenkunde fur Pflanzer und Studierende. 8vo. Pp. 217. (Berlin: Verlagsgesellschaft fur Ackerbau, 1930.) 12 gold marks.

Wagner, Christof. Lehrbuch des Forstschutzes. 4to. Pp. viii + 357. (Berlin: Paul Parey, 1930.) 26 gold marks.

Anatomy: Physiology

Crow, W. B. Voice and the Vocal Apparatus. Cr. 8vo. Pp. 29. (Cambridge: W. Heffer and Sons, Ltd., 1930.) 1*s*. net.*

Friedrichsen, Friedrich. Die Zuckerkrankheit: ihr Wesen und ihre Behandlung fur Ärzte und Patienten. 8vo. Pp. 212. (Bad Neuenahr: Verlag Strehlitz, 1930.) 3.75 gold marks.

Hartridge, H., and Haynes, F. Histology for Medical Students. (Oxford Medical Publications.) Pp. 416. (London: Oxford University Press, 1930.) 15*s*. net.

Henke, Friedrich, und Lubarsch, Otto, Herausgegeben von. Handbuch der speziellen pathologischen Anatomie und Histologie. Band 7: Weibliche Geschlechtsorgane. Bearbeitet von Oskar Frankl, K. Kaufmann und Robert Meyer. Teil 1: Uterus und Tuben. 4to. Pp x + 931. (Berlin: Julius Springer, 1930.) 195 gold marks.

Jossifow, G. M. Das Lymphgefässsystem des Menschen: mit Beschreibung der Adenoide und der Lymphbewegungsorgane. Übersetzt aus dem Russischen von J. W. Avtokratow. Roy. 8vo. Pp iv + 176. (Jena: Gustav Fischer, 1930.) 12 gold marks.

Kugelmass, I. Newton. Clinical Nutrition Feeding: in Infancy and Childhood. 8vo. (Philadelphia and London: J. B. Lippincott Co., 1930.) 25*s*. net.

Laird, Donald A., and Muller, Charles G. Sleep: Why we need It and How to get It. Cr. 8vo. Pp. x + 212. (London: Williams and Norgate, Ltd., 1930.) 6*s*. net.*

Lamb, F. W. An Introduction to Human Experimental Physiology. Demy 8vo. Pp. xii + 335. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 12*s*. 6*d*.*

Medical Research Council. Special Report Series, No. 147: The Electrocardiogram. By H. W. Craib. Roy. 8vo. Pp. 57 + 4 plates. (London: H.M. Stationery Office, 1930.) 1*s*. 3*d*. net.*

Möllendorff, Wilhelm von, Herausgegeben von. Handbuch der mikroskopischen Anatomie des Menschen. Band 2: Die Gewebe. Teil 2: Stutzgewebe, Knochengewebe, Skelettsystem. Bearbeitet von Hans Petersen, Josef Schaffer und Franz Weidenreich. 4to. Pp. vii + 699. (Berlin: Julius Springer, 1930.) 168 gold marks.

Oppenheimer, Carl, Herausgegeben von. Handbuch der Biochemie des Menschen und der Tiere. Zweite Auflage, Ergänzungsband. Roy. 8vo. Pp. viii + 528. (Jena: Gustav Fischer, 1930.) 42 gold marks.

Piersol, G. A. Normal Histology. Fourteenth edition, edited by W. H. F. Addison. Roy. 8vo. Pp. 479. (Philadelphia and London: J. B. Lippincott Co., 1930.) 25*s*. net.

Scheunert, Arthur. Der Vitamingehalt der deutschen Nahrungsmittel. Teil 2: Mehl und Brot. p. 25. (Berlin: Julius Springer, 1930.) 1.80 gold marks.

Troup, W. Annandale. Therapeutic Uses of Infra-red Rays. Demy 8vo. Pp. viii + 58 + 16 plates. (London: The Actinic Press, Ltd., 1930.) 5*s*. 6*d*. net.*

Anthropology: Archæology

Baikie, Rev. James. Ancient Jerusalem. (Peeps at Ancient Civilisations.) Cr. 8vo. Pp. 90 + 4 plates. (London: A. and C. Black, Ltd., 1930.) 2*s*. 6*d*. net.

Bendann, E. Death Customs: an Analytical Study of Burial Rites. (The History of Civilization Series.) Roy. 8vo. Pp. xiii + 304. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 12*s*. 6*d*. net *

Collingwood, R. G. The Archaeology of Roman Britain. (Methuen's Handbooks of Archaeology.) Demy 8vo. Pp. xvi + 293 + 8 plates. (London: Methuen and Co., Ltd., 1930.) 16*s*. net.*

Coulton, G. G. The Medieval Scene: an Informal Introduction to the Middle Ages. Cr. 8vo. Pp. x + 164 + 8 plates. (Cambridge: At the University Press, 1930.) 5*s*. net.

Granet, Marcel. Chinese Civilization. Translated by Kathleen E. Innes and Mabel R. Brailsford. (The History of Civilization Series.) Roy. 8vo. Pp. xxiii + 444 + 12 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 25*s*. net.*

Knowlson, T. Sharper. The Origins of Popular Superstitions and Customs. Demy 8vo. Pp. x + 242. (London: T. Werner Laurie, Ltd., 1930.) 7*s*. 6*d*.

Lehmann, Friedrich Rudolf. Die polynesischen Tabusitten: eine ethno-soziologische und religionswissenschaftliche Untersuchung. (Veroffentlichungen der staatlich-sächs. Forschungsinstitut fur Volkerkunde in Leipzig, Reihe 1, Band 10.) 4to. Pp. vii + 344. (Leipzig: R. Voigtländer, 1930.) 7 gold marks.

Luquet, G.-H. L'art primitif. (Encyclopédie scientifique: Bibliothèque d'anthropologie.) Gl. 8vo. Pp. iii + 267. (Paris: Gaston Doin et Cie, 1930.) 30 francs.*

Nordenskiöld, Erland. Comparative Ethnographical Studies. Vol. 7, Part 2: Picture-Writings and other Documents. By Néle, Charles Slater, Charlie Nelson and other Cuna Indians. Med. 8vo. Pp. iv + 75 + 8 plates. (London: Oxford University Press, 1930.) 8*s.* net.*

Pope, Saxton T. A Study of Bows and Arrows. Demy 8vo. Pp. iv + 102 + 20 plates. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1930.) 11*s.* 6*d.* net.

Smith, W. Ramsay. Myths and Legends of the Australian Aboriginals. Demy 8vo. Pp. 356 + 38 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 21*s.* net.*

Tylor, Sir Edward B. Anthropology: an Introduction to the Study of Man and Civilization. (The Thinker's Library, Vols. 14 and 15.) Fcap. 8vo. Vol. 1. Pp. xvi + 180. Vol. 2. Pp. vi + 166. (London: Watts and Co., 1930.) 1*s.* net each Vol.*

Waddell, L. A. Egyptian Civilization: its Sumerian Origin and Real Chronology, and Sumerian Origin of Egyptian Hieroglyphs. Med. 8vo. Pp. xx + 223 + 21 plates. (London: Luzac and Co., 1930.) 12*s.* 6*d.* net.*

Wilson-Haffenden, Capt. J. R. The Red Men of Nigeria: an Account of a lengthy residence among the Fulani, or "Red Men", and other Pagan Tribes of Central Nigeria. Demy 8vo. Pp. 318. (London: Seeley, Service and Co., Ltd., 1930.) 21*s.* net.

Philosophy: Psychology

Alberini, Coriolano. Die deutsche Philosophie in Argentinien. Herausgegeben von Iso Brante Schweide. Autorisierte übersetzung von Hilda B. de Schweide. Pott 8vo. Pp. 84. (Berlin-Charlottenburg: Verlag Hendrioek, 1930.)

Bernhard, Ernst Adolf. Philosophische und naturwissenschaftliche Grundlagen der Psychologie. (Bibliothek fur Philosophie, Band 32.) Roy. 8vo. Pp. 123. (Berlin: Carl Heymann, 1930.) 8 gold marks.

Brandenstein, Frhr. Béla von. Metaphysik des organischen Lebens. (Bücher der neuen Biologie und Anthropologie, Band 8.) 8vo. Pp. 120. (Habelschwerdt: Verlag Franke, 1930.) 3 gold marks.

Brüll, Erhard. Erkenntnistheoretische Grundprobleme der Relativitätstheorie, Quanten- und Wellenmechanik. 8vo. Pp. 66. (Breslau: Verlag Borgmeyer, 1930.)

Bühler, Karl. Die geistige Entwicklung des Kindes. Sechste, durchgesehene Auflage. Roy. 8vo. Pp. xx + 488. (Jena: Gustav Fischer, 1930.) 18 gold marks.

Burkamp, Wilhelm. Naturphilosophie der Gegenwart. (Philosophische Forschungsberichte, Heft 2.) Roy. 8vo. Pp. v + 55. (Berlin: Junker und Dunnhaupt, 1930.) 2.50 gold marks.

Dempf, Alois. Metaphysik des Mittelalters. (Handbuch der Philosophie, Lieferung 30.) 4to. Pp. 154. (Munchen und Berlin: R. Oldenbourg, 1930.) 4 gold marks.

Doležal, Jan. Über die Bewegungsform bei der Arbeit an Drehkurbeln. (Neue psychologischen Studien, Band 5, Heft 2.) Roy. 8vo. Pp. ii + 62. (Munchen: C. H. Beck, 1930.)

Groddeck, Georg. The Unknown Self: a New Psychological Approach to the Problems of Life, with Special Reference to Disease. Cr. 8vo. Pp. 207. (London: The C. W. Daniel Co., 1930.) 7*s.* 6*d.* net.*

Hallett, H. F. Aeternitas: a Spinozistic Study. Demy 8vo. Pp. xix + 344. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 16*s.* net.*

Lafora, Gonzalo R. Don Juan and other Psychological Studies. Translated by Janet H. Perry. Cr. 8vo. Pp. 288. (London: Thornton Butterworth, Ltd., 1930.) 7*s.* 6*d.* net.*

Lodge, Sir Oliver. Beyond Physics, or the Idealisation of Mechanism: being a Survey and Attempted Extension of Modern Physics in a Philosophical and Psychical Direction. Second edition. Cr. 8vo. Pp. 184. (London: George Allen and Unwin, Ltd., 1930.) 5*s.* net.*

Manley, R. M. Kinetic Space and its Speculative Consequences. Cr. 8vo. Pp. 93. (Cleveland, Ohio: The Author, 1930.) *

Paulhan, F. The Laws of Feeling. Translated by C. K. Ogden. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. xiv + 213. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1930.) 10*s.* 6*d.* net.*

Schmidt, Peter. Don't be Tired: the Campaign against Fatigue. Translated by Mary Chadwick. Cr. 8vo. Pp. 143. (London and New York: G. P. Putnam's Sons, 1930.) 3*s.* 6*d.* net.*

Bacteriology: Hygiene

Crookshank, F. G. Epidemiological Essays. Ex. Cr. 8vo. Pp. ix + 136. (London: Kegan Paul and Co., Ltd., 1930.) 7*s.* 6*d.* net.*

Levine, Max, and **Schoenlein, H. W.** A Compilation of Culture Media for the Cultivation of Microorganisms. (Monographs on Systematic Bacteriology.) Prepared at the Request of the Society of American Bacteriologists and Financed by a Grant from the Digestive Ferment Company, Detroit, Michigan. Roy. 8vo. Pp. xvi + 969. (London: Baillière, Tindall and Cox, 1930.) 67*s.* 6*d.* net.*

Thomas, Stanley. Laboratory Manual in Bacteriology. Med. 8vo. Pp. ix + 154. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 8*s.* 9*d.* net.*

Weichardt, Wolfgang, Herausgegeben von. Ergebnisse der Hygiene, Bakteriologie, Immunitatforschung und experimentellen Therapie. Band 11. 4to. Pp. iv + 929. (Berlin: Julius Springer, 1930.) 128 gold marks.

Miscellany

British Science Guild. A Catalogue of British Scientific and Technical Books. Third edition, compiled by Daphne Shaw. Demy 8vo. Pp. xxi + 754. (London: A. and F. Denny, Ltd., 1930.) 20*s.* net.*

Bushnell, George Herbert. University Librarianship. Cr. 8vo. Pp. 224. (London: Grafton and Co., 1930.) 7*s.* 6*d.* net.

Coleman, Emily Holmes. The Shutter of Snow. Cr. 8vo. Pp. iv + 219. (London: George Routledge and Sons, Ltd., 1930.) 6*s.* net.*

Curry, Manfred. Wind and Water. Med. 4to. Pp. 28 + 120 plates. (London: *Country Life*, Ltd., 1930.) 25*s.* net.*

Dawson, Warren R. The Treasures of Lloyd's: a Descriptive Account of the Monuments, Pictures, Drawings, Plate, Medals, Manuscripts and other Objects of Historic Interest preserved at Lloyd's, London, preceded by a Sketch of the History of Lloyd's. Fourth edition enlarged and rewritten. Demy 8vo. Pp. vi + 200 + 22 plates. (London: Lloyd's, 1930.) *

Gregory, Joshua C. The Scientific Achievements of Sir Humphry Davy. Cr. 8vo. Pp. viii + 144. (London: Oxford University Press, 1930.) 6*s.* net.*

Jackson, Jr., Dugald C., and **Jones, W. Paul.** The Scientific Age: Essays in Modern Thought and Achievement. Ex. Cr. 8vo. Pp. vii + 353. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 10*s.* net.*

Pierce, S. W. and **J. T.** A Patient Looks at her Doctors. Cr. 8vo. Pp. 251. (London: George Routledge and Sons, Ltd., 1930.) 7*s.* 6*d.* net.*

Powys, A. R. The English Parish Church. (The English Heritage Series.) Gl. 8vo. Pp. xix + 165. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 3*s.* 6*d.* net.*

Smith, Preserved. A History of Modern Culture: the Great Renewal 1543–1687. Demy 8vo. Pp. xi + 672. (London: George Routledge and Sons, Ltd., 1930.) 12*s.* 6*d.* net.*

Strassmann, Paul. Aus der Medizin des Rinascimento. An der Hand des "Leben von Benvenuto Cellini" nach der Übersetzung Goethes. Roy. 4to. Pp. 56. (Leipzig: Georg Thieme, 1930.) 13 gold marks.*

Taylor, Stewart, and **Snell, James E.** Practical Science. (Practical Work for Senior Schools, First Year.) Cr. 8vo. Pp. 88. (London: Oxford University Press, 1930.) 1*s.* 9*d.*

Wingfield-Stratford, Esmé. The Victorian Tragedy. Demy 8vo. Pp. ix + 296. (London: George Routledge and Sons, Ltd., 1930.) 10*s.* 6*d.* net.*

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "Nature" Office.

Mathematics: Mechanics: Physics

Anniss, F. The New Practical Physics. Book 1. Cr. 8vo. Pp. 179. (London and New York: The Gregg Publishing Co., Ltd., 1930.) 2*s.* 6*d.* net.

Appell, Paul, et Goursat, Édouard. Théorie des fonctions algébriques et de leurs intégrales. Deuxième édition, revue et augmentée par Pierre Fatou. Roy. 8vo. Tome 1: Étude des fonctions analytiques sur une surface de Riemann. Pp. xxxv + 526. Tome 2: Théorie des fonctions algébriques d'une variable et des transcendantes qui s'y rattachent; fonctions automorphes. Pp. xiv + 521. (Paris: Gauthier-Villars et Cie, 1930.) 200 francs.*

Armstrong, Henry F. Descriptive geometry. Third edition. Roy. 8vo. Pp. 137. (London: Chapman and Hall, Ltd., 1930.) 10*s.* net.

Bessière, G. La relativité vue simplement. Ex Cr. 8vo. Pp. viii + 148. (Paris: Libr. Dunod, 1930.) 15 francs.

Borchardt, W. G. Geometry Test Papers. Fcap. 8vo. (London: Rivingtons, 1930.) 1*s.* 3*d.*

Brand, Louis. Vectorial Mechanics. Demy 8vo. Pp. xvii + 544. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 25*s.* net.*

Carrington, H. Experimental Mechanics of Materials: a Book for Students of Engineering, including Undergraduates and those intending to sit for the National Certificate and the Union of Lancashire and Cheshire Institutes Examinations. Cr 8vo. Pp. viii + 84. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3*s.* 6*d.* net.*

Chisnell, Edwin T. By Graph to Calculus. Cr. 8vo. Pp. viii + 40 + 84. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 2*s.*

Chisnell, Edwin T. Find the Formula. Cr. 8vo. Pp. 40. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 10*d.*

Chisnell, Edwin T. From Formula to Calculus. Cr. 8vo. Pp. 86. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 1*s.* 3*d.*

Dantzig, Tobias. Number: the Language of Science. Demy 8vo. Pp. xi + 260 + 11 plates. (London: George Allen and Unwin, Ltd., 1930.) 10*s.* net.*

Debye, P., Herausgegeben von. Elektroneninterferenzen. (Leipziger Vorträge, 1930.) Demy 8vo. Pp. vii + 85. (Leipzig: S. Hirzel, 1930.) 6 gold marks.*

Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 27: The Measurement of a Rapidly Fluctuating Flow of Gas. By J. G. King and B. H. Williams. Roy. 8vo. Pp. vi + 18 + 2 plates. (London: H.M. Stationery Office, 1930.) 6*d.* net.*

Department of Scientific and Industrial Research: Illumination Research. Technical Paper No. 11. The Efficiency of Light Wells. By H. F. Meacock and G. E. V. Lambert. Roy. 8vo. Pp. vi + 36 + 4 plates. (London: H.M. Stationery Office, 1930.) 9*d.* net.*

Dirac, P. A. M. Die Prinzipien der Quantenmechanik. Roy. 8vo. Pp. xi + 274. (Leipzig: S. Hirzel, 1930.) 18 gold marks.

Forchheimer, Philipp. Hydraulik. Dritte Auflage. Roy. 8vo. Pp. x + 596. (Berlin und Leipzig: B. G. Teubner, 1930.) 36 gold marks.

Forsyth, A. R. Geometry of Four Dimensions. Imp. 8vo. Vol. 1. Pp. xxix + 468. Vol. 2. Pp. xi + 520. (Cambridge: At the University Press, 1930.) 75*s.* net.*

Frank, Philipp, und Mises, Richard v. Die Differential- und Integralgleichungen der Mechanik und Physik. Zweite vermehrte Auflage (zugleich achte Auflage von Riemann-Webers Partiellen Differentialgleichungen der mathematischen Physik). Band 1: Mathematischer Teil. Herausgegeben von Richard v. Mises. Roy. 8vo. Pp. xxiii + 916. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 57 gold marks.

Gemant, Andreas. Elektrophysik der Isolierstoffe. Roy. 8vo. Pp. vi + 222. (Berlin: Julius Springer, 1930.) 20 gold marks.

Gilbert, Leo. Das Gesetz der strahlenden Materie und die Einheitsskala der Spektra. Roy. 8vo. Pp. 80. (Wien und Leipzig: Wilhelm Braumüller Universitäts-Verlagsbuchhandlung G.m.b.H., 1930.) 3 gold marks.*

Hasse, Helmut. Bericht über neuere Untersuchungen und Probleme aus der Theorie der algebraischen Zahlkörper. Roy. 8vo. Teil 1: Klassenkörpertheorie. Teil 1a, Beweise zu Teil 1. (Sonderdruck aus dem Jahresbericht der Deutschen Mathematiker-Vereinigung, Band 35.) Pp. 135. 7.40 gold marks. Teil 2: Reziprozitätsgesetz. (Jahresbericht der Deutschen Mathematiker-Vereinigung, Erg.-Band 6.) Pp. iv + 204. 11.80 gold marks. (Berlin und Leipzig: B. G. Teubner, 1930.)

Hayashi, Keiichi. Fünfstellige Funktionentafeln: Kreis-, zyklometrische, Exponential-, Hyperbel-, Kugel-, Besselsche, elliptische Funktionen, Thetanullwerte, natürlicher Logarithmus, Gammafunktion u. a. m. nebst einigen häufig vorkommenden Zahlenwerten. Roy. 8vo. Pp. viii + 176. (Berlin: Julius Springer, 1930.) 28 gold marks.

Hayashi, Keiichi. Tafeln der Besselschen, Theta-, Kugel- und anderer Funktionen. Roy. 8vo. Pp. v + 125. (Berlin: Julius Springer, 1930.) 21 gold marks.

Heisenberg, Werner. The Physical Principles of the Quantum Theory. Translated into English by Carl Eckart and Frank C. Hoyt. (The University of Chicago Science Series.) Cr. 8vo. Pp. xii + 186. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 8*s.* 6*d.* net.*

Heyden, A. F. van der. Elementary Trigonometry. Cr. 8vo. Pp. v + 161 + xii. (London: Rivingtons, 1930.) 2*s.* 6*d.**

Holmes' A Comprehensive Arithmetic and Mensuration: for Advanced Division, Central and Secondary Schools. Cr. 8vo. Pp. viii + 253. (Glasgow: W. and R. Holmes, 1930.) 2*s.* 6*d.*; with Answers, 3*s.*

Houstoun, R. A. A Treatise on Light. Sixth edition. Demy 8vo. Pp. xi + 494. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 12*s.* 6*d.* net.*

Johnson, B. K. Lecture Experiments in Optics. Demy 8vo. Pp. 112. (London: Edward Arnold and Co., 1930.) 8*s.* 6*d.* net.*

Kohlrausch, Fr. Lehrbuch der praktischen Physik. Roy. 8vo. Sechzehnte stark vermehrte Auflage. Pp. xxx + 860. (Leipzig und Berlin: B. G. Teubner, 1930.) 23 gold marks.

Kolthoff, Isaac Maurits. Die Massanalyse. Teil 1: Die theoretischen Grundlagen der Massanalyse. Zweite Auflage. 8vo. Pp. xiii + 277. (Berlin: Julius Springer, 1930.) 15 gold marks.

Lamborn, E. A. Greening. Reason in Arithmetic. Cr. 8vo. Pp. iv + 139. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 3*s.* 6*d.*

Landé, A. Vorlesungen über Wellenmechanik: Gehalten an der Staatsuniversität zu Columbus, U.S.A. Demy 8vo. Pp. iv + 132. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 9.50 gold marks.*

Larcombe, H. J. Larcombe's Senior Arithmetics. Demy 8vo. Book 4: for Pupils of Ages 13-15 years. Pp. 84. 1*s.* 6*d.* net. Teacher's Book. Pp. 84. 3*s.* 6*d.* net. (London: Evans Bros., Ltd., 1930.)

Lea, Frederick Charles. Hydraulics: for Engineers and Engineering Students. Fifth edition. Demy 8vo. Pp. xii + 775. (London: Edward Arnold and Co., 1930.) 21*s.* net.*

Lockwood, E. H. A Revision Arithmetic. Cr. 8vo. Pp. viii + 175 + viii. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 2*s.* 6*d.*

Lusin, Nicolas. Leçons sur les ensembles analytiques et leurs applications. (Collection de monographies sur la théorie des fonctions.) Roy. 8vo. Pp. xv + 328. (Paris: Gauthier-Villars et Cie, 1930.) 60 francs.*

Mott, N. F. An Outline of Wave Mechanics. Demy 8vo. Pp. vi + 156. (Cambridge: At the University Press, 1930.) 8*s.* 6*d.* net.*

Norris, P. W. Arithmetic of Commerce. Revised and enlarged edition. Demy 8vo. Pp. xi + 236. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 4*s.* net.

Orthner, R. Mechanisch und optisch elektr. Vorgänge an bewegten Körpern. Pp. 24. (Linz a.D.: Franz Winkler, 1930.) 1.50 gold marks.

Philippe, P. Éléments d'arithmétique commerciale suivis de notions d'algèbre financière: à l'usage des Écoles de Commerce. Ex. Cr. 8vo. Pp. viii + 372. (Paris: Libr. Dunod, 1930.) 22.50 francs.

Rademacher, Hans, und Toeplitz, Otto. Von Zahlen und Figuren: Proben mathematischen Denkens für Liebhaber der Mathematik. Med. 8vo. Pp. vi + 164. (Berlin: Julius Springer, 1930.) 9.60 gold marks.*

Reiche, Fritz. The Quantum Theory. Translated by H. S. Hatfield and Henry L. Brose. Third edition, revised. Cr. 8vo. Pp. 218. (London: Methuen and Co., Ltd., 1930.) 6*s.* net.

Rosmanith, G. Mathematische Statistik der Personenversicherung. (Sammlung mathematisch-physikalischer Lehrbücher, Band 28.) Cr. 8vo. Pp. vi + 141. (Berlin und Leipzig: B. G. Teubner, 1930.) 8 gold marks.

Rycroft, Robert. Model Solutions to Royal Society of Arts Arithmetic Examinations (Stage 1). Cr. 8vo. Pp. 72. (London and New York: The Gregg Publishing Co., Ltd., 1930.) 1*s.*

Saunders, Frederick A. A Survey of Physics: for College Students. Demy 8vo. Pp. x + 635. (New York: Henry Holt and Co., 1930.) 3.75 dollars.*

Saunders, Vivian T., Prepared from numerous sources by. Temperature Chart. 77½ in. by 25½ in. (London: John Murray, 1930.) Unmounted, 5*s.* 6*d.* net; mounted on strong white linen, 9*s.* 6*d.* net; mounted on linen, varnished, on rollers, 15*s.* 6*d.* net.*

Schwamb, P., and others. The Elements of Mechanism. Fourth edition, rewritten. Roy. 8vo. Pp. 372. (London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

Spikes, W. H. The Properties of Matter. Cr. 8vo. Pp. vii + 152. (London: Sidgwick and Jackson, Ltd., 1930.) 4*s.**

Toms, Harold. School Certificate Magnetism and Electricity. (Pitman's School Certificate Series.) Cr. 8vo. Pp. viii + 440. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 5*s.**

Walton, J. J. Test Papers in Trigonometry and Calculus: for the Use of Candidates preparing for School Certificate, Matriculation and similar Examinations. Demy 8vo. Pp. iv + 104. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.**

Williams, W. Ewart. Applications of Interferometry. (Methuen's Monographs on Physical Subjects.) Feap. 8vo. Pp. vii + 104. (London: Methuen and Co., Ltd., 1930.) 2*s.* 6*d.* net.*

Wisdom, Alfred. Arithmetical Dictation: a Systematic Series of Exercises in Mental Arithmetic. Books 5-7, with Answers: Senior Series. Cr. 8vo. Pp. vii + 150. (London: University of London Press, Ltd., 1930.) 3*s.* 6*d.*

Zenneck, Jonathan. Aus Physik und Technik: Vorträge und Aufsätze. Roy. 8vo. Pp. vii + 189. (Stuttgart: Ferdinand Enke, 1930.) 15.50 gold marks.

Engineering

Balcke, Hans. Die Kraftwirtschaft. Band 1. Roy. 8vo. Pp. 692. (München und Berlin: R. Oldenbourg, 1930.) 36 gold marks.

Berard, S. J., and Waters, E. O. Machine Design Problems. Roy. 8vo. Pp. vii + 118. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 8*s.* 6*d.* net.

Biel, R. Die wirtschaftlich günstigsten Rohrweiten: ihre Bestimmung für die Fortleitung von Wasser, Wasserdampf und Gas. Roy. 8vo. Pp. 78 + 14 Tafeln. (München und Berlin: R. Oldenbourg, 1930.) 12 gold marks.

Brooks, E. E., and James, W. H. N. Electric Light and Power. Ninth edition, completely revised. Cr. 8vo. Pp. 450 + 15 plates. (London: Methuen and Co., Ltd., 1930.) 10*s.* net.

Carrington, H. Experimental Mechanics of Materials. Cr. 8vo. Pp. 84. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3*s.* 6*d.* net.

Department of Scientific and Industrial Research: Building Research. Technical Paper No. 10: Studies in Reinforced Concrete. 1: Bond Resistance. By W. H. Glanville. Roy. 8vo. Pp. vi + 37 + 1 plate. 9*d.* net. Technical Paper No. 11: Studies in Reinforced Concrete. 2: Shrinkage Stresses. By W. H. Glanville. Roy. 8vo. Pp. vi + 49 + 2 plates. 1*s.* net. Technical Paper No. 12: Studies in Reinforced Concrete. 3: The Creep or Flow of Concrete under Load. By W. H. Glanville. Roy. 8vo. Pp. vi + 39 + 6 plates. 1*s.* net. (London: H.M. Stationery Office, 1930.) *

Farnham, J. A. Accumulators and Batteries. Feap. 8vo. Pp. 61. (London: W. Foulsham and Co., Ltd., 1930.) 1*s.* net.

Franke, Rudolf. Eine vergleichende Schalt- und Getriebelehre: neue Wege der Kinematik. Roy. 8vo. Pp. 77. (München und Berlin: R. Oldenbourg, 1930.) 4 gold marks.

Geissler, Alb. Experimentelle Untersuchungen an schnellaufenden Kleinmotoren unter besonderer Berücksichtigung des Ausspülverlustes bei Zweitakt-Gemischmaschinen. Roy. 8vo. Pp. 69 + 8 Tafeln. (München und Berlin: R. Oldenbourg, 1930.) 5 gold marks.

Gest, Alexander Purves. Engineering. (Our Debt to Greece and Rome Series.) Cr. 8vo. Pp. xv + 221. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1930.) 5*s.* net.

Hamburger, R. Musterbetriebe deutscher Wirtschaft. Band 1: Die Elektrizitätswirtschaft. Zweite Auflage. Pp. 54. (Berlin: Organisation Verlagsgesellschaft m.b.H. (S. Hirzel), 1930.) 2.75 gold marks.

Hamilton, M. B. Pressure Vessels for High Pressure Boilers (Land Type). Demy 8vo. Pp. 32. (London: The Draughtsman Publishing Co., Ltd., 1930.) 2*s.* net.*

Hutchinson, Robert W. Easy Lessons in Television. Cr. 8vo. Pp. vii + 175. (London: University Tutorial Press, Ltd., 1930.) 1*s.* 9*d.**

Johnson's Materials of Construction. Rewritten by M. O. Withey and James Aston. Edited by F. E. Turneaure. Seventh edition. Med. 8vo. Pp. xxii + 859. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 30*s.* net.*

Leder, W. Kraft und Wärme in der Landwirtschaft und in landwirtschaftlich-industriellen Betrieben. (Wärmelehre und Wärmewirtschaft, Band 9.) Roy. 8vo. Pp. x + 222. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 18.50 gold marks.

Maccall, W. Tolmé. Alternating Current Electrical Engineering. Second edition. Demy 8vo. Pp. viii + 496. (London: University Tutorial Press, Ltd., 1930.) 15*s.**

Marks, Lionel S. Mechanical Engineers' Handbook. Third edition. Cr. 8vo. Pp. 2264. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 35*s.* net.

Maschmeier, G. Untersuchungen an Zylinder- und Globoid-Schneckentrieben. Roy. 8vo. Pp. 47. (München und Berlin: R. Oldenbourg, 1930.) 4 gold marks.

Moore, Herbert F. Textbook of the Materials of Engineering. Fourth edition. Med. 8vo. Pp. 409. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.

Morgan, Alfred P. The Boy Electrician: Practical Plans for Electrical Apparatus for Work and Play, with an Explanation of the Principles of Everyday Electricity. New edition, revised by J. W. Sims. Demy 8vo. Pp. 302 + 8 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7*s.* 6*d.* net.*

Newcomen Society for the Study of the History of Engineering and Technology. Extra Publication No. 2: R. d'Acres's "The Art of Water-Drawing". Published by Henry Brome, at the Gun in Ivie Lane, London, 1659 and 1660. With Introduction and a Diagram by Rhys Jenkins. Gl. 4to. Pp. xxiii + 43. (Cambridge: W. Heffer and Sons, Ltd., 1930.) 7*s.* 6*d.* net.*

Pickels, George W., and Wiley, C. C. Road Surveying. Cr. 8vo. Pp. 380. (London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

Reyner, J. H. Testing Radio Sets. Demy 8vo. Pp. vii + 178 + 8 plates. (London: Chapman and Hall, Ltd., 1930.) 10*s.* 6*d.* net.*

Riley, Arthur, and **Dunkerley, Edward.** Textile Mechanics and Heat Engines. Demy 8vo. Pp. 286. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 15*s.* net.

Schmitz, Joh. Bestimmung der Rohrweiten von Dampfleitungen, insbesondere von Niederdruck- und Unterdruckdampfleitungen. Zweite Auflage. 4to. Pp. 5 + 18 Tafeln. (München und Berlin: R. Oldenbourg, 1930.) 4.50 gold marks.

Tenot, A. Turbines hydrauliques et régulateurs automatiques de vitesse. Livre 1: Description, théorie générale, construction et exploitation; turbines Francis, Pelton, roues-hélices, application de la similitude. Roy. 8vo. Pp. 573. (Paris: Léon Eyrolles, 1930.) 100 francs.

Chemistry: Chemical Industry

Abegg, R., Auerbach, Fr., und **Koppel, I.,** Herausgegeben von. Handbuch der anorganischen Chemie. In 4 Bänden. Band 4, Abteilung 3: Die Elemente der achten Gruppe des periodischen Systems. Teil 2: Eisen und seine Verbindungen. B Lieferung 1. Sup. Roy. 8vo. Pp. B xvi + B 463. (Leipzig: S. Hirzel, 1930.) 45 gold marks.*

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis and Proximate Analytical Examination of the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc. Vol. 8: Glucosides, Non-Glucosidal Bitter Principles, Enzymes, Putrefaction Bases, Animal Bases, Animal Acids, the Cyanogen Compounds, the Proteins, the Digestion Products of Proteins. By the Editor and the following Contributors: Julius Grant, G. Barger, K. G. Falk, Philip B. Hawk and O. Bergeim, G. H. Buchanan, S. B. Schryver and H. W. Buston. Editor: C. Ainsworth Mitchell. Fifth edition, revised and partly rewritten. Med. 8vo. Pp. x + 761. (London: J. and A. Churchill, 1930.) 30*s.**

Bauer, K. H., Herausgegeben von. Neues Handwörterbuch der Chemie. Band 10, Lieferung 10-12 (Schluss des Gesamtwerkes). Roy. 8vo. Pp. 721-900. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 7.20 gold marks.

Briggs, William, and **Bausor, H. W.** Elementary Quantitative Analysis. Revised by D. R. Snellgrove. Second edition. Cr. 8vo. Pp. vii + 125. (London: University Tutorial Press, Ltd., 1930.) 3*s.**

Clark, A. H. Organic Chemistry: for Students of Pharmacy and Medicine. 8vo. (New York: D. Van Nostrand Co.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

Davidsohn, J., und **Stadlinger, H.** Hilfsbuch für das Gebiet der Fette und Fettprodukte: ein Vademekum für die Wirtschaftsgebiete der Fette, Öle, Fettsäuren, Seifen, Firnisse, Textilöle, Lederfette, Glyzerine und der verwandten Stoffe (Wachse, Harze, Riechstoffe, Losungsmittel usw.) 8vo. Pp. xvi + 484. (Leipzig: S. Hirzel, 1930.) 15 gold marks.

Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water: Eleventh (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by John Purser and H. J. Grose. Roy. 8vo. Pp. iv + 24. (London: H.M. Stationery Office, 1930.) 9*d.* net.*

Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 28: The Determination of Aromatic, Unsaturated and Naphthene Hydrocarbons in Light Oils and Motor Spirits. By A. B. Manning and F. M. E. Shepherd. Roy. 8vo. Pp. iv + 14. (London: H.M. Stationery Office, 1930.) 4*d.* net.*

Fiero, George W. Condensed Review of Pharmacy: specially adapted to College of Pharmacy Graduates. Third edition, revised and enlarged. Med. 8vo. Pp. 109. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 10*s.* net.*

Fornet, A. Die Theorie der praktischen Brot- und Mehlbereitung. Fünfte Auflage. 8vo. Pp. 352. (Berlin: F. A. Günther und Sohn A.-G., 1930.) 8 gold marks.

Foster, William. Inorganic Chemistry for Colleges. Second printing. 8vo. Pp. 838. (London: Chapman and Hall, Ltd., 1930.) 20*s.* net.

Fulmer, Ellis I., and **Werkman, C. H.,** assisted by **Wieben, Anella,** and **Breden, Calvin R.** An Index to the Chemical Action of Microorganisms on the Non-Nitrogenous Organic Compounds. Med. 8vo. Pp. xiii + 198. (London: Baillière, Tindall and Cox, 1930.) 20*s.* net.*

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. Sup. Roy. 8vo. System-Nummer 26: Beryllium. Pp. viii + 180. 30 gold marks. System-Nummer 58: Kobalt. Teil B: Die Ammine des Kobalts. Pp. xxv + 376. 58 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1930.) *

Gosselin, A., et **Gosselin, M.** Constitution et thermochimie des molécules: les constituants moléculaires, les liaisons intramoléculaires, la valeur énergétique des liaisons. 8vo. Pp. viii + 232. (Paris: Les Presses universitaires de France, 1930.) 40 francs.

Haas, Arthur. Quantum Chemistry: a Short Introduction in Four Non-Mathematical Lectures. Translated by L. W. Codd. Cr. 8vo. Pp. ix + 77. (London: Constable and Co., Ltd., 1930.) 6*s.* net.*

Hemmelmayr, Franz. Chemische Technologie für Bauingenieure und verwandte Berufe: mit besonderer Berucksichtigung der Studierenden. (Enkes Bibliothek für Chemie und Technik, herausgegeben von L. Vanino, Band 18.) Roy. 8vo. Pp. ix + 123. (Stuttgart: Ferdinand Enke, 1930.) 7 gold marks.

Holleman, A. F. A Text-Book of Organic Chemistry. Seventh English edition, completely revised with the co-operation of the Author. Med. 8vo. Pp. xx + 594. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.*

Holleman, A. F. Lehrbuch der Chemie. Autorisierte dt. Ausgaben. Anorganischer Teil: Lehrbuch der anorganischen Chemie für Studierende an Universitäten und technischen Hochschulen. Zwanzigste verbesserte Auflage. Bearbeitet von E. H. Büchner. Roy. 8vo. Pp. xii + 491. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 20 gold marks.

Hooton, W. M. Inorganic Chemistry for Schools. Second edition. Cr. 8vo. Pp. viii + 408. (London: Edward Arnold and Co., 1930.) 5*s.*

Kielmeyer, A. Der Färberlehrling im Chemie-Examen. Vierte Auflage. 8vo. Pp. 282. (Wittenberg (Bez. Halle): A. Ziemsen, 1930.) 16 gold marks.

Kof, Karl. Einführung in die analytische Praxis der Agrikulturchemie: für Studierende der Landwirtschaft. Teil 2: Quantitative Analyse. Roy. 8vo. Pp. 39. (Berlin: Paul Parey, 1930.) 3 gold marks.

Kohlenberg, Karl, und **Reifenstahl, Otto.** Wegweiser durch die Chemie: Anleitung zum Verständnis chemischer Vorgange durch "chemisches Denken." Roy. 8vo. Pp. ii + 29. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 1.20 gold marks.

Margival, F. Couleurs et pigments. 8vo. Pp. vi + 192. (Paris: Gauthier-Villars et Cie, 1930.) 25 francs.

Metzger, H. La civilisation européenne moderne: la chimie. (L'Histoire du monde, Tome 13, Partie 4.) 8vo. Pp. 170. (Paris: E. De Boccard, 1930.) 20 francs.

Morris, J. A Chemistry Note-Book: for School Certificate and Higher Certificate Students. Fcap. 8vo. Pp. vii + 96. (London: Methuen and Co., Ltd., 1930.) 2*s.* 6*d.*

Morton, James. Dyes and Textiles in Britain, 1930. (As read at the Meeting of the British Association at Bristol, September 1930.) Demy 8vo. Pp. 43. (London: The Association of British Chemical Manufacturers, 1930.)*

Ostwald-Luther. Hand- und Hilfsbuch zur Ausführung physiko-chemischer Messungen. Unter Mitwirkung von W. Bothe, W. Gerlach, R. Gross, H. v. Halban, R. Luther, F. Paneth, F. Weigert. Herausgegeben von C. Drucker. Fünfte, neubearbeitete Auflage. Med. 8vo. Pp. xix + 979. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 52 gold marks.*

Partington, J. R. A Text-Book of Inorganic Chemistry: for University Students. Third edition. Cr. 8vo. Pp. viii + 1083. (London: Macmillan and Co., Ltd., 1930.) 15*s.**

Pascal, Paul. Explosifs, poudres, gaz de combat. Deuxième édition. Roy. 8vo. Pp. vi + 320. (Paris: Hermann et Cie, 1930.) 60 francs.*

Pascal, Paul. Synthèses et catalyses industrielles: fabrications minérales. Deuxième édition. Roy. 8vo. Pp. vi + 456. (Paris: Hermann et Cie, 1930.) 70 francs.*

Remsen-Seubert. Einleitung in das Studium der Chemie. Siebente Auflage. (Unveränderter Neudruck der sechsten Auflage.) 8vo. Pp. 347 + 2 Tafeln. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 7.50 gold marks.

Schäffner, A. Enzyme und ihre Bedeutung zur Konstitutionsvermittlung von Naturstoffen. (Fortschritte der Chemie, Physik und physikalischen Chemie, Band 20, Heft 7.) Roy. 8vo. Pp. v + 58 + iii. (Berlin: Gebruder Borntraeger, 1930.) 8 gold marks.

Stadnikoff, G. Neuere Torfchemie. Roy. 8vo. Pp. viii + 166. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 12 gold marks.

Stewart, Alfred W. Recent Advances in Physical and Inorganic Chemistry. Sixth edition. Demy 8vo. Pp. xi + 387 + 5 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 18s. net.*

Thoms, Hermann. Handbuch der praktische und wissenschaftliche Pharmazie. Lieferung 30, Band 5, Hälfte 2. 8vo. Pp. 1173-1348. (Berlin und Wien: Urban und Schwarzenberg, 1930.)

Treadwell, F. P., Based on the German Text of. Analytical Chemistry. Translated and revised by William T. Hall. Vol. 1: Qualitative Analysis. Seventh English edition, revised. Med. 8vo. Pp. ix + 610. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 23s. net.*

Tschirch, A., Herausgegeben von. Handbuch der Pharmakognosie. Zweite, erweiterte Auflage. Imp. 8vo. Lieferung 3. 8 gold marks. Lieferung 4. 8 gold marks. (Leipzig: Bernhard Tauchnitz, 1930.)

Ubbelohdes Handbuch. Band 3, Teil 2: Chemie und Technologie der Seifen und Waschmittel. Zweite Auflage. Herausgegeben von Hans Heller. Roy. 8vo. Pp. xx + 752. (Leipzig: S. Hirzel, 1930.) 68 gold marks.

Union Académie Internationale. Catalogue des manuscrits alchimiques grecs. Publié sous la direction de J. Bidez, F. Cumont, A. Delatte, Sir Frederic Kenyon, O. Lagercrantz, J. Ruska et C. O. Zuretti. Tome 7: Anonymi de arte metallica seu de metallorum conversione in aurum et argentum. Edidit C. O. Zuretti. Med. 8vo. Pp. lx + 466. (Bruxelles: Maurice Lamertin, 1930.) *

Vernadsky, Wladimir Ivanovič. Geochemie in ausgewählten Kapiteln ("Očerki Geochimii"). Autorisierte Übersetzung aus dem Russischen von Ernst Kordes. Roy. 8vo. Pp. xii + 370. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 25 gold marks.

Wagner, Alfred, Herausgegeben von. Die Reichstoffe und ihre Derivate. Band 5: Die Aldehyde. Abteilung 3: Aromatische Oxyaldehyde mit gesattigter Seitenkette, Zweiwertige Oxyaldehyde, Äther aromat., Oxyaldehyde mit gesättigter und ungesättigter Seitenkette, Aroxyaldehyde. Bearbeitet von Alfred Wagner, Alfons M. Burger und Fritz Elze. 4to. Pp. xv + 775. (Wien: A. Hartleben, 1930.) 40 gold marks.

Winter, H. Taschenbuch für Gaswerke, Kokereien, Schwelereien und Teerdestillationen. Roy. 8vo. Pp. 606. (Halle a.S.: Wilhelm Knapp, 1930.) 14 gold marks.

Astronomy

Baker, Robert H. Astronomy: an Introduction. Med. 8vo. Pp. xix + 521. (London: Macmillan and Co., Ltd., 1930.) 16s. net.*

Beavis, Gerald. The Romance of the Heavens. Med. 8vo. Pp. xii + 244. (London: Sampson Low, Marston and Co., Ltd., 1930.) 6s. net.

Doublet, E. L'astronomie de l'amateur. (Bibliothèque pratique de l'amateur.) Cr. 8vo. Pp. 93. (Paris: J. B. Baillière et fils, 1930.) 6 francs.*

Jeans, Sir James. The Mysterious Universe. Cr. 8vo. Pp. ix + 154 + 2 plates. (Cambridge: At the University Press, 1930.) 3s. 6d. net.*

Jeans, Sir James. The Universe Around Us. Second edition. Demy 8vo. Pp. x + 364 + 24 plates. (Cambridge: At the University Press, 1930.) 12s. 6d. net.*

Kepler, Johannes. Neue Astronomie (Astronomia Nova). Übersetzt und eingeleitet von Max Caspar. 4to. Pp. 482. (München und Berlin: R. Oldenbourg, 1930.) 38.50 gold marks.

• **Shapley, Harlow.** Star Clusters. (Harvard Observatory Monographs, No. 2.) Demy 8vo. Pp. xi + 276 + 3 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 15s.*

Strangman, Charles. The Origin of the Solar System. Revised edition. Demy 8vo. Pp. 37. (Victoria, B.C.: The Author, The Uplands, 1930.) Free.*

Meteorology: Geophysics

Air Ministry: Meteorological Office. The Meteorological Glossary. (M.O. 225ii.) Second edition, entirely rewritten. In continuation of "The Weather Map". Published by the Authority of the Meteorological Committee. Roy. 8vo. Pp. 233 + 12 plates. (London: H.M. Stationery Office, 1930.) 4s. 6d. net.*

Haarmann, Erich. Die Oszillations-Theorie: eine Erklärung der Krustenbewegungen von Erde und Mond. Roy. 8vo. Pp. xii + 260. (Stuttgart: Ferdinand Enke, 1930.) 17 gold marks.

Hettner, A. Die Klimate der Erde. (Geographische Schriften, Heft 5.) 8vo. Pp. iv + 115. (Berlin und Leipzig: B. G. Teubner, 1930.) 5.40 gold marks.

Kerner-Marilaun, Fritz. Palaoklimatologie. Roy. 8vo. Pp. viii + 512. (Berlin: Gebruder Borntraeger, 1930.) 39 gold marks.*

Wien, W., und Harms, F., Herausgegeben von. Handbuch der Experimentalphysik. Unter Mitarbeit von H. Lenz. Band 25, Teil 3: Angewandte Geophysik. Unter der Redaktion von G. Angenheister. Sup. Roy. 8vo. Pp. xii + 556. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 54 gold marks.*

Geology: Mineralogy

Beurlen, K. Vergleichende Stammesgeschichte: Grundlagen, Methoden, Probleme unter besonderer Berücksichtigung der hoheren Krebse. (Fortschritte der Geologie und Paläontologie, herausgegeben von W. Soergel, Band 8, Heft 26.) Roy. 8vo. Pp. viii + 317-586. (Berlin: Gebruder Borntraeger, 1930.) 30 gold marks.*

Dégoutin, N. Étude pratique des minerais et leurs essais industriels: guide pratique pour les missions d'études minières et les essais aux usines de traitement. Roy. 8vo. Pp. iv + 429. (Paris: Libr. Dunod, 1930.) 85 francs.

Geological Society. List of Geological Literature added to the Geological Society's Library during the Year ended December 31, 1929. Compiled by the Library Staff. Demy 8vo. Pp. iv + 245. (London: Geological Society, 1930.) 10s.*

Geological Survey, England and Wales, Memoirs of the. Explanation of Sheet 22: The Geology of the Maryport District. By T. Eastwood. Roy. 8vo. Pp. viii + 137 + 3 plates. (London: H.M. Stationery Office, 1930.) 3s. net.*

Geological Survey, Scotland, Memoirs of the. The Geology of Ardnamurchan, North-west Mull and Coll. By J. E. Richey and H. H. Thomas; with Contributions by E. B. Bailey, J. B. Simpson, V. A. Eyles and the late G. W. Lee; with Chemical Analyses by E. G. Radley and B. E. Dixon. Roy. 8vo. Pp. viii + 393 + 7 plates. 10s. net. Sheet 51: Coll. Scale of one Inch to a statute Mile. Third edition. Colour printed. 30½ in. × 22½ in. 3s. net. (Edinburgh and London: H.M. Stationery Office, 1930.) *

Greenly, Edward. The Earth: its Nature and History. (The Forum Series, No. 6.) Second edition, revised. Cr. 8vo. Pp. ix + 54. (London: Watts and Co., 1930.) Paper, 7d. net; cloth, 1s. net.*

Gregory, J. W., Edited by. From Meteorite to Man: the Evolution of the Earth. By J. W. Gregory, Sir Arthur Smith Woodward, W. W. Watts, A. C. Seward. (The Forum Series, No. 11.) Cr. 8vo. Pp. vi + 58. (London: Watts and Co., 1930.) Paper, 7d. net; cloth, 1s. net.*

Hibsch, J. E. Geologischer Führer durch das Böhmische Mittelgebirge. (Sammlung geologischer Führer, Band 34.) Pott 8vo. Pp. xii + 363. (Berlin: Gebruder Borntraeger, 1930.) 16 gold marks.*

Imbeaux, Ed. Essai d'hydrogéologie: recherche, étude et captage des eaux souterraines. Imp. 8vo. Pp. xx + 678. (Paris: Libr. Dunod, 1930.) 270 francs.

Laatsch, W. Étude résumée des métaux précieux: extraction, récupération, séparation. Traduit de l'allemand par A. Schubert. Roy. 8vo. Pp. vi+152. (Paris: Libr. Dunod, 1930.) 32 francs.

Quenstedt, Werner. Die Anpassung an die grabende Lebensweise in der Geschichte der Solenomyiden und Nuculaceen. (Geologische und palaontologische Abhandlungen, herausgegeben von J. F. Pompeckj und Fr. Freih. von Huene, Neue Folge, Band 18 (der ganzen Reihe Band 22), Heft 1.) 4to. Pp. 119+3 Tafeln. (Jena: Gustav Fischer, 1930.) 24 gold marks.

General Biology: Natural History Botany: Zoology

Baker, E. C. Stuart. The Game-Birds of India, Burma and Ceylon. (Published by the Bombay Natural History Society.) Vol. 3: Pheasants and Bustard Quail. Imp. 8vo. Pp. x+341+20 plates. (London: John Bale, Sons and Danielsson, Ltd., 1930.) 42*s.* net.*

Biden, C. Leo. Sea-Angling Fishes of the Cape (South Africa): a Natural History of some of the Principal Fishes caught by Sea Anglers and Professional Fishermen in Cape Waters. Demy 8vo. Pp. xii+304+48 plates. (London: Oxford University Press, 1930.) 18*s.* net.*

Borradaile, L. A. Elementary Zoology for Medical Students. (Oxford Medical Publications.) Second edition. Cr. 8vo. Pp. 398. (London: Oxford University Press, 1930.) 10*s.* 6*d.* net.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology, Vol. 7, No. 4: Chætognatha. By S. T. Burfield. Roy. 4to. Pp. 203-228+3 plates. (London: British Museum (Natural History), 1930.) 2*s.* 6*d.**

Castle, W. E. Genetics and Eugenics: a Text-Book for Students of Biology and a Reference Book for Animal and Plant Breeders. Fourth revised edition. Med. 8vo. Pp. x+474+66 plates. (Cambridge, Mass.; Harvard University Press; London: Oxford University Press, 1930.) 12*s.* 6*d.* net.*

Castle, W. E. The Genetics of Domestic Rabbits: a Manual for Students of Mammalian Genetics and an Aid to Rabbit Breeders and Fur Farmers. Med. 8vo. Pp. vi+31+13 plates. (Cambridge, Mass.; Harvard University Press; London: Oxford University Press, 1930.) 6*s.* net.*

Cherrie, George K. Dark Trails: Adventures of a Naturalist. Roy. 8vo. Pp. 322. (New York and London: G. P. Putnam's Sons, 1930.) 15*s.* net.

***Discovery* Reports**, Vol. 2. Roy. 4to. Polychaete Worms. By C. C. A. Monro. Pp. 222. 18*s.* net. Thoracic Cirripedes collected in 1925-1927. By C. A. Nilsson-Cantell. Pp. 223-260+plate 1. 4*s.* net. Oceanic Fishes and Flat Fishes collected in 1925-1927. By J. R. Norman. Pp. 261-370+plate 2. 11*s.* net. (Cambridge: At the University Press, 1930.)

Edwin, Maribel. "In England—Now!": the Countryside Week by Week. Cr. 8vo. Pp. 255. (London: The Sheldon Press, 1930.) 5*s.* net.*

Fishery Board for Scotland. Scientific Investigations, 1930, No. 2: The Surface Water Drift in the Northern and Middle Areas of the North Sea and in the Faroe-Shetland Channel. Part 1: A Preliminary Report upon the Results of Scottish Experiments with Surface-Floating Bottles, 1910-1914. By John B. Tait. Imp. 8vo. Pp. 82. (Edinburgh and London: H.M. Stationery Office, 1930.) 4*s.* net.*

Gadow, Hans. Jorullo: the History of the Volcano of Jorullo and the Reclamation of the Devastated District by Animals and Plants. Demy 8vo. Pp. xviii+100+2 plates. (Cambridge: At the University Press, 1930.) 7*s.* 6*d.* net.*

Gideon, P. W. An Introduction to Zoology. Feap. folio. Pp. vi+90. (Dharwar: Students' Own Book Depot, 1930.) 5.8 rupees.*

Goebel, K., und Sandt, W. Untersuchungen an Luftwurzeln. (Botanische Abhandlungen, herausgegeben von K. Goebel, Heft 17.) Roy. 8vo. Pp. 124+6 Tafeln. (Jena: Gustav Fischer, 1930.) 12 gold marks.*

Gudger, Eugene W. The Candirú, the only Vertebrate Parasite of Man. Pp. xvii+120. (New York: Paul B. Hoeber, 1930.) 1.50 dollars.

Haempel, Oskar. Fischereibiologie der Alpenseen. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von August Thienemann, Band 10.) Roy. 8vo. Pp. viii+259+15 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nagele) G.m.b.H., 1930.) 27.50 gold marks.*

Haire, Norman, Edited by. Sexual Reform Congress, London, 8-14: ix: 1929. World League for Sexual Reform. Proceedings of the Third Congress. Med. 8vo. Pp. xl+670+8 plates. (London: Kegan Paul and Co., Ltd., 1930.) 25*s.* net.*

Hogben, Lancelot. The Nature of Living Matter. Demy 8vo. Pp. ix+316. (London: Kegan Paul and Co., Ltd., 1930.) 15*s.* net.*

Holzworth, John N. The Wild Grizzlies of Alaska. Roy. 8vo. Pp. 418. (New York and London: G. P. Putnam's Sons, 1930.) 21*s.* net.

Huxley, Julian. Bird-Watching and Bird Behaviour. Cr. 8vo. Pp. xii+116+8 plates. (London: Chatto and Windus, 1930.) 5*s.* net.*

Kükenthal, Willy, Gegrundet von. Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Herausgegeben von Thilo Krumbach. Band 2: Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida. Lieferung 10, Teil 4. Demy 4to. Pp. 403-482. (Leipzig und Berlin: Walter de Gruyter und Co., 1930.) 10 gold marks.*

Lucas, William John. The Aquatic (Naiad) Stage of the British Dragonflies (Paraneuroptera). (Ray Society Volume, No. 117, for the Year 1930.) Demy 8vo. Pp. xii+132+35 plates. (London: Dulau and Co., Ltd., 1930.) 25*s.**

MacDougal, D. T. The Green Leaf: the Major Activities of Plants in Sunlight. (Appleton New World of Science Series.) Cr. 8vo. Pp. v+142. (New York and London: D. Appleton and Co., 1930.) 6*s.* net.*

Maiden, J. H. A Critical Revision of the Genus Eucalyptus. Published by Authority of the Government of the State of New South Wales. Vol. 8, Part 4 (Part 74 of the complete Work). Roy. 4to. Pp. 181-246+4 plates. (Sydney, N.S.W.: Alfred James Kent, 1930.) 3*s.* 6*d.**

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 12, No. 1, 1930: The Natural History of the Hake. Part 3: Seasonal Changes in the Condition of the Hake. By C. F. Hickling. Imp. 8vo. Pp. 78. 3*s.* 6*d.* net. Fishery Investigations, Series 2, Vol. 12, No. 2, 1930: The Influence of Phæocystis on the Migrations of the Herring. By R. E. Savage. Imp. 8vo. Pp. 14. 9*d.* net. (London: H.M. Stationery Office, 1930.)*

Molisch, Hans. Pflanzenphysiologie als Theorie der Gartnerei: fur Botaniker, Gartner, Landwirte, Forstleute und Pflanzenfreunde. Sechste neubearbeitete Auflage. 4to. Pp. xii+368. (Jena: Gustav Fischer, 1930.) 16 gold marks.

Nall, G. Herbert. The Life of the Sea Trout, especially in Scottish Waters: with Chapters on the Reading and Measuring of Scales. Demy 8vo. Pp. 335+94 plates. (London: Seeley, Service and Co., Ltd., 1930.) 21*s.* net.*

Pascher, A., Herausgegeben von. Die Süsswasserflora Mitteleuropas. Heft 10: Bacillariophyta (Diatomeæ). Zweite Auflage, bearbeitet von Friedrich Hustedt. (Jena: Gustav Fischer, 1930.) 18 gold marks.

Pincussen, Ludwig. Photobiologie: Grundlagen, Ergebnisse, Ausblicke. Roy. 8vo. Pp. x+543. (Leipzig: Georg Thieme, 1930.) 36 gold marks.*

Przibram, Hans. Experimental-Zoologie: eine Zusammenfassung der durch Versuche ermittelten Gesetzmässigkeiten tierischer Formen und Verrichtungen. Band 7: Zootechniken: eine Zusammenfassung der fur Versuche mit Tieren verfugbaren Forschungsweisen (Fragestellung, Versuchsführung, Bearbeitung). Sup. Roy. 8vo. Pp. viii+269+10 Tafeln. (Leipzig und Wien: Franz Deuticke, 1930.) 30 gold marks.*

Rensch, Bernhard. Eine biologische Reise nach der Kleinen Sunda-Inseln. Demy 8vo. Pp. xii+236+33 Tafeln. (Berlin: Gebruder Borntraeger, 1930.) 14 gold marks.*

Rivera, V. Malattie delle piante. Parte generale: Appunti sulle lezioni di introduzione al corso. Sup. Roy. 8vo. Pp. 109. (Roma: G. Bardi, 1930.) 23 lire.*

Riviere, B. B. A History of the Birds of Norfolk. Demy 8vo. Pp. xlviii + 296 + 16 plates. (London: H. F. and G. Witherby, 1930.) 25*s*. net.*

Rosenberg, O. Apogamie und Parthenogenesis bei Pflanzen. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Band 2.) Sup. Roy. 8vo. Pp. 66. (Berlin: Gebrüder Borntraeger, 1930.) 13.60 gold marks.*

Sapper, Karl. Biologie und organische Chemie. (Abhandlungen zur theoretischen Biologie, herausgegeben von Julius Schaxel, Heft 28.) Roy. 8vo. Pp. vii + 50. (Berlin: Gebrüder Borntraeger, 1930.) 5 gold marks.*

Scheidter, Franz. Die Läuse unserer Nadelholzer. 8vo. Pp. viii + 119. (Neudamm: Verlag Neumann, 1930.) 8 gold marks.

Stapf, O., Edited by. Curtis's Botanical Magazine. Published for the Royal Horticultural Society, London. Vol. 154 (1928), Part 1. Roy. 8vo. Pp. 35 + plates 9205-9215. (London: Bernard Quaritch, Ltd., 1930.) 17*s*. 6*d*. net.*

Stapf, O. Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies: being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns, compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries. Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew. Roy. 4to. Pp. iv + 568. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 105*s*. net.*

Thurston, Edgar. British and Foreign Trees and Shrubs in Cornwall. Published for the Royal Institution of Cornwall. Demy 8vo. Pp. xi + 288 + 44 plates. (Cambridge: At the University Press, 1930.) 12*s*. 6*d*. net.*

Whitehouse, R. H., and **Grove, A. J.** The Dissection of the Frog. Cr. 8vo. Pp. x + 101. (London: University Tutorial Press, Ltd., 1930.) 2*s*.*

Williams-Ellis, Amabel, helped by Ann Stephen and Charlotte and Christopher William-Ellis. H.M.S. *Beagle* in South America. Adapted from the Narratives of Charles Darwin and Capt. Fitz Roy. (The World of Youth Series, No. 4.) Cr. 8vo. Pp. x + 147. (London: Watts and Co., 1930.) 1*s*. 6*d*. net.*

Anthropology : Archaeology

Allcroft, A. Hadrian. The Circle and the Cross: a Study in Continuity. In 2 volumes. Demy 8vo. Vol. 2: The Cross. Pp. vii + 454 + 4 plates. (London: Macmillan and Co., Ltd., 1930.) 12*s*. 6*d*. net.*

Boulton, W. H. The Romance of Archæology. (Romance Series.) Med. 8vo. Pp. x + 246. (London: Sampson Low, Marston and Co., Ltd., 1930.) 6*s*. net.

Buren, E. Douglas van. Clay Figurines of Babylonia and Assyria. (Yale Oriental Series: Researches, Vol. 16.) Sup. Roy. 8vo. Pp. 368. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1930.) 27*s*. net.

Childe, V. Gordon. The Bronze Age. Cr. 8vo. Pp. xiii + 258. (Cambridge: At the University Press, 1930.) 8*s*. 6*d*. net.*

Dorsey, George A. Why we Behave like Human Beings. (Blue Ribbon Books.) Demy 8vo. Pp. 512. (New York and London: Harper and Bros., 1930.) 5*s*. net.

Driberg, J. H. The East African Problem. Cr. 8vo. Pp. 96. (London: Williams and Norgate, Ltd., 1930.) 2*s*. 6*d*. net.*

Ebers. The Papyrus Ebers. Translated from the German Version by Cyril P. Bryan. Demy 8vo. Pp. xl + 167 + 8 plates. (London: Geoffrey Bles, 1930.) 10*s*. 6*d*. net.*

Hall, H. R. A Season's Work at Ur: al-'Ubaid, Abu Shahrain (Eridu), and Elsewhere; being an Unofficial Account of the British Museum Archæological Mission to Babylonia, 1919. Sup. Roy. 8vo. Pp. xxiii + 300. (London; Methuen and Co., Ltd., 1930.) 25*s*. net.*

Heydrich, M., Herausgegeben von. Ethnologischer Anzeiger: Jahresbibliographie und Bericht über die völkerkundliche Literatur. Band 2, Heft 4. Sup. Roy. 8vo. Pp. 129-200. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1930.) 9.40 gold marks.*

Jessup, R. F. The Archæology of Kent. (The County Archæologies.) Cr. 8vo. Pp. xiv + 272 + 13 plates. (London: Methuen and Co., Ltd., 1930.) 10*s*. 6*d*. net.*

Leenhardt, Maurice. Notes d'ethnologie néo-calédonienne. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, 8.) Sup. Roy. 8vo. Pp. ix + 340 + 36 planches. (Paris: Institut d'Ethnologie, 1930.) 120 francs.*

Macdonald, D. Mœurs et coutumes des Thibétains. Traduction française par R. Bilot. (Collection d'études de documents et de témoignages pour servir à l'histoire de notre temps.) Pp. 264. (Paris: Payot et Cie, 1930.) 25 francs.

Magoffin, R. V. D., and **Davis, Emily C.** The Romance of Archæology. Roy. 8vo. Pp. xv + 348. (London: G. Bell and Sons, Ltd., 1930.) 18*s*. net.

Malinowski, B. Das Geschlechtsleben der Wilden in Nordwest-Melanesien. 8vo. Pp. 461. (Leipzig: Grethlein und Ko, 1930.)

Mann, Ludovic MacLellan. Craftsmen's Measures in Prehistoric Times. Cr. 4to. Pp. ii + 25 (10 plates). (Glasgow and London: The Mann Publishing Co., Ltd., 1930.) Paper, 3*s*. 6*d*. net; cloth, 5*s*. net.*

Narath, R. Die Union von Sudafrika und ihre Bevölkerung. (Geographische Schriften, Band 6.) 8vo. Pp. vi + 262. (Berlin und Leipzig: B. G. Teubner, 1930.) 12 gold marks.

Petrie, Sir Flinders. Decorative Patterns of the Ancient World. Roy. 4to. Pp. 17 + 88 plates. (London: British School of Archæology in Egypt; Bernard Quaritch, Ltd., 1930.)*

Pöch, R. Anthropologie von Nordost-Neuguinea. 8vo. Pp. 210. (Wien: Anthropologische Gesellschaft, 1930.) 60 gold marks.

Power, Rhoda. How it Happened: Myths and Folk Tales. Cr. 4to. Pp. xii + 190. (Cambridge: At the University Press, 1930.) 7*s*. 6*d*. net.

Scot, Reginald. The Discovery of Witchcraft. Pott folio. Pp. xxxvii + 283. (London: John Rodker, 1930.) 42*s*. net.

Shetrone, Henry Clyde. The Mound-Builders: a Reconstruction of the Life of a Prehistoric American Race, through Exploration and Interpretation of their Earth Mounds, their Burials and their Cultural Remains. Roy. 8vo. Pp. xx + 500. (New York and London: D. Appleton and Co., 1930.) 30*s*. net.

Shirokogoroff, S. M. Social Organization of the Northern Tungus: with Introductory Chapters concerning Geographical Distribution and History of these Groups. Imp. 8vo. Pp. xv + 427. (Shanghai: The Commercial Press, Ltd., 1929.) 10 dollars.*

Weinert, Hans. Menschen der Vorzeit: ein Überblick über die altsteinzeitlichen Menschenreste. Roy. 8vo. Pp. viii + 138. (Stuttgart: Ferdinand Enke, 1930.) 8 gold marks.

Westermarck, Edward, with the assistance of Shereef 'Abd-es-Salām el-Baqqālī. Wit and Wisdom in Morocco: a Study of Native Proverbs. Demy 8vo. Pp. xi + 448. (London: George Routledge and Sons, Ltd., 1930.) 25*s*. net.*

Williams, Joseph J. Hebrewisms of West Africa: from Nile to Niger with the Jews. Roy. 8vo. Pp. viii + 443. (London: George Allen and Unwin, Ltd., 1930.) 30*s*. net.

Philosophy : Psychology

Adamson, Robert. The Development of Modern Philosophy. Edited by W. R. Sorley. New impression. Med. 8vo. Pp. 364. (Edinburgh and London: Wm. Blackwood and Sons, Ltd., 1930.) 10*s*. 6*d*. net.

Brabant, Rev. F. H. Religion and the Mysterious. (Anglican Library of Faith and Thought.) Cr. 8vo. Pp. x + 97. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) Paper, 2*s*. 6*d*. net; cloth, 4*s*. net.*

Brunner, Emil. Gott und Mensch. 8vo. Pp. iii + 100. (Tübingen: J. C. B. Mohr, 1930.)

Cross, F. Leslie. Religion and the Reign of Science. (Anglican Library of Faith and Thought.) Cr. 8vo. Pp. x + 111. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) Paper, 2*s*. 6*d*. net; cloth, 4*s*. net.*

Curti, Margaret Wooster. Child Psychology. (Longmans' Psychology Series.) Ex. Cr. 8vo. Pp. ix + 527. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1930.) 12*s*. 6*d*. net.

Dampier-Whetham, William Cecil Dampier. A History of Science: and its Relations with Philosophy and Religion. Second edition. Med. 8vo. Pp. xxii + 514. (Cambridge: At the University Press, 1930.) 18*s*. net.*

Dell, Floyd. Love in the Machine Age: a Psychological Study of the Transition from Patriarchal Society. Demy 8vo. Pp. vii + 428. (London: George Routledge and Sons, Ltd., 1930.) 12*s*. 6*d*. net.*

Driesch, Hans. Philosophische Forschungswege: Ratschläge und Warnungen. Med. 8vo. Pp. xii + 121. (Leipzig: Emmanuel Reinicke, 1930.) 5 gold marks.*

Durant, Will. Die grossen Denker. Übersetzt von Andreas Hecht. 8vo. Pp. xxiv + 557. (Zürich: Orell Füssli, 1930.) 17 gold marks.

Ehrlich, Walter. Stufen der Personalität: Grundlegung e. Metaphysik des Menschen. Roy. 8vo. Pp. iii + 165. (Halle a. S.: Verlag Niemeyer, 1930.) 8 gold marks.

Fröhlich, Rudolf. Zum Kategorienproblem der physikalischen Erkenntnis. Roy. 8vo. Pp. 72. (Weida: Thomas und Hubert, 1930.)

Fürstenheim, Walter. Junge Psychopathen: ein Rückblick und Ausblick auf ihre Erfassung, Erforschung und Betreuung. Pott 8vo. Pp. iii + 30. (Leipzig: Leopold Voss, 1930.) 2.40 gold marks.

Gore, Rev. Charles. The Philosophy of a Good Life: being the Gifford Lectures delivered in the University of St. Andrews, 1929-30. Med. 8vo. Pp. xiii + 346. (London: John Murray, 1930.) 10*s*. 6*d*. net.

Grensted, Rev. L. W. Psychology and God: a Study of the Implications of Recent Psychology for Religious Belief and Practice; being the Bampton Lectures for 1930. Demy 8vo. Pp. xiii + 258. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s*. 6*d*. net.

Groves, Ernest R., and **Blanchard, Phyllis.** Introduction to Mental Hygiene. Demy 8vo Pp. vii + 467. (London: Gerald Howe, Ltd., 1930.) 16*s*. net.*

Hook, Arthur. The Universal Mind: a Study in Psychology and Religion. Demy 8vo. Pp. 311. (London: Jonathan Cape, Ltd., 1930.) 12*s*. 6*d*. net.

Huxley, Julian S. Science, Religion and Human Nature. Fcap. 8vo. Pp. 80. (London: Watts and Co., 1930.) Paper, 1*s*. net; cloth, 2*s*. net.

Isaacs, Susan. Intellectual Growth in Young Children. With an Appendix on Children's "Why" Questions, by Nathan Isaacs. Demy 8vo. Pp. xi + 370. (London: George Routledge and Sons, Ltd., 1930.) 12*s*. 6*d*. net.*

Isbyam, I. C. Infinity and Ego: an Experimental Study in the Psychology of Self-Consciousness. Cr. 8vo. Pp. 25. (London: The C. W. Daniel Co., 1930.) 1*s*. net.*

Kant, Immanuel. Lectures on Ethics. Translated from the German by Louis Infield. Cr. 8vo. Pp. xiv + 253. (London: Methuen and Co., Ltd., 1930.) 10*s*. 6*d*. net.*

Krueger, Felix, und **Sander, Friedrich,** Herausgegeben von. Gestalt und Sinn. (Neue Psychologischen Studien, Band 4, Heft 2.) Roy. 8vo. Pp. 158-318. (München: C. H. Beck, 1930.) 8 gold marks.

Langdon-Davies, John. Man and his Universe. Roy. 8vo. Pp. xviii + 334 + 14 plates. (London and New York: Harper and Bros., 1930.) 16*s*. net.*

Leisegang, Hans. Religionsphilosophie der Gegenwart. (Philosophische Forschungsberichte, Heft 3.) Roy. 8vo. Pp. v + 102. (Berlin: Junker und Dunnhaupt, 1930.) 4.50 gold marks.

Levinas, E. La théorie de l'intuition dans la phénoménologie de Husserl. (Bibliothèque de Philosophie contemporaine.) 8vo. Pp. 224. (Paris: Félix Alcan, 1930.) 30 francs.

McTaggart, John McTaggart Ellis. Some Dogmas of Religion. Cr. 8vo. Pp. lii + 299. (London: Edward Arnold and Co., 1930.) 6*s*. net.*

Martin, Everett Dean. Liberty. Demy 8vo. Pp. x + 307. (London: George Routledge and Sons, Ltd., 1930.) 10*s*. 6*d*. net.*

Matthews, Rev. W. R. God: in Christian Thought and Experience. (Library of Constructive Theology.) Demy 8vo. Pp. xix + 283. (London: Nisbet and Co., Ltd., 1930.) 10*s*. 6*d*. net.*

Meistring, Walter. Beiträge zur Prüfung der Koordinationsfähigkeit. Roy. 8vo. Pp. iv + 154. (Leipzig: Johann Ambrosius Barth, 1930.) 8 gold marks.

Miller, Emanuel. Modern Psychotherapy. (Modern Treatment Series.) Cr. 8vo. Pp. 131. (London: Jonathan Cape, Ltd., 1930.) 5*s*. net.*

Morgan, C. Lloyd. The Animal Mind. Demy 8vo. Pp. xii + 275. (London: Edward Arnold and Co., 1930.) 12*s*. 6*d*. net.*

Müller-Freienfels, Richard. Allgemeine Sozial- und Kulturpsychologie. Roy. 8vo. Pp. xii + 292. (Leipzig: Johann Ambrosius Barth, 1930.)

Myers, Garry Cleveland. The Modern Parent: a Practical Guide to Everyday Problems. Cr. 8vo. Pp. 350. (London: Williams and Norgate, Ltd., 1930.) 8*s*. 6*d*. net.

Nathan, Marcel. L'esprit et ses maladies. (Bibliothèque générale illustrée, 15.) Pott 4to. Pp. 80 + 60 planches. (Paris: Les Éditions Rieder, 1930.) 20 francs.*

Nicole, J. Ernest. Psychopathology: a Survey of Modern Approaches. Demy 8vo. Pp. xii + 203. (London: Baillière, Tindall and Cox, 1930.) 10*s*. 6*d*. net.

Nicolson, M. J. Art and Sex: the Psychology of Art. Cr. 8vo. Pp. 98. (London: The Mitre Press, 1930.) 5*s*. net.

Parodi, D. Du positivisme à l'idéalisme: philosophies d'hier, études critiques. (Bibliothèque d'histoire de la philosophie.) 8vo. Pp. 228. (Paris: J. Vrin, 1930.) 25 francs.

Parodi, D. Du positivisme à l'idéalisme: philosophies d'hier et d'aujourd'hui, études critiques. (Bibliothèque d'histoire de la philosophie.) 8vo. Pp. 256. (Paris: J. Vrin, 1930.) 25 francs.

Pauli, R. Psychologisches Praktikum: Leitfaden fur experimentell-psychologische Übungen. Vierte, verbesserte und vermehrte Auflage Roy. 8vo. Pp. xii + 244 + 5 Tafeln. (Jena: Gustav Fischer, 1930.) 9.50 gold marks.

Rank, Otto. Seelenglaube und Psychologie: eine prinzipielle Untersuchung uber Ursprung, Entwicklung und Wesen d. Seelischen. Roy. 8vo. Pp. v + 193. (Wien und Leipzig: Franz Deuticke, 1930.) 10 gold marks.

Russell, Bertrand. The Conquest of Happiness. Cr. 8vo. Pp. 252. (London: George Allen and Unwin, Ltd., 1930.) 7*s*. 6*d*. net.

Schröder, Paul. Stimmungen und Verstimmungen. 8vo. Pp. 43. (Leipzig: Johann Ambrosius Barth, 1930.) 2.40 gold marks.

Schulte-Vaarting, Hermann. Neubegrundung der Psychoanalyse. Roy. 8vo. Pp. 72. (Berlin-Friedenau: Verlag Pfeiffer, 1930.) 3.50 gold marks.

Segond, J. Traité de psychologie. Ex. Cr. 8vo. Pp. 512. (Paris: Armand Colin, 1930.) 45 francs.

Smith, Thomas V., and **Wright, William Kelley,** Edited by. Essays in Philosophy. By Seventeen Doctors of Philosophy of the University of Chicago. Demy 8vo. Pp. xvi + 337. (Chicago and London: The Open Court Co., 1930.) 16*s*. net.

Stebbing, L. S. A Modern Introduction to Logic. Demy 8vo. Pp. xviii + 505. (London: Methuen and Co., Ltd., 1930.) 15*s*. net.

Stern, William. Psychology of Early Childhood up to the Sixth Year of Age. Supplemented by Extracts from the unpublished Diaries of Clara Stern. Demy 8vo. Pp. 612 + 11 plates. (London: George Allen and Unwin, Ltd.; New York: Henry Holt and Co., 1930.) 18*s*. net.

Stone, C. G. The Social Contract of the Universe. Cr. 8vo. Pp. vii + 118. (London: Methuen and Co., Ltd., 1930.) 6*s*. net.*

Stückrath, Fritz. Das geometrische Erleben des Kindes in seinem Werkschaffen: eine bildungspsychologische Studie. Sup. Roy. 8vo. Pp. vii + 88 + 15 Tafeln. (Hamburg: Broschek und Co., 1930.) 7.50 gold marks.

Tauscher, Edwin. Über die Korrelation zwischen Handgeschicklichkeit und Intelligenz. (Neue psychologischen Studien, Band 5, Heft 2.) Roy. 8vo. Pp. 201-226. (Munchen: C. H. Beck, 1930.)

Ulbricht, Oswald. Über die optimalen Bedingungen bei der Arbeit an Drehkurbeln. (Neue psychologischen Studien. Band 5, Heft 2.) Roy. 8vo. Pp. 231-252. (München: C. H. Beck, 1930.)

Vallon, Henri. Principes de psychologie appliquée. (Collection Armand Colin.) Cr. 8vo. (Paris: Armand Colin, 1930.) 10.50 francs.

Wheeler, Raymond Holder. Readings in Psychology. With Special Readings by Harry Helson, Milton Metfessel and Thomas D. Cutsforth. Med. 8vo. Pp. x + 597. (New York: Thomas Y. Crowell, 1930.) 3.75 dollars.

Whitehead, A.-N. La science et le monde moderne. (Bibliothèque scientifique.) 8vo. (Paris: Payot et Cie, 1930.) 25 francs.

Wilson, T. Stacey. The Spiritual Life: Viewed from a Scientific Standpoint. Cr. 8vo. Pp. viii + 50. (Birmingham: Cornish Bros., Ltd., 1930.) 1*s*. net.*

Wyatt, H. G. The Psychology of Intelligence and Will. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. viii + 273. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1930.) 12*s*. 6*d*. net.*

Bacteriology: Hygiene

Adams, S. H. Modern Sewage Disposal and Hygienics: being a Treatise on the Subject of Sewage Disposal, with details of Present Day Practice outlining the Basic Laws relating thereto and the Requirements of the Ministry of Health regarding Works for the Purification of Sewage. Demy 8vo. Pp. x + 484. (London: E. and F. N. Spon, Ltd., 1930.) 25*s*. net.

Eyre, J. W. H. Bacteriological Technique: a Laboratory Guide for Medical, Dental and Technical Students. Third edition. Demy 8vo. Pp. xii + 619. (London: Baillière, Tindall and Cox, 1930.) 21*s*. net.*

Henrici, Arthur T. Molds, Yeasts and Actinomycetes: a Handbook for Students of Bacteriology. Med. 8vo. Pp. x + 296. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s*. 6*d*. net.*

Kruif, Paul de. Microbe Hunters. (The Life and Letters Series.) Ex. Cr. 8vo. Pp. 320. (London: Jonathan Cape, Ltd., 1930.) 4*s*. 6*d*. net.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 7. By C. H. Andrewes, J. A. Arkwright, S. P. Bedson, F. R. Blaxall, F. M. Burnet, J. Burton Cleland, A. Felix, G. Marshall Findlay, W. Fletcher, I. A. Galloway, M. H. Gordon, J. G. Greenfield, W. E. Gye, W. F. Harvey, E. Hindle, P. P. Laidlaw, J. C. G. Ledingham, R. J. Ludford, J. E. McCartney, J. McIntosh, A. G. McKendrick, H. B. Maitland, M. S. Mayou, R. St. John-Brooks, J. Henderson Smith, A. Theiler, C. Todd, J. Walker. Sup. Roy. 8vo. Pp. 509. (London: H.M. Stationery Office, 1930.) 21*s*. net.*

Oliver, Wade W. Stalkers of Pestilence: the Story of Man's Ideas of Infection. Pp. xix + 251. (New York: Paul B. Hoeber, 1930.) 3 dollars.

Pankhurst, E. Sylvia. Save the Mothers: a Plea for Measures to Prevent the Annual Loss of about 3000 Child-bearing Mothers and 20,000 Infant Lives in England and Wales and a similar Grievous Wastage in other Countries. Cr. 8vo. Pp. 216. (London: Alfred A. Knopf, 1930.) 6*s*.*

Reitz, Adolf. Apparate und Arbeitsmethoden der Bakteriologie. Band 1: Allgemeine Vorschriften, Einrichtung d. Arbeitsräume, Kulturverfahren, Färbeverfahren, Bestimmungstabellen. (Handbuch der mikroskopischen Technik, Teil 6.) 4to. Pp. iv + 84. (Stuttgart: Franckh'sche Verlagsbuchhandlung, 1930.) 3.60 gold marks.

Thomas, Stanley. Bacteriology: a Textbook on Fundamentals. Second edition. Med. 8vo. Pp. 301. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 15*s*. net.

Tobey, James A. Riders of the Plagues: the Story of the Conquest of Disease. Demy 8vo. Pp. xv + 348 + 8 plates. (New York and London: Charles Scribner's Sons, 1930.) 12*s*. 6*d*. net.*

Whitman, R. C. Hygiene: a College Textbook for Non-Medical Students. Demy 8vo. Pp. xiii + 327. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12*s*. 6*d*. net.*

Miscellany

Adams, James Truslow. A Searchlight on America. Demy 8vo. Pp. xviii + 261. (London: George Routledge and Sons, Ltd., 1930.) 12*s*. 6*d*. net.*

Adamson, John William. English Education, 1789–1902. Roy. 8vo. Pp. x + 519. (Cambridge: At the University Press, 1930.) 21*s*. net.*

Bridges, T. C., and Tiltman, H. Hessell. Master Minds of Modern Science. Demy 8vo. Pp. 278 + 32 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 7*s*. 6*d*. net.*

Brown, John. Teaching Science in Schools. Second edition. Cr. 8vo. Pp. xii + 172. (London: University of London Press, Ltd., 1930.) 3*s*. 6*d*. net.*

Cammaerts, Emile. Discoveries in England. Ex. Cr. 8vo. Pp. iv + 186. (London: George Routledge and Sons, Ltd., 1930.) 6*s*. net.*

Caspar, Max, und Dyck, Walther von, Herausgegeben von. Johannes Kepler in seinen Briefen. 2 Bände. Demy 8vo. Band 1. Pp. xxviii + 396. Band 2. Pp. xvi + 348. (München und Berlin: R. Oldenbourg, 1930.) 20 gold marks.*

Garbo, Carl. A Newton among Poets: Shelley's Use of Science in Prometheus Unbound. Demy 8vo. Pp. xiv + 208. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1930.) 13*s*. 6*d*. net.*

Howell, A. C. A Handbook of English in Engineering Usage. Cr. 8vo. Pp. vii + 308. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 12*s*. 6*d*. net.*

Jones, Rufus M. George Fox: Seeker and Friend. Cr. 8vo. Pp. 221. (London: George Allen and Unwin, Ltd., 1930.) 5*s*. net.*

Mowrer, Edgar Ansel. Sinon: or The Future of Politics. (To-day and To-morrow Series.) Pott 8vo. Pp. 96. (London: Kegan Paul and Co., Ltd., 1930.) 2*s*. 6*d*. net.*

Naturwissenschaften, Herausgegeben von der Schriftleitung der. Ergebnisse der exakten Naturwissenschaften. Band 9. Roy. 8vo. Pp. iii + 348. (Berlin: Julius Springer, 1930.) 28 gold marks.

Nauka Polska: Materjały do Spisu Instytucyj i Towarzystw Naukowych w Polsce (Science and Letters in Poland: Scientific Institutes and Learned Societies in Poland). Tome 12. Gl. 4to. Pp. x + 359. 12 zł. Tome 13. Gl. 4to. Pp. ix + 279. n.p. (Warszawa: Im. Mianowskiego, 1930.) *

Osborn, Henry Fairfield. Fifty-two Years of Research, Observation and Publication, 1877–1929: a Life Adventure in Breadth and Depth. Edited by Florence Milligan. With Complete Bibliography, Chronologic and Classified by Subject, 1877–1929. Med. 8vo. Pp. xii + 160 + 9 plates. (New York and London: Charles Scribner's Sons, 1930.) 1.50 dollars.*

Stapledon, W. Olaf. Last and First Men: a Story of the Near and Far Future. Cr. 8vo. Pp. xi + 355. (London: Methuen and Co., Ltd., 1930.) 7*s*. 6*d*. net.*

Unwin, Stanley. The Truth about Publishing. Third edition. Ex. Cr. 8vo. Pp. 359. (London: George Allen and Unwin, Ltd., 1930.) 7*s*. 6*d*. net.*

Viets, Henry R. A Brief History of Medicine in Massachusetts. Demy 8vo. Pp. xii + 194 + 8 plates. (Boston and New York: Houghton Mifflin Co., 1930.) 4 dollars.*

Walsh, John W. T. The Indexing of Books and Periodicals. Cr. 8vo. Pp. 118. (London: Edward Arnold and Co., 1930.) 6*s*. net.*

West, Geoffrey. H. G. Wells: a Sketch for a Portrait. Ex. Cr. 8vo. Pp. 316. (London: Gerald Howe, Ltd., 1930.) 10*s*. 6*d*. net.*

White, Ernest Geo. Light on the Voice Beautiful: Presenting the Science and Art of Sinus Tone Production as it appeared in various Forms to many Minds. Demy 8vo. Pp. 210. (London: James Clarke and Co., Ltd., 1930.) 6*s*. net.*

Whyte, Adam Gowans. Our World and Us: a Simple Account of "How the Wheels go Round" from the Electron to the Star. (The World of Youth Series, No. 5.) Cr. 8vo. Pp. xi + 144. (London: Watts and Co., 1930.) 1*s*. 6*d*. net.*

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "Nature" Office.

Mathematics: Mechanics: Physics

Anderson, John S., Editor. Photo-Electric Cells and their Applications: a Discussion at a Joint Meeting of the Physical and Optical Societies, June 4 and 5, 1930. Imp. 8vo. Pp. 236. (London: The Physical and Optical Societies, 1930.) 12*s.* 6*d.**

Berkeley, L. M. Addition-Subtraction Logarithms to Five Decimal Places. Sup. Roy. 8vo. Pp. xii + 135. (New York: White Book and Supply Co., 1930.) 3.25 dollars.*

Bragg, Sir William. Was ist Materie? Aus dem Englischen ubersetzt von Dr. Finkelstein. Pp. viii + 191 + 32 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 9.80 gold marks.

Bruhat, G. Cours d'optique à l'usage de l'enseignement supérieur. Roy. 8vo. Pp. ix + 756. (Paris: Masson et Cie, 1931.) 100 francs.*

Chadwick, J. Radioactivity and Radioactive Substances. Fcap. 8vo. Pp. 116. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s.* 6*d.* net.

Chappuis, J., et **Jacquet, A.** Notions de physique: à l'usage des Écoles professionnelles et des Écoles pratiques de Commerce et d'Industrie (sections commerciales) Troisième édition. Ex. Cr. 8vo. Pp. iv + 277. (Paris: Libr. Dunod, 1930.) 16 francs.

Cleary, Stephen F. Descriptive Geometry: Drawing-room Problems. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 4*s.* net.

David, Pierre. L'Électro-acoustique: rapports de l'acoustique moderne et de l'électricité; Conférence faite au Conservatoire National des Arts et Métiers le 9 mai 1930. (Conférences d'actualités scientifiques et industrielles, 14.) Roy. 8vo. Pp. 39. (Paris: Hermann et Cie, 1930.) 5 francs.*

Durell, C. V., and **Robson, A.** Key to Advanced Trigonometry. Cr. 8vo. Pp. 380. (London: G. Bell and Sons, Ltd., 1930.) 15*s.* net.

Enriques, Federigo. Leçons de géométrie projective. Traduit de la quatrième édition italienne par P. Labérenne. Roy. 8vo. Pp. iv + 430. (Paris: Gauthier-Villars et Cie, 1930.) 60 francs.*

Estève, R. Initiation à l'emploi des lettres en arithmétique. 8vo. Pp. 54. (Paris: Gauthier-Villars et Cie, 1930.) 6 francs.

Ewald, P. P., Pöschl, Th., and **Prandtl, L.** The Physics of Solids and Fluids: with Recent Developments. Authorised translation by J. Dougall and W. M. Deans. Med. 8vo. Pp. xii + 372 + 4 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 17*s.* 6*d.* net.*

Ezekiel, Mordecai. Methods of Correlation Analysis. Med. 8vo. Pp. xiv + 427. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22*s.* 6*d.* net.*

Haas, Arthur. Einführung in die theoretische Physik: mit besonderer Berücksichtigung ihrer modernen Probleme. Band 2. Fünfte und sechste, abermals vollig umgearbeitete und wesentlich vermehrte Auflage. Roy. 8vo. Pp. viii + 448 + 6 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 17 gold marks.*

Johnson, George F. Practical Mathematics and Handwork. Books 1-2. Ex. Cr. 8vo. Pp. 47. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 1*s.* net.

Kamke, Erich. Differentialgleichungen reeller Funktionen. (Mathematik und ihre Anwendungen in Monographien und Lehrbuchern, herausgegeben von E. Hilb, Band 7.) Roy. 8vo. Pp. xiv + 436. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 28 gold marks.

Kuehn, Martin H. Mathematics for Electricians. Ex. Cr. 8vo. Pp. 220. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 8*s.* 9*d.* net.

'Lector Insipiens.' Aether, Einstein and Hyperatomics: being Rhetorical Notes on Modern Physics. Cr. 4to. Pp. 84. (London: Strangeways and Sons, Ltd., 1927-1928.) 5*s.**

Lefschetz, Solomon. Topology. (American Mathematical Society Colloquium Publications, Vol. 12.) Med. 8vo. Pp. ix + 410. (New York: American Mathematical Society; Berlin: Hirschwaldsche Buchhandlung; Cambridge: Bowes and Bowes, 1930.) 4.50 dollars.*

Mitis, L. Einsteins Grundirrtum. Zweite erganzte Auflage. Pott 8vo. Pp. 16. (Leipzig: O. Hillmann, 1930.) 1 gold mark.

Nippoldt, Alfred. Verwertung magnetischer Messungen zur Mutung; fur Geologen und Bergingenieure. Med. 8vo. Pp. v + 74 + 36 Tafeln. (Berlin: Julius Springer, 1930.) 16.50 gold marks.*

Osborne, R. S. Commercial Calculations. Second edition. Demy 8vo. Part 1. Pp. viii + 226 + ii. Part 2. Pp. viii + 227-412. (London: Effingham Wilson, 1930.) 4*s.* each Part.

Reichenbach, Hans. Atom und Kosmos: das physikalische Weltbild der Gegenwart. Cr. 8vo. Pp. 323 + 4 Tafeln. (Berlin: Deutsche Buch-Gemeinschaft G.m.b.H., 1930.) 4.90 gold marks.*

Riggs, Norman C. Applied Mechanics. (Engineering Science Series.) Demy 8vo. Pp. x + 328. (New York: The Macmillan Co., 1930.) 16*s.* net.*

Rohr, Moritz von. Die optischen Instrumente: Brille, Lupe, Mikroskop, Fernrohr, Aufnahmeluse und ihnen verwandte Vorkehrungen. Vierte, vermehrte und verbesserte Auflage. Pp. v + 130. (Berlin: Julius Springer, 1930.) 5.70 gold marks.

Rohrberg, Albert. Didaktik des mathematischen Unterrichtes. Teil 1: Infinitesimalrechnung und Rechnen. 8vo. Pp. vi + 171. (Munchen und Berlin: R. Oldenbourg, 1930.) 5.60 gold marks.

Struve, W. W., Herausgegeben und kommentiert von. Mathematischer Papyrus des Staatlichen Museums der Schonen Kunste in Moskau. Unter Benutzung einer hieroglyphischen Transkription von B. A. Turajeff. (Quellen und Studien zur Geschichte der Mathematik, Abteilung A: Quellen.) Sup. Roy. 8vo. Pp. xii + 198 + 10 Tafeln. (Berlin: Julius Springer, 1930.) 18.80 gold marks.*

Thomson, G. P. The Wave Mechanics of Free Electrons. Med. 8vo. Pp. 170. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12*s.* 6*d.* net.

Tropfke, Johannes. Geschichte der Elementar-Mathematik in systematischer Darstellung, mit besonderer Berucksichtigung der Fachworter. Band 1: Rechnen. Dritte, verbesserte und vermehrte Auflage. Roy. 8vo. Pp. vii + 222. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 12 gold marks.*

Wilson, J. Douglas, and **Rogers, C. M.** Carpentry Mathematics. Part 1. Ex. Cr. 8vo. Pp. 232. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 9*s.* net.

Engineering

Bentley, Wallace. Machine Shop Companion. Ninth edition, revised. 18mo. (London: Chapman and Hall, Ltd., 1930.) 2*s.* net.

Bishop, Calvin C. Alternating Currents for Technica Students. Ex. Cr. 8vo. Pp. viii + 317. (London: Macmillan and Co., Ltd., 1930.) 8*s.* 6*d.* net.

Brinkhaus, H. Paul. Das Rohrnetz stadtischer Wasserwerke: Berechnung, Bau, Betrieb. Dritte, neubearbeitete Auflage. 8vo. Pp. ix + 334 + 60 Tafeln. (Munchen und Berlin: R. Oldenbourg, 1930.) 12 gold marks.

Caunter, C. F. Light Aero Engines. Cr. 8vo. Pp. 288. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 12*s.* 6*d.* net.

Cross, Charles N. Heat Engines. (Engineering Science Series.) Demy 8vo. Pp. x + 607. (New York: The Macmillan Co., 1930.) 21*s.* net.*

Dubouloz, M. Comptabilité à résultats mensuels d'une société de distribution d'énergie électrique. Roy. 8vo. Pp. viii + 150. (Paris: Libr. Dunod, 1930.) 36 francs.

Gaunin, J., Houdaille, L., et Bernard, A. Tables pour le tracé des courbes de chemins de fer, routes et canaux. Première partie : Tables trigonométriques. Par J. Gaunin. Deuxième partie : Recueil de coordonnées. Par J. Gaunin, L. Houdaille et A. Bernard. Nouvelle édition, revue et corrigée. Nouveau tirage. Demy 8vo. Pp. 426. (Paris : Libr. Dunod, 1930.) 42 francs.

Gutton, C. Les ondes électriques de très courtes longeurs et leurs applications : Conférence faite au Conservatoire National des Arts et Métiers le 6 mai 1930. (Conférences d'actualités scientifiques et industrielles, 13.) Roy. 8vo. Pp. 20. (Paris : Hermann et Cie, 1930.) 4 francs.*

Kersten, Carl. Brucken in Eisenbeton : ein Leitfaden für Unterricht und Praxis. Band 2 : Bogenbrucken. Fünfte neubearbeitete Auflage. Roy. 8vo. Pp. xii + 226. (Berlin : Wilhelm Ernst und Sohn, 1930.) 15 gold marks.

Lehmann, W. Die Rundfunktechnik. Unter Mitarbeit von Wilhelm Langewiesche und Erich Schwandt. 4to. Pp. viii + 468. (Nordhausen a.H. : Verlag Killinger, 1930.) 23 gold marks.

Lehr, Ernst. Schwingungstechnik : ein Handbuch für Ingenieure. Band 1 : Grundlagen, die Eigenschwingungen eingliedriger Systeme. Roy. 8vo. Pp. xxii + 295. (Berlin : Julius Springer, 1930.) 24 gold marks.

Lovell, Alfred H. Generating Stations : Economic Elements of Electrical Design. Med. 8vo. Pp. 359. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1930.) 20*s*. net.

Main, Francis W. Electric Cables : a Practical Treatise on the Construction, Properties, Installation and Maintenance of Electric Cables ; for Junior Engineers, Students and those in charge of Works and Factories. (Pitman's Technical Primer Series.) Second edition. Fcap. 8vo. Pp. xii + 115. (London : Sir Isaac Pitman and Sons, Ltd., 1930.) 2*s*. 6*d*. net.*

Mann, Clair V. Objective Type Tests in Engineering Education : as Applied to Engineering Drawing and Descriptive Geometry. Med. 8vo. Pp. 122. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.

Miller, Kempster B. Telephone Theory and Practice : Theory and Elements. Med. 8vo. Pp. 492. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1930.) 25*s*. net.

Möller, Walter. Funktechnisches Arbeitsbuch : Demonstrationsversuche und praktischen Übungen zur Hochfrequenztechnik. 8vo. Pp. iv + 89. (Leipzig und Berlin : B. G. Teubner, 1930.) 2.80 gold marks.

Nachtergal, A. Calcul et construction des grues. Deuxième édition. Roy. 8vo. Pp. 358. (Paris : Ch. Béranger, 1930.) 85 francs.

Nilson, Arthur R., and Hornung, J. L. Radio Operating Questions and Answers. Third edition. Ex. Cr. 8vo. Pp. 267. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1930.) 10*s*. net.

Paul, Erwin. Praktische Radio-Messtechnik : ein Leitfaden für Untersuchungen an Rundfunkgeraten. (Die Fachschriftenreihe der "Funk", Heft 5.) 8vo. Pp. 52. (Berlin : Verlag Weidmann, 1930.) 2.50 gold marks.

Peele, Robert. Compressed Air Plant. Fifth edition, revised. Roy. 8vo. Pp. 534. (London : Chapman and Hall, Ltd., 1930.) 37*s*. 6*d*. net.

Perrott, S. Wright. Surveying for Schools. Cr. 8vo. Pp. viii + 160 + 7 plates. (London : Chapman and Hall, Ltd., 1930.) 6*s*. net.*

Reed, Brian. The Internal-Combustion Locomotive. Demy 8vo. Pp. 73. (London : The Draughtsman Publishing Co., Ltd., 1930.) 3*s*. net.*

Ricaud, Marget et Routin. Applications de l'électricité à la marine. (Encyclopédie d'Électricité industrielle.) Roy. 8vo. Pp. 320. (Paris : J.-B. Baillière et fils, 1930.) 60 francs.

Sumner, Capt. P. H. Marine Aircraft : Elementary Naval Architecture. Demy 8vo. Pp. xv + 196. (London : Crosby Lockwood and Son, Ltd., 1930.) 16*s*. net.*

Sutherland, Hale, and Bowman, Harry Lake. An Introduction to Structural Theory and Design : Theory. Med. 8vo. Pp. ix + 318. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1930.) 17*s*. 6*d*. net.*

Tochtermann, Wilhelm. Maschinenelemente : Leitfaden zur Berechnung und Konstruktion fur Maschinenbauschulen und für die Praxis mittlerer Techniker. Fünfte völlig neubearbeitete Auflage der "Maschinenelemente" von Hugo Krause. Roy. 8vo. Pp. x + 456. (Berlin : Julius Springer, 1930.) 15 gold marks.

Chemistry : Chemical Industry

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Abteilung 1 : Chemische Methoden, Teil 2, Halfte 2, Heft 6. Lieferung 336. Die Verseifung. Von F. Bacher. Sup. Roy. 8vo. Pp. 2585-2878. 16 gold marks. Abteilung 1 : Chemische Methoden, Teil 2, Hälfte 2, Heft 7. Lieferung 339. Neuere Synthesen biologisch wichtiger Pyridinkorper. Von H. und H. Horsters. Sup. Roy. 8vo. Pp. 2879-2970. 5 gold marks. (Berlin und Wien : Urban und Schwarzenberg, 1930.)

Baker, John W. Natural Terpenes. Cr. 8vo. Pp. viii + 169. (London : Methuen and Co., Ltd., 1930.) 6*s*.*

Bausor, H. W. An Introductory Course of Chemistry. Second edition. Cr. 8vo. Pp. viii + 262. (London : University Tutorial Press, Ltd., 1930.) 3*s*. 6*d*

Berg, Ragnar. Kontrolle des Mineralstoffwechsels. 8vo. Pp. 87. (Leipzig : S. Hirzel, 1930.) 5 gold marks

Brunold, Ch. L'Entropie : son rôle dans le développement historique de la thermodynamique. 8vo. Pp. 221. (Paris : Masson et Cie, 1930.) 30 francs.

Caven, R. M., and Lander, G. D. Systematic Inorganic Chemistry : from the Standpoint of the Periodic Law. Post 8vo. Pp. xviii + 510. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1930.) 9*s*. net.*

Deming, Horace G., and Arenson, Saul B. Exercises in General Chemistry and Qualitative Analysis. Third edition, rewritten and revised. Demy 8vo. Pp. xiv + 298. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1930.) 9*s*. net.*

Fajans, K., and Wüst, J. A Textbook of Practical Physical Chemistry. Translated from the German by Bryan Topley. Demy 8vo. Pp. xv + 233. (London : Methuen and Co., Ltd., 1930.) 15*s*. net.*

Glasstone, S. The Electrochemistry of Solutions. Demy 8vo. Pp. x + 476. (London : Methuen and Co., Ltd., 1930.) 21*s*. net.*

Hall, William Thomas. Textbook of Quantitative Analysis. Roy. 8vo. Pp. 279. (London : Chapman and Hall, Ltd., 1930.) 12*s*. 6*d*. net.

Hopkins, B. Smith. General Chemistry for Colleges. Demy 8vo. Pp. x + 757. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1930.) 12*s*. 6*d*.

Janet, Charles. Concordance de l'arrangement quantique, de base, des électrons planétaires des atomes, avec la classification scalariforme, hélicoïdale, des éléments chimiques. Roy. 8vo. Pp. 54 + 6 planches. (Beauvais : Imprimerie Départementale de l'Oise, 1930.) *

Jellinek, Karl. Lehrbuch der physikalischen Chemie. Funf Bände. Band 3 : Die Lehre von der Statik chemischer Reaktionen in verdunnten Mischungen (Losungen). Erste und zweite Auflage. Lieferung 9. Roy. 8vo. Pp. xv + 657-893. (Stuttgart : Ferdinand Enke, 1930.) 21 gold marks.*

Kremann, R., und Müller, Rob. Elektromotorische Kräfte, Elektrolyse und Polarisation. (Handbuch der allgemeinen Chemie, Band 8, Teil 2.) Teil 2 : Elektrolyse und Polarisation. Roy. 8vo. Pp. xii + 835. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1930.) 74 gold marks.

Lehne, Adolf. Textilchemische Erfindungen. Lieferung 6 (1 Juli 1929 bis 31 Dezember 1929). Roy. 8vo. Pp. xv + 136. (Wittenberg : A. Ziemsen, 1930.) 10 gold marks.

Lévi, Lucien. Technologie et analyse des principales marchandises. Roy. 8vo. Pp. viii + 269. (Paris : Libr. Dunod, 1930.) 52 francs.

Lewis, Harry F. Fundamentals of Organic Chemistry. (International Chemical Series.) Ex. Cr. 8vo. Pp. viii + 390. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1930.) 13*s*. 9*d*. net.*

Mathews, Albert. Physiological Chemistry. Fifth edition. Roy. 8vo. (London : Baillière, Tindall and Cox, 1930.) 31*s*. net.

Ministry of Health. Reports on Public Health and Medical Subjects, No. 60: The Effect on Foods of Fumigation with Hydrogen Cyanide. By G. W. Monier-Williams. Roy. 8vo. Pp. 32. (London: H.M. Stationery Office, 1930.) 6*d*. net.*

Newman, F. H. Electrolytic Conduction. Demy 8vo. Pp. xii + 441. (London: Chapman and Hall, Ltd., 1930.) 25*s*. net.*

Oppenheimer, C. Handbuch der Biochemie. Zweite Auflage. Ergänzungsband. Pp. 528. (Jena: Gustav Fischer, 1930.) 42 gold marks.

Pope, Sir William J. Science and Modern Industry: being the Sixth Annual Norman Lockyer Lecture, delivered on November 13th, 1930, at 4.30 P.M., in the Hall of the Goldsmiths' Company, London. Med. 8vo. Pp. 19. (London: British Science Guild, 1930.) 1*s*.*

Sauerwald, Franz. Physikalische Chemie der metallurgischen Reaktionen: ein Leitfaden der theoretischen Hüttenkunde. Roy. 8vo. Pp. x + 142. (Berlin: Julius Springer, 1930.) 15 gold marks.

Sauter, Erwin. Heterogene Katalyse. 8vo. Pp. 80. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 7.20 gold marks.

Schmidt, Julius. Jahrbuch der organischen Chemie. Jahrgang 15. (Wien und Leipzig: Franz Deuticke, 1930.) 24 gold marks.

Smith, Alexander, und **D'Ans, I.** Einführung in die allgemeine und anorganische Chemie. Sechste Auflage. 8vo. Pp. 801. (Karlsruhe: G. Braun, 1930.) 16 gold marks.

Staudinger, H., en collaboration avec **Frost, W.** Introduction à l'analyse qualitative organique. Traduit de la deuxième édition allemande par Eric W. Reuss. Roy. 8vo. Pp. viii + 192. (Paris: Libr. Dunod, 1930.) 16 francs.

Style, D. W. G. Photochemistry. (Methuen's Monographs on Physical Subjects.) Feap. 8vo. Pp. vii + 96. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.*

Timm, John Arrend. An Introduction to Chemistry: a Pandemic Text. (International Chemical Series.) Ex. Cr. 8vo. Pp. xviii + 561. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 17*s*. 6*d*. net.*

Timm, John A., and **Schupp, Jr., Orion E.** Laboratory Exercises in General Chemistry. (International Chemical Series.) Ex. Cr. 8vo. Pp. ix + 138 (every other page blank). (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 6*s*. 3*d*. net.*

Ulich, Hermann. Chemische Thermodynamik: Einführung in die Lehre von den chemischen Affinitäten und Gleichgewichten. Roy. 8vo. Pp. xvi + 353. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 18.50 gold marks.*

Washington, Henry S. The Chemical Analysis of Rocks. Fourth edition, revised and rewritten. Roy. 8vo. (London: Chapman and Hall, Ltd., 1930.) 20*s* net.

Weichherz, Josef, und **Schröder, Jul.** Fabrikationsmethoden für galenische Arzneimittel. (Technisch-Gewerbliche Bücher, Band 5.) 8vo. Pp. 350. (Wien und Berlin: Julius Springer, 1930.) 28.50 gold marks.

Wenzel, Alvensleben und **Witt.** Die Beseitigung der beim Tauch- und Spritzlackieren entstehenden Dämpfe. Zweite Auflage. 8vo. Pp. 47. (Berlin: Julius Springer, 1930.) 3.90 gold marks.

Wurmser, René. Oxydations et réductions. (Les problèmes biologiques, Vol. 15.) Roy. 8vo. Pp. xix + 381. (Paris: Les Presses universitaires de France, 1930.) 95 francs.*

Zühlke, Eduard. Praktischer Leitfaden zum Färben von Textilfasern in Laboratorien: für Studenten der Hochschulen und für Schüler an höheren Textilfachschulen. 8vo. Pp. vii + 234. (Berlin: Julius Springer, 1930.) 9.50 gold marks.

Technology

Adam, J. P. Manuel du tourneur mécanicien: formules et procédés pratiques d'usinage. Neuvième édition. Feap. 8vo. Pp. 104. (Paris: Libr. Dunod, 1930.) 10.50 francs.

Barker, Aldred F. Ornamentation and Textile Design. Cr. 4to. Pp. 31 + 91 plates. (London: Methuen and Co., Ltd., 1930.) 15*s*. net.

Barker, G. H. Woodcraft Design and Construction: a Manual for Teachers, Students and Craftsmen. Cr. 4to. Pp. x + 146 + 34 plates. (London: Crosby Lockwood and Son, 1930.) 9*s*. 6*d*. net.

Benedicks, Carl, and **Löfquist, Helge.** Non-Metallic Inclusions in Iron and Steel. Roy. 8vo. Pp. xi + 311 + 44 plates. (London: Chapman and Hall, Ltd., 1930.) 30*s*. net.*

Berl, E., und **Taack, F. van.** Über die Einwirkung von Laugen und Salzen auf Flusseisen unter Hochdruckbedingungen und über die Schutzwirkung von Natriumsulfat gegen den Angriff von Ätznatron und von Chlormagnesium. (Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, Heft 330.) 4to. Pp. 31 + 33 Tafeln. (Berlin: V.D.I.-Verlag, G.m.b.H., 1930.) 5 gold marks.

Boulton, Sir Harold, Edited by. A Century of Wood Preserving. Demy 8vo. Pp. x + 150 + 3 plates. (London: Philip Allan and Co., Ltd., 1930.) 8*s*. 6*d*. net.*

Ceillier, Rémi. La photographie d'amateur. (Bibliothèque pratique de l'amateur.) Cr. 8vo. Pp. 96. (Paris: J.-B. Baillière et fils, 1930.) 6 francs.*

Clements, Fred. Blast Furnace Practice. Cr. 4to. Vol. 2: Design of Plant and Equipment. Pp. 509. Vol. 3: Operation and Products. Pp. 400. (London: Ernest Benn, Ltd., 1929.) 63*s*. net each vol.*

Davenport, Fred. Binding Crafts for the Junior School. Demy 8vo. Pp. 135. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 4*s*. net.

Field, Samuel, and **Weill, A. Dudley.** Electro-plating: including Nickel, Zinc, Cadmium and Chromium. Cr. 8vo. Pp. 206. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 5*s*. net.

Gowland, Wm. The Metallurgy of the Non-ferrous Metals. Med. 8vo. Pp. 633. (London: Charles Griffin and Co., Ltd., 1930.) 30*s*. net.

Grayshon, Alfred B. General Metal Work. Roy. 8vo. (New York: D. Van Nostrand Co.; London: Chapman and Hall, Ltd., 1930.) 8*s*. 6*d*. net.

Grundy, R. F. B. Builders' Materials. Demy 8vo. Pp. x + 240. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 5*s*.

Harrison, T. The Bookbinding Craft and Industry: an Outline of its History, Development and Technique. (Pitman's Common Commodities and Industries Series.) Second edition. Cr. 8vo. Pp. x + 139. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3*s*. net.

Herzog, R. O. Technologie der Textilfasern. Band 5, Teil 1: Der Flachs. Abteilung 1: Botanik, Kultur, Aufbereitung, Bleicherei und Wirtschaft des Flachses. Bearbeitet von Walter Kind, Paul Koenig, Willy Müller, E. Schilling und C. Steinbrinck. Roy. 8vo. Pp. xi + 427. 54 gold marks. Band 5, Teil 3: Die Jute. Abteilung Pflanze und Fasergewinnung, Handel und Wirtschaft, Spinnerei. Von E. Nonnenmacher. Roy. 8vo. Pp. viii + 571. 86 gold marks. (Berlin: Julius Springer, 1930.)

Hewitt, Graily. Lettering: for Students and Craftsmen. (New Art Library, Vol. 14.) Demy 8vo. Pp. 336. (London: Seeley, Service and Co., Ltd., 1930.) 15*s*. net.

Kausch, Oscar. Der Graphit. (Kohle, Koks, Teer, Band 24.) Roy. 8vo. Pp. vii + 247. (Halle a.S.: Wilhelm Knapp, 1930.) 25 gold marks.

Kay, J. Simple Art Metalwork. (The Practical Workroom Series.) Ex. Cr. 8vo. Pp. 48. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1930.) 1*s*. 3*d*.

Kempér, August. Gasfernversorgung: Beiträge zur Klärung des Problems. (Kohle, Koks, Teer, Band 23.) Roy. 8vo. Pp. viii + 122. (Halle a.S.: Wilhelm Knapp, 1930.) 10.20 gold marks.

Ludwig, Wilhelm. Musterbetriebe Deutscher Wirtschaft. Band 18: Das deutsche Messewesen. Pp. 69. (Berlin: Organisation Verlagsgesellschaft m.b.H. (S. Hirzel), 1930.) 2.75 gold marks.

Macey, Frank W. Specifications in Detail. Fourth edition, revised by Donald Brooke and J. W. Summerfield. Roy. 8vo. Pp. 645. (London: Crosby Lockwood and Son, 1930.) 35*s*. net.

McMurtrie, Douglas C. Modern Typography and Layout. Sup. Roy. 4to. Pp. 190. (London: The Library Press, Ltd., 1930.) 31*s*. 6*d*. net.

Marcusson, J. Die natürlichen und künstlichen Asphalte: ihre Gewinnung, Verwendung, Zusammensetzung und Untersuchung. Herausgegeben unter Mitwirkung von H. Burchartz und P. Wilke. Zweite verbesserte Auflage. Roy. 8vo. Pp. xii + 253. (Leipzig: Wilhelm Engelmann, 1930.) 19 gold marks.

Olson, Kenneth E. Typography and Mechanics of the Newspaper. Demy 8vo. Pp. 441. (New York and London: D. Appleton and Co., 1930.) 21*s*.

Pfanhauser, W. L'électro-déposition des métaux. Roy. 8vo. Pp. 850. (Paris: Ch. Béranger, 1930.) 180 francs.

Pull, E. Modern Workshop Practice: a Practical Text-Book for the Use of Engineers, Apprentices and Students in Technical Institutes. Seventh edition, revised. Cr. 8vo. Pp. xix + 672 + 10 plates. (London: Crosby Lockwood and Son, 1930.) 15*s*. net.

Reeder, H. Elementary Practical Drawing. Demy 8vo. Pp. 52. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 1*s*. 6*d*.

Rüf, Eugen. Die Praxis der Baumwollwaren-Appretur. Band 4. 8vo. Pp. 278. (Berlin und Wien: Julius Springer, 1930.) 15 gold marks.

Safety in Mines Research Board. What every Mining Man should Know. No. 3: How some Firedamp Explosions are Prevented. Cr. 4to. Pp. 30. (London: H.M. Stationery Office, 1930.) 3*d*. net.*

Saunders, B. Heat Treatment in Forging Steel: a Manual on the Application of Science to the Heating, Cooling and Forging of Steel. Cr. 8vo. Pp. 120. (London: Crosby Lockwood and Son, 1930.) 5*s*. net.

Schwarzkopf, Ernest. Plain and Ornamental Forging. Second edition. Cr. 8vo. (London: Chapman and Hall, Ltd., 1930.) 11*s*. net.

* **Scotland, John.** The Talkies. Cr. 8vo. Pp. xv + 194 + 36 plates. (London: Crosby Lockwood and Son, 1930.) 7*s*. 6*d*. net.

Shannon, R. W. Sheet Steel and Tin Plate. 8vo. Pp. 285. (New York: The Chemical Catalog Co., Inc., 1930.) 5 dollars.

Sparkes, W. E. Art and Artists: Drawing, Painting, Engraving. Cr. 4to. Pp. 224 + 48 plates. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1930.) 10*s*. 6*d*. net.

Stahl, Carl Josef. Ofenbau und Wärmewirtschaft in der Glasindustrie. 8vo. Pp. iv + 186. (Dresden: Verlag "Die Glashütte", 1930.) 5 gold marks.

Taylor, Stewart, and Snell, James E. Craft Work. (Practical Work for Senior Schools: Second Year.) Cr. 8vo. Pp. 96. (London: Oxford University Press, 1930.) 1*s*. 9*d*.

Walker-Tisdale, C. W., and others. The Practice of Soft Cheese-making. Cr. 8vo. Pp. 116. (London: George Allen and Unwin, Ltd., 1930.) 3*s*. 6*d*. net.

Wecke, F. Zement. (Technische Fortschrittsberichte, herausgegeben von B. Rassow, Band 25.) Roy. 8vo. Pp. viii + 96. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 4.80 gold marks.

Weiss, Max. Das Trocknen der Kohle. (Kohle, Koks, Teer, Band 25.) Roy. 8vo. Pp. viii + 196. (Halle a.S.: Wilhelm Knapp, 1930.) 15 gold marks.

Wheeler, E. La soie artificielle: fabrication et propriétés. Traduit de l'Anglais par H. Tatu. Roy. 8vo. Pp. xii + 156. (Paris: Libr. Dunod, 1930.) 41 francs.

Whitaker, J. W. Mining Physics and Chemistry. Second edition. Cr. 8vo. Pp. xii + 268. (London: Edward Arnold and Co., 1930.) 9*s*.*

Woodworth, J. Découpage, matriçage, poinçonnage, emboutissage. Deuxième édition française d'après la septième édition américaine par J. Lévy. Roy. 8vo. Pp. viii + 375. (Paris: Libr. Dunod, 1930.) 56 francs.

Zschacke, F. H. Glas: seine Herstellung und Verwendung. (Technische Fortschrittsberichte, herausgegeben von B. Rassow, Band 24.) Roy. 8vo. Pp. xii + 208. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 12 gold marks.

Meteorology: Geophysics

Air Ministry: Meteorological Office. The Observatories' Year Book, 1928: comprising the Meteorological and Geophysical Results obtained from Autographic Records and Eye Observations at the Observatories at Lerwick, Aberdeen, Eskdalemuir, Cahirciveen (Valentia Observatory), and Richmond (Kew Observatory), and the results of Soundings of the Upper Atmosphere by means of Registering Balloons. (M.O. 320.) Published by the Authority of the Meteorological Committee. Roy. 4to. Pp. 450 + 14 plates. (London: H.M. Stationery Office, 1930.) 63*s*. net.*

Air Ministry: Meteorological Office. Professional Notes, No. 59: Some Observations of Upper Air Temperature in Iraq. By S. P. Peters. (M.O. 273*s*.) Published by the Authority of the Meteorological Committee. Roy. 8vo. Pp. 11 + 3 plates. (London: H.M. Stationery Office, 1930.) 3*d*. net.*

Douglas, C. K. M. On the Relation between Temperature and Pressure in the Troposphere. (Memoirs of the Royal Meteorological Society, Vol. 3, No. 29.) Roy. 8vo. Pp. 159-168. (London: Edward Stanford, Ltd., 1930.) 2*s*. 6*d*.*

Faber, O. M. Physikalische Staubbestimmungen. (Messen und Prüfen, Heft 2.) 8vo. Pp. viii + 60. (Halle a.S.: Wilhelm Knapp, 1930.) 3.50 gold marks.

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 2, No. 19 (January-June, 1930). Roy. 8vo. Pp. 301-343. (London: Royal Meteorological Society, 1930.) 2*s*. 6*d*.*

Simpson, G. C. Thunder and Lightning: being the Thirty-second Robert Boyle Lecture delivered before the Oxford University Junior Scientific Club on 7 June 1930. Demy 8vo. Pp. 15 + 2 plates. (Oxford: The Vincent Printing Works, 1930.) *

Geology: Mineralogy

Barker, T. V. Systematic Crystallography: an Essay on Crystal Description, Classification and Identification. Roy. 8vo. Pp. xi + 115. (London: Thomas Murby and Co., 1930.) 7*s*. 6*d*. net.*

Blanck, E. Handbuch der Bodenlehre. Band 6: Die physikalische Beschaffenheit des Bodens. Roy. 8vo. Pp. 423. (Berlin: Julius Springer, 1930.) 43.60 gold marks.

Brune, Alfred. Beitrag zur Geologie des produktiven Karbons der Bochumer Mulde zwischen Dortmund und Kamen. (Archive für Lagerstättenforschung, Heft 44.) Roy. 8vo. Pp. 128 + 18 Tafeln. (Berlin: Preussischen Geologischen Landesanstalt, 1930.) 22.50 gold marks.

Geological Survey of England and Wales. Sheet 22 Maryport. Solid edition, colour printed. Scale of one Inch to one Statute Mile. 26 in. × 21 in. 2*s*. net. Drift edition, colour printed. Scale of one Inch to one Statute Mile. 26 in. × 21 in. 2*s*. net. (Southampton: Ordnance Survey Office, 1930.) *

Gross, Walter. Die Fische des mittleren Old Red Süd-Livlands. (Geologische und paläontologische Abhandlungen, herausgegeben von J. F. Pompeckj und Fr. Freih. von Huene, Neue Folge, Band 18 (der ganzen Reihe Band 22), Heft 2. 4to. Pp. 36 + 5 Tafeln. (Jena: Gustav Fischer, 1930.) 15 gold marks.

Pia, Julius. Grundbegriffe der Stratigraphie: mit ausführlicher Anwendung auf die europäische Mitteltrias. Sup. Roy. 8vo. Pp. v + 252. (Leipzig und Wien: Franz Deuticke, 1930.) 16 gold marks.*

Schaffer, Franz Xaver. Lehrbuch der Geologie. Teil 3: Geologische Länderkunde (Regionale Geologie). Lieferung 1. Sup. Roy. 8vo. Pp. vii + 96. (Leipzig und Wien: Franz Deuticke, 1930.) 6 gold marks.*

Scherzer, Hans. Geologisch-botanische Wanderungen durch die Alpen. Band 2: Das Algäu. 8vo. Pp. 356 + 43 Tafeln. (München: Kösel und Pustet, 1930.) 7.50 gold marks.

Tarr, W. A. Introductory Economic Geology. Med. 8vo. Pp. 664. (New York: McGraw-Hill Book Co., Inc. London: McGraw-Hill Publishing Co., Ltd., 1930.) 25*s*. net.

Woldstedt, Paul. Das Eiszeitalter: Grundlinien einer Geologie des Diluviums. Roy. 8vo. Pp. xv + 406. (Stuttgart: Ferdinand Enke, 1929.) 29 gold marks.*

Geography: Travel

Adler, Elkan Nathan, Edited, with an Introduction, by. Jewish Travellers. (The Broadway Travellers.) Demy 8vo. Pp. xxiv + 391 + 8 plates. (London: George Routledge and Sons, Ltd., 1930.) 15*s*. net.*

Aurosseau, Marcel. Highway into Spain. Med. 8vo. Pp. 686. (London: Peter Davies, Ltd., 1930.) 21*s*. net.

Beebe, William. Im Dschungel der Fasanen. Aus dem Englischen von Max Muller. Roy. 8vo. Pp. 184. (Leipzig: F. A. Brockhaus, 1930.) 7 gold marks.

Beer, G. R. de. Early Travellers in the Alps. Roy. 8vo. Pp. 204. (London: Sidgwick and Jackson, Ltd., 1930.) 10*s*. 6*d*. net.

Braun, Gustav, Neu bearbeitet von. Grundzuge der Physiogeographie. Mit Benutzung von W. M. Davis "Physical Geography" und der deutschen Ausgaben; zum Gebrauch beim Studium und auf Exkursionen. Band 2: Allgemeine vergleichende Physiogeographie. Dritte Auflage. Ex. Cr. 8vo. Pp. xii + 256. (Leipzig und Berlin: B. G. Teubner, 1930.) 10 gold marks.*

Buchheit, Gert. Die schone Rheinpfalz: ein Bildwerk. Roy. 8vo. Pp. 108 + 88 Tafeln. (Munchen: Knorr und Hirth, 1930.) 5.80 gold marks.

Buckley, W. Big Game Hunting in Central Africa. Med. 8vo. Pp. viii + 268. (London: Cecil Palmer, 1930.) 10*s*. 6*d*. net.

Burnell, F. S. Rome. Cr. 8vo. Pp. vii + 303 + 8 plates. (London: Edward Arnold and Co., 1930.) 7*s*. 6*d*. net.

Chilvers, Hedley A. The Seven Lost Trails of Africa: being a Record of Sundry Expeditions, New and Old, in search of Buried Treasure. Med. 8vo. Pp. xiii + 212 + 8 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1930.) 7*s*. 6*d*. net.

Cohen-Portheim, Paul. England, die unbekannte Insel. 8vo. Pp. 253. (Berlin: Klinkhardt und Biermann, 1931.) 5 gold marks.

Drake, H. B. Korea of the Japanese. Med. 8vo. Pp. 225. (London: John Lane, The Bodley Head, Ltd., 1930.) 12*s*. 6*d*. net.

Dugmore, A. Radclyffe. Corsica the Beautiful. Roy. 8vo. Pp. 288. (London: Hurst and Blackett, Ltd., 1930.) 18*s*. net.

Dugmore, A. Radclyffe. In the Heart of the Northern Forests. Cr. 4to. Pp. 243. (London: Chatto and Windus, 1930.) 21*s*. net.

Eardley-Wilmot, Sir S. Leaves from Indian Forests. Ex. Cr. 8vo. Pp. viii + 200 + 8 plates. (London: Edward Arnold and Co., 1930.) 10*s*. 6*d*. net.*

Farquhar, Francis, Edited by. Up and Down California in 1860–1864: the Journal of William H. Brewer, Professor of Agriculture in the Sheffield Scientific School from 1864 to 1903. Published on the Foundation established in Memory of Philip Hamilton McMillan of the Class of 1894 Yale College. Med. 8vo. Pp. xxx + 601 + 32 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1930.) 27*s*. net.*

Grimshaw, Beatrice. Isles of Adventure. Demy 8vo. Pp. 307. (London: Herbert Jenkins, Ltd., 1930.) 15*s* net.

Hastings, A. C. G. Nigerian Days. (Travellers' Library.) Gl. 8vo. Pp. 285. (London: Jonathan Cape, Ltd., 1930.) 3*s*. 6*d*. net.

Herbertson, F. D. The Clarendon Geography. Part 4: Asia. Revised by O. J. R. Howarth. Eighth impression. (London: Oxford University Press, 1930.) 2*s*.

Hettner, Alfred. Grundzüge der Länderkunde. Band 2: Die aussereuropaischen Erdteile. Vierte verbesserte Auflage. Roy. 8vo. Pp. vi + 488. (Leipzig und Berlin: B. G. Teubner, 1930.) 18 gold marks.

Hofmann-Montanus, Hans, und Eisler, Max. Salzburg: Stadt und Land. (Städte und Landschaften, Band 1.) 4to. Pp. 232. (Wien: Gerlach und Wiedling, 1930.) 12 gold marks.

Hutchison, Isobel Wylie. On Greenland's Closed Shore: the Fairyland of the Arctic. Demy 8vo. Pp. xviii + 395. (Edinburgh and London: Wm. Blackwood and Sons, Ltd., 1930.) 21*s*. net.

James, M. R. Suffolk and Norfolk: a Perambulation of the two Counties with Notices of their History and their Ancient Buildings. Cr. 4to. Pp. xv + 240. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 5*s*. net.

Kaarsberg, Helge. Mein Sumatrabuch (Hoid man og brun mand). Aus dem Danischen von Erwin Magnus. (Welt und Wildnis.) 8vo. Pp. 173. (Berlin: A. Scherl, 1930.) 5 gold marks.

Koenig-Warthausen, F. K. Baron von. Wings Around the World. Demy 8vo. Pp. xii + 185. (New York and London: G. P. Putnam's Sons, 1930.) 6*s*. net.

Laborde, E. D. Great and Greater Britain. (Cambridge School Geographies, Book 4.) Cr. 8vo. Pp. xii + 170. (Cambridge: At the University Press, 1930.) 2*s*. 6*d*.

Le Strange, G. The Lands of the Eastern Caliphate: Mesopotamia, Persia and Central Asia from the Moslem Conquest to the time of Timur. (Cambridge Geographical Series.) Second impression. Cr. 8vo. Pp. xx + 536. (Cambridge: At the University Press, 1930.) 21*s*. net.

Lépiney, Jacques and Tom de. Climbs on Mont Blanc. Translated by Sydney Spencer. Ex. Cr. 8vo. Pp. xii + 179 + 16 plates. (London: Edward Arnold and Co., 1930.) 10*s*. 6*d*. net.*

Lilius, Aleko E. I Sailed with Chinese Pirates. Demy 8vo. Pp. 245. (London and Bristol: J. W. Arrowsmith, Ltd., 1930.) 15*s*. net.

Lockley, R. M. Dream Island: a Record of the Simple Life. Demy 8vo. Pp. 192 + 7 plates. (London: H. F. and G. Witherby, 1930.) 8*s*. 6*d*. net.*

Lyall, Archibald. The Balkan Road. Demy 8vo. Pp. viii + 241. (London: Methuen and Co., Ltd., 1930.) 12*s*. 6*d*. net.

Meyers Reisebucher. Donauland: Passau, Wien, Budapest, Wachau, Muhl- und Waldviertel, Semmering, Burgenland, Plattensee. Pott 8vo. Pp. xxxii + 424 + 18. (Leipzig: Bibliographisches Institut A. G., 1930.) 6.50 gold marks.

Midgley, Cyril. Individual Exercises in School Geography. Demy 4to. Pp. 44. (Exeter: A. Wheaton and Co., Ltd., 1930.) 10*d*.

Mill, Hugh Robert. The Record of the Royal Geographical Society, 1830–1930. Published at the Celebration of the Society's Centenary, October 1930. Roy. 8vo. Pp. xvi + 288 + 35 plates. (London: Royal Geographical Society; Edward Stanford, Ltd.; John Murray, 1930.) 10*s*.*

Mittelholzer, Walter. Kilimandjaro-Flug. Roy. 8vo. Pp. 114. (Zurich: Orell Fussli und Co., 1930.) 6.40 gold marks.

Mjöberg, Eric. In der Wildnis des tropischen Urwaldes: Abenteuer und Schilderungen aus Niederländ.-Indien. Aus dem Schwedischen von Theodor Geiger. 8vo. Pp. 180. (Leipzig: F. A. Brockhaus, 1930.) 6.50 gold marks.

Nansen, Fridtjof. Durch den Kaukasus zur Wolga. Aus dem Norwegischen von Theodor Geiger. Roy. 8vo. Pp. 184. (Leipzig: F. A. Brockhaus, 1930.) 8.50 gold marks.

Norden, Hermann. Durch Abessinien und Erythraa: Reise-erlebnisse. Aus dem Amerikanischen von Karl Soll. (Welt und Wildnis.) 8vo. Pp. 203. (Berlin: A. Scherl, 1930.) 5 gold marks.

Ogilvie, Alan G., Edited by. Great Britain: Essays in Regional Geography. By Twenty-six Authors. With an Introduction by Sir E. J. Russell. Second edition. Demy 8vo. Pp. xxxi + 502. (Cambridge: At the University Press, 1930.) 21*s*. net.*

Okey, T. Venice and its Story. Roy. 8vo. Pp. 326. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 15*s*. net.

Pedersen, Alwin. Der Scoresbysund: drei Jahre Forschungsreisen an d. Ostküste Grönlands. (Welt und Wildnis.) 8vo. Pp. 157. (Berlin: A. Scherl, 1930.) 5 gold marks.

Philby, H. St. J. Arabia. (The Modern World Series.) Demy 8vo. Pp. xix + 387. (London: Ernest Benn, Ltd., 1930.) 18*s*. net.

Rankin, Sir Reginald. A Tour in the Himalayas and Beyond. Med. 8vo. Pp. 298. (London: John Lane, The Bodley Head, Ltd., 1930.) 12*s*. 6*d*. net.

Rihani, Ameen. Arabian Peak and Desert: Travels in Al-Yaman. Med. 8vo. Pp. ix + 280. (London: Constable and Co., Ltd., 1930.) 15*s*. net.

Roerich, Nicholas. Altai-Himalaya: a Travel Diary. Roy. 8vo. Pp. xix + 408. (London: Jarrolds Publishers (London), Ltd., 1930.) 18*s*. net.

Rutter, Eldon. The Holy Cities of Arabia. Popular edition. Demy 8vo. Pp. xv + 594. (New York and London: G. P. Putnam's Sons, 1930.) 15*s*. net.

Rutter, Owen. The Pirate Wind. Demy 8vo. Pp. 292. (London: Hutchinson and Co., Ltd., 1930.) 12*s*. 6*d*. net.

Rutter, W. P. Commercial Geography of the World. Completely revised edition. Cr. 8vo. Pp. 236. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 6*s*. net.

Sayers, Gerald F., General Editor. The Handbook of Tanganyika. First Issue, 1930. Issued by the Chief Secretary's Office. Demy 8vo. Pp. x + 636 + 25 plates. (London: Macmillan and Co., Ltd., 1930.) 10*s*. net.

Shurcliff, Sidney N. Jungle Islands: the *Illyria* in the South Seas. Imp. 8vo. Pp. 298. (New York and London: G. P. Putnam's Sons, 1930.) 42*s*. net.

Smith, T. Alford. A Geography of Europe. (Macmillan's Practical Modern Geographies.) Second edition. Cr. 8vo. Pp. ix + 300. (London: Macmillan and Co., Ltd., 1930.) 4*s*.

Smithes, M. F. Things Seen in Portugal: "The Garden of the West", a Land of Mountains and Rivers, of the Vine, the Olive and the Cork Tree, and of Ancient Buildings richly carved, Picturesque Peasantry and Hardy Fishermen. (The Things Seen Series.) Feap. 8vo. Pp. 158. (London: Seeley, Service and Co., Ltd., 1930.) 3*s*. 6*d*. net.

Stamp, Elsa C., and **Stamp, L. Dudley.** The Practical Atlas of Modern Geography. Roy. 4to. Pp. 48. (London: Geo. Gill and Sons, Ltd., 1930.) 2*s*. 6*d*. net.

Stamp, L. Dudley. A Regional Geography: for Higher School and Intermediate Courses. Part 4: Asia. Demy 8vo. Pp. viii + 188. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 4*s*.

Stamp, L. Dudley, and **Stamp, Elsa C.** More Travels round the World. (Longmans' New Age Geographies: Junior Series, Book 3B.) Cr. 8vo. Pp. vi + 170 + 4 plates. 2*s*. Round the British Isles. (Longmans' New Age Geographies: Junior Series, Book 4.) Cr. 8vo. Pp. iv + 172 + 4 plates. 2*s*. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.)

Strong, Richard P., Edited by. The African Republic of Liberia and the Belgian Congo: based on the Observations made and Material collected during the Harvard African Expedition, 1926–1927. (Contributions from the Department of Tropical Medicine and the Institute for Tropical Biology and Medicine, No. 5.) Members of the Expedition: Richard P. Strong, George C. Shattuck, Max Theiler, Loring Whitman, Joseph C. Bequaert, Glover M. Allen, David H. Linder, Harold J. Coolidge, Jr. In 2 volumes. Imp. 8vo. Vol. 1. Pp. xxvi + 568. Vol. 2. Pp. ix + 569-1064. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 67*s*. 6*d*. net.*

Sykes, Brig.-General Sir Percy. A History of Persia. Third edition, with Supplementary Essays. In 2 volumes. Demy 8vo. Vol. 1. Pp. xxxix + 563 + 15 plates. Vol. 2. Pp. xx + 616 + 16 plates. (London: Macmillan and Co., Ltd., 1930.) 42*s*. net.*

Taylor, E. G. R. Tudor Geography, 1485–1583. Demy 8vo. Pp. x + 290 + 16 plates. (London: Methuen and Co., Ltd., 1930.) 15*s*. net.

Thompson, W. Harding. Cornwall: a Survey of its Coast, Moors and Valleys, with Suggestions for the Preservation of Amenities. Prepared for the Cornwall Branch of the Council for the Preservation of Rural England. With Notes on the Antiquities of Cornwall, by Charles Henderson. Roy. 4to. Pp. xix + 130 + 42 plates. (London: University of London Press, Ltd., 1930.) 17*s*. 6*d*. net.*

Thomson, A. A. Let's See the Lowlands. Ex. Cr. 8vo. Pp. 280. (London: Herbert Jenkins, Ltd., 1930.) 7*s*. 6*d*. net.

Treatt, Major C. Court. Out of the Beaten Track: a Narrative of Travel in little known Africa. Roy. 8vo. Pp. 288. (London: Hutchinson and Co., Ltd., 1930.) 18*s*. net.

Willoughby, Barrett. Sitka: "To know Alaska one must first know Sitka". Roy. 8vo. Pp. 248. (London: Hodder and Stoughton, Ltd., 1930.) 20*s*. net.

Wolseley, Viscountess. Some Sussex Byways. Feap. 4to. Pp. xiv + 167. (London: The Medici Society, 1930.) 15*s*. net.

General Biology: Natural History Botany: Zoology

Bodemeyer, Bodo von. Über meine entomologischen Reisen nach Kleinasien (1911), Ost-Sibirien, Schilka und Amur (1912), Tunis, Oasis Gafsa, Khroumerie (1913) und Iran, das Elbursgebirge (1914). Band 4: Iran, das Elbursgebirge. Roy. 8vo. Pp. 96. (Stuttgart: Verlag Kernen, 1930.) 3.50 gold marks.

Boulenger, E. G. Animals in the Wild and in Captivity. Med. 8vo. Pp. 224. (London: Ward, Lock and Co., Ltd., 1930.) 7*s*. 6*d*. net.

Brightwell, L. R. The Tiger in Town. Demy 8vo. Pp. viii + 248. (London: Chapman and Hall, Ltd., 1930.) 7*s*. 6*d*. net.*

British Museum (Natural History). The Cockroach: its Life-History and how to deal with It. By Frederick Laing. (Economic Series, No. 12.) Second edition. Demy 8vo. Pp. 23 + 1 plate. (London: British Museum (Natural History), 1930.) 6*d*.*

British Museum (Natural History). Insects of Samoa and other Samoan Terrestrial Arthropoda. Part 6: Diptera. Fasc. 6: Lonchaeidæ, Chloropidæ and Piophilidæ. By J. R. Malloch. Cr. 4to. Pp. 239-251. (London: British Museum (Natural History), 1930.) 1*s*.*

Bronn, Heinrich Georg. Klassen und Ordnungen des Tierreichs. Band 3: Mollusca (Weichtiere). Abteilung 1: Amphineura und Scaphopoda. Bearbeitet von H. Simroth und H. Hoffmann. 4to. Pp. 369-511. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 18.80 gold marks.

Brüning, Detlev. Die deutsche Karpfenteichwirtschaft: ein betriebswirtschaftlicher Beitrag zur Lage der Binnenfischerei. (Sammlung fischereilicher Zeitfragen, Heft 19.) Roy. 8vo. Pp. 64. (Neudamm: Verlag Neumann, 1930.) 5 gold marks.

Buchner, Paul. Tier und Pflanze in Symbiose. Zweite völlig umgearbeitete und erweiterte Auflage von "Tier und Pflanze in intrazellularer Symbiose". Sup. Roy. 8vo. Pp. xx + 900. (Berlin: Gebruder Borntraeger, 1930.) 96 gold marks.*

Cresswell, Ernest J. J. Sponges: their Nature, History, Modes of Fishing, Varieties, Cultivation, etc. (Pitman's Common Commodities and Industries Series.) Second edition. Cr. 8vo. Pp. vii + 126. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 3*s*. net.*

***Discovery* Reports,** Vol. 2. Cephalopoda, I. Octopoda. By G. C. Robson. Roy. 4to. Pp. 371-402 + plates 3 and 4. (Cambridge: At the University Press, 1930.) 3*s*. net.

Edwards, F. W. Diptera of Patagonia and South Chile, based mainly on Material in the British Museum (Natural History). Part 2, Fascicule 3: Bibionidæ, Scatopsidæ, Cecidomyiidæ, Culicidæ, Thaumaleidæ (Orphnephilidæ), Anisopodidæ (Rhyphidæ). Demy 8vo. Pp. 77-119 + plates 9-11. (London: British Museum (Natural History), 1930.) 2*s*. 6*d*.*

Fishery Board for Scotland. Scientific Investigations, 1930, No. 3: The Tunicata of the Scottish Area (Part 1). By Harold Thompson. Imp. 8vo. Pp. 45 + 8 plates. 3*s*. net. Scientific Investigations, 1930, No. 4: The Surface Water Drift in the Northern and Middle Areas of the North Sea and in the Faroe-Shetland Channel. Part 2, Section 1: A Cartographical Analysis of the Results of Scottish Surface Drift-Bottle Experiments commenced in the Year 1910. By John B. Tait. Imp. 8vo. Pp. 56. 2*s*. 6*d*. net. (Edinburgh and London: H.M. Stationery Office, 1930.)*

Gilbert, H. A., and **Brook, Arthur.** Secrets of Bird Life. Cr. 8vo. Pp. 203. (London and Bristol: J. W. Arrowsmith, Ltd., 1930.) 5*s*. net.

Irvine, F. R. Plants of the Gold Coast. Cr. 8vo. Pp. lxxix + 521 + 32 plates. (London: Oxford University Press, 1930.) 5*s*. net.*

Kearton, Cherry. The Island of Penguins. Demy 8vo. Pp. 223 + 64 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 10*s.* 6*d.* net.*

Kiesel, Alexander. Chemie des Protoplasmas. (Protoplasma-Monographien, Band 4.) Roy. 8vo. Pp. viii + 302. (Berlin: Gebrüder Borntraeger, 1930.) 20 gold marks.

Kleinschmidt, O. The Formenkreis Theory and the Progress of the Organic World: a Re-casting of the Theory of Descent and Race-Study to prepare the Way for a Harmonious Conception of the Universal Reality. Translated by the Rev. F. C. R. Jourdain. Demy 8vo. Pp. 192 + 16 plates. (London: H. F. and G. Witherby, 1930.) 10*s.* 6*d.* net.*

Kühn, Alfred. Grundriss der allgemeinen Zoologie. Vierte, verbesserte und vermehrte Auflage. Sup. Roy. 8vo. Pp. viii + 264. (Leipzig: Georg Thieme, 1931.) 13.20 gold *marks*.*

Lakhovsky, Georges. Le sécret de la vie. Deuxième édition, revue et augmentée, de "L'origine de la vie". 8vo. Pp. 278. (Paris: Gauthier-Villars et Cie, 1930.) 25 francs.

Maeterlinck, Maurice. The Life of the Ant. Translated by Bernard Miall. Cr. 8vo. Pp. 192. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1930.) 6*s.* net.*

Marine Biology. Contributions to Marine Biology: Lectures and Symposia given at the Hopkins Marine Station, December 20-21, 1929, at the Midwinter Meeting of the Western Society of Naturalists. Sup Roy. 8vo. Pp. viii + 277. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1930.) 35*s.* net.*

Meinertzhagen, Col. R Nicoll's Birds of Egypt. Published under the Author y of the Egyptian Government. In 2 volumes. Roy. 4to Vol. 1. Pp xvi + 348 + 19 plates. Vol. 2. Pp. 349-700 19 plates. (London: Hugh Rees, Ltd., 1930.) 30*s.*.*

Michaelsen, W., und **Hartmeyer, R.,** Herausgegeben von. Die Fauna Südwestaustraliens: Ergebnisse der Hamburger sudwestaustralischen Forschungsreise 1905. Band 5, Lieferung 7: Ascidiae krikobranchiae. Von W. Michaelsen. Pp. 461-596. (Jena: Gustav Fischer, 1930.)

Ministry of Agriculture and Fisheries. Bulletin No. 9: Bee Keeping. Roy. 8vo. Pp. v + 55 + 7 plates. 9*d.* net. Bulletin No. 20: Some Beneficial Insects. Third edition. Roy. 8vo. Pp. v + 14 + 2 plates. 4*d.* net. (London: Ministry of Agriculture and Fisheries, 1930.) *

Morgan, Ann Haven. Field Book of Ponds and Streams: an Introduction to the Life of Fresh Water. (Putnam's Nature Field Books.) Feap. 8vo. Pp. xvi + 448 + 23 plates. (New York and London: G. P. Putnam's Sons, 1930.) 15*s.* net.*

Needham, James G. A Manual of the Dragonflies of China: a Monographic Study of the Chinese Odonata. (Zoologia Sinica, Series A: Invertebrates of China, Vol. 1, Fascicle 1.) Published by the Fan Memorial Institute of Biology, Peking, China. 4to. Pp. 304 + 20 plates. (Peking: French Bookstore, 1930.) 10 dollars; 20*s.*

Rigg, George B. General Botany: with Special Reference to Liberal Education. Cr. 8vo. Pp. 442. (London: Henry Kimpton, 1931.) 18*s.* net.*

Rosenthaler, L. The Chemical Investigation of Plants. Authorised translation of the third improved and enlarged German edition by Sudhamoy Ghosh. Demy 8vo. Pp. viii + 197. (London: G. Bell and Sons, Ltd., 1930.) 12*s.* 6*d.* net.*

Russell, E. S. The Interpretation of Development and Heredity: a Study in Biological Method. Demy 8vo. Pp. vi + 312. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 15*s.* net.*

Savory, T. H. Elementary Biology: Notes for Revision. Cr. 8vo. Pp. 182. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 2*s.* 6*d.**

Stomps, Theo. J. Fünfundzwanzig Jahre Mutationstheorie: Vortrag, gegen Jahresschluss 1929 gehalten für die Mitglieder der wissenschaftlichen Gesellschaft Diligentia im Haag. Roy. 8vo. Pp. iii + 68. (Jena: Gustav Fischer, 1930.) 3 gold marks.

Ulbrich, Johannes. Die Bisamratte: Lebensweise, Gang ihrer Ausbreitung in Europa, wirtschaftliche Bedeutung und Bekampfung. Roy. 8vo. Pp. 137 + 46 Tafeln. (Dresden: Verlag Heinrich, 1930.) 18 gold *marks*.

Weiss, Paul. Entwicklungsphysiologie der Tiere. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Raphael Ed. Liesegang, Band 22.) Med. 8vo. Pp. xi + 138 (Dresden und Leipzig: Theodor Steinkopff, 1930.) 11 gold marks *

Williams, C. B. The Migration of Butterflies. (Biological Monographs and Manuals.) Demy 8vo. Pp. xi + 473. (Edinburgh and London: Oliver and Boyd, 1930.) 21*s.* net.*

Yonge, C. M. A Year on the Great Barrier Reef: the Story of Corals and of the Greatest of their Creations. Roy. 8vo. Pp. xx + 246 + 70 plates. (London and New York P. Putnam's Sons, 1930.) 21*s* net.*

Horticulture: Forestry: Agriculture

Aldrich-Blake, R. N. The Elasticity of the Root System of Corsican Pine in Early Life: Researches designed to facilitate the establishment of this Tree in Great Britain. (Oxford Forestry Memoirs, No. 12.) Imp. 8vo Pp. 64 + 10 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 6*s* net.*

Department of Scientific and Industrial Research: Forest Products Research, Bulletin No. 7: Home Grown Timbers, their Anatomical Structure and its relation to Physical Properties Elm. By S. H. Clarke. Cr. 4to. Pp. vi + 27 + 12 plates. (London: H.M. Stationery Office, 1930.) 3*s.* 6*d* net *

Fry, Walter, and **White, John R.** Big Trees. Roy. 8vo. Pp. xii + 114. (Calif.: Stanford University Press; London: Oxford University Press, 1930.) 9*s* net.

Jull, Morley A. Poultry Husbandry. Med. 8vo. Pp. 639. (New York: McGraw-Hill Book Co., Inc.; London; McGraw-Hill Publishing Co., Ltd, 1930.) 20*s.* net.

McConnell, Primrose. Note book of Agricultural Facts and Figures for Farmers and Farm Studen Eleventh edition. Feap. 8vo Pp. 540. (London: Cro Lockwood and Son, 1930) 15*s.* net.

McFarland, J. Horace. Modern Roses: a Unifor Descriptive List of all Important Roses in Commerc Prepared for the American Rose Society. Cr. 8vo. Pp. viii + 284 (39 plates). (New York: The Macmillan Co., 1930.) 21*s.* net.

Ministry of Agriculture and Fisheries. Bulletin No. 2: Fruit Production Tree Fruits. Roy. 8vo. Pp. v + 110 + 23 plates. 1*s.* 6*d.* net. Bulletin No. 4: Fruit Production Soft Fruits and Nuts Roy. 8vo. Pp. v + 69 + 20 plates. 1*s.* net. (London: Ministry of Agriculture and Fisheries, 1930.) *

Rice, James E., Hall, Goldan O., and **Marble, Dean R.** Judging Poultry for Production. (Poultry Science Series.) Med. 8vo. Pp. xii 425. (New York: John Wiley and Sons, Inc.; London Chapman and Hall, Ltd., 1930.) 18*s.* 6*d.* net.*

Sutton and Sons. The Cultur of Vegetables and Flowers from Seeds and Roots. Eighteenth edition. Demy 8vo. Pp. 462. (Reading: Sutton and Sons; London: Simpkin Marsh Ltd., 1930) 6*d.* net.

Anatomy Physiology

Abderhalden, Emil, Herausgegeben von. Biochemisches Handlexikon. Band 12 (Erg.-Band 5) Harnstoff und Derivate, Guanidin, Kreatin, Kreatinin, Amine, Basen mit unbekannter und nicht sicher bekannte Konstitution, Cholin, Betain, Neurin, Muscarin, Stachydrin, Indol und Indolabkommlinge, Aminosäuren, die im Eiweiss vorkommen, Biologisch interessante Aminosäuren, die im Eiweiss nicht vorkommen, Abbauprodukte von solchen und von im Eiweiss vorkommenden Aminosäuren, Polypeptyde, Diketopiperazine. Bearbeitet von Herbert Malin, Ernst Rossner und Hans Sickelt. Roy. 8vo. Pp. v + 1103. (Berlin: Julius Springer, 1930) 136 gold marks.

Atzler, Edgar, und **Lehmann, Günther.** Anatomie und Physiologie der Arbeit. (Handbuch der Arbeitswissenschaften, Band 3, Teil 1.) 4to. Pp. xii + 364. (Halle a.S.: Verlag Marhold, 1930.) 20.70 gold marks.

Bronson, Barnard S. Nutrition and Food Chemistry. Med. 8vo. Pp. viii+467. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18s. 6d. net.*

Broom, R. The Origin of the Human Skeleton: an Introduction to Human Osteology. Demy 8vo. Pp. 164. (London: H. F. and G. Witherby, 1930.) 10s. 6d. net.*

Chen, K. K., and **Schmidt, Carl F.** Ephedrine and related Substances. (Medicine Monographs, Vol. 17.) Med. 8vo. Pp. v+121. (London: Baillière, Tindall and Cox; Baltimore, Md.: Williams and Wilkins Co., 1930.) 11s. 6d. net.*

Deinhardt, Dietrich. Der Einfluss des Alkohols auf den Harn. (Pharmakologische Beitrage zur Alkoholfrage, herausgegeben von H. Kionka, Heft 6.) Roy. 8vo. Pp. v+36. (Jena: Gustav Fischer, 1930.) 3 gold marks.

Haberlandt, Ludwig. Das Herzhormon. Roy. 8vo. Pp. vii+64. (Jena: Gustav Fischer, 1930.) 3.60 gold marks.

Haldane, J. B. S. Enzymes. (Monographs on Biochemistry.) Roy. 8vo. Pp. vii+235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 14s. net.*

Halliburton, W. D., and **McDowall, R. J. S.** Handbook of Physiology. Nineteenth edition. Med. 8vo. Pp. x+842. (London: John Murray, 1930.) 18s. net.

Jordan, Harvey Ernest. A Text-Book of Histology. Fifth edition. Med. 8vo. Pp. xxviii+857. (New York and London: D. Appleton and Co., 1930.) 25s. net.

Medical Research Council. Special Report Series, No. 148: Reports of the Committee upon the Physiology of Vision. 8: The Movements of the Eye in Reading. By M. D. Vernon. Roy. 8vo. Pp. 45+1 plate. (London: H.M. Stationery Office, 1930.) 9d. net.*

Möllendorff, Wilhelm v., Herausgegeben von. Handbuch der mikroskopischen Anatomie des Menschen. Band 7: Harn- und Geschlechtsapparat. Teil 1: Exkretionsapparat und weibl. Genitalorgane. Bearbeitet von W. v. Möllendorff und Robert Schröder. 4to. Pp. vii+574. (Berlin: Julius Springer, 1930.) 138 gold marks.

Parsons, T. R. The Materials of Life: a Simple Presentation of the Science of Biochemistry. Demy 8vo. Pp. 288. (London: George Routledge and Sons, Ltd., 1930.) 10s. 6d. net.*

Piney, A. Recent Advances in Hæmatology. Third edition. Ex. Cr. 8vo. Pp. 334+4 plates. (London: J. and A. Churchill, 1930.) 12s. 6d.

Wilson, Isabel. How you Work: an Introduction to the Human Body. Cr. 8vo. Pp. xi+178. (London: Gerald Howe, Ltd., 1930.) 3s. 6d. net.*

Winton, F. R., and **Bayliss, L. E.** Human Physiology. With a Chapter on The Physiology of the Sense Organs, by R. J. Lythgoe. Roy. 8vo. Pp. xiv+583. (London: J. and A. Churchill, 1930.) 15s.*

Philosophy: Psychology

Driesch, Hans, Herausgegeben von. Das Lebensproblem im Lichte der modernen Forschung. Unter Mitarbeit von O. Kestner, L. Rhumbler, J. von Uexkull, L. Weickmann und P. Mildner, G. Wolff, R. Woltereck. Unter Mitwirkung von Heinz Woltereck. Sup. Roy. 8vo. Pp. xi+461. (Leipzig: Quelle und Meyer, 1931.) 20 gold marks.*

Flügel, J. C. The Psychology of Clothes. (The International Psycho-Analytical Library, No. 18.) Roy. 8vo. Pp. 257+17 plates. (London: The Hogarth Press, 1930.) 21s.*

Hill, Sir Leonard. Philosophy of a Biologist. Gl. 8vo. Pp. viii+88. (London: Edward Arnold and Co., 1930.) 3s. 6d. net.*

Medical Research Council: Industrial Health Fatigue Board (formerly the Industrial Health Research Board). Report No. 59: Sickness amongst Operatives in Lancashire Cotton Spinning Mills (with Special Reference to Workers in the Cardroom). By A. Bradford Hill. Roy. 8vo. Pp. xi+91. (London: H.M. Stationery Office, 1930.) 1s. 6d. net.*

Miscellany

Ballard, P. B. Fundamental English. Imp. 16mo. Junior Series, Book 1, Answers only. Pp. 18. 8d. Junior Series, Book 2, Answers only. Pp. 29. 9d. Junior Series, Book 3, Answers only. Pp. 31. 9d. Junior Series, Book 4, Answers only. Pp. 42. 10d. (London: University of London Press, Ltd., 1930.)*

Caton, A. R., Edited by. The Key of Progress: a Survey of the Status and Conditions of Women in India. By several Contributors. Cr. 8vo. Pp. x+250. (London: Oxford University Press, 1930.) 7s. 6d. net.*

Churchill, Rt. Hon. Winston S. My Early Life: a Roving Commission. Demy 8vo. Pp. 392+16 plates. (London: Thornton Butterworth, Ltd., 1930.) 21s. net.*

Davies, David. The Problem of the Twentieth Century: a Study in International Relationships. Roy. 8vo. Pp. xvii+795. (London: Ernest Benn, Ltd., 1930.) 21s. net.*

Dickinson, G. Lowes. After Two Thousand Years: a Dialogue between Plato and a Modern Young Man. Cr. 8vo. Pp. 213. (London: George Allen and Unwin, Ltd., 1930.) 6s. net.*

Gamble, William, Edited by. Penrose's Annual: the Year's Progress in the Graphic Arts. Vol. 33, 1931. Cr. 4to. Pp. xix+172+72+98 plates. (London: Percy Lund, Humphries and Co., Ltd., 1930.) 8s. net.*

Grove, R. B. Practical Science for Senior Pupils Teacher's Book. Cr. 8vo. Pp. 123. (London: Edward Arnold and Co., 1930.) 3s. net.

Hind, A. M. Early Italian Engraving. Annual Lecture on Aspects of Art, Henriette Hertz Trust of the British Academy, 1930. (From the *Proceedings of the British Academy*, Vol. 16.) Roy. 8vo. Pp. 18+7 plates. (London: Oxford University Press, 1930.) 2s. net.*

Hooton, W. M. Junior Experimental Science. Third edition. Cr. 8vo. Pp. viii+302. (London: University Tutorial Press, Ltd., 1930.) 3s. 6d.*

McMurrich, J. Playfair. Leonardo da Vinci, the Anatomist (1452-1519). (Published for the Carnegie Institution: Publication No. 411.) Sup. Roy. 8vo. Pp. xx+265+72 plates. (Baltimore, Md.: Williams and Wilkins Co., 1930.) 6 dollars.*

Medical Research Council. Special Report Series, No. 149: Tuberculosis in Man and Lower Animals; a Study in Comparative Pathology. By H. Harold Scott. Roy. 8vo. Pp. 270. (London: H.M. Stationery Office, 1930.) 4s. net.*

Praeger, Robert Lloyd. Beyond Soundings. Cr. 8vo. Pp. 208. (Dublin and Cork: The Talbot Press, Ltd., 1930.) 5s. net.*

Prain, Lieut.-Col. Sir David. Science Discipline: the Alexander Pedler Lecture 1930, delivered on the 22nd October 1930, in the University of Liverpool. Roy. 8vo. Pp. 24. (London: British Science Guild, 1930.) 1s.*

Quirke, Capt. Arthur J. Forged, Anonymous and Suspect Documents. Demy 8vo. Pp. xii+282. (London: George Routledge and Sons, Ltd., 1930.) 15s. net.*

Roll, Erich. An Early Experiment in Industrial Organisation: being a History of the Firm of Boulton and Watt, 1775–1805. Demy 8vo. Pp. xvi+320+3 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 15s. net.*

Saidla, Leo E., and **Gibbs, Warren E.** Science and the Scientific Mind. Demy 8vo. Pp. 508. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 15s. net; Text-book edition, 12s. 6d. net.

Searle, V. H. L. Everyday Marvels of Science: a Popular Account of the Scientific Inventions in Daily Use. Demy 8vo. Pp. 208. (London: Ernest Benn, Ltd., 1930.) 10s. 6d. net.*

Shearcroft, W. F. F. Post-Primary Science. Book 1: First Year's Course. Cr. 8vo. Pp. 194. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 2s. 6d.*

Thompson, C. J. S. The Mystery and Lore of Monsters: with Accounts of some Giants, Dwarfs and Prodigies. Demy 8vo. Pp. iv+256+32 plates. (London: Williams and Norgate, Ltd., 1930.) 15s. net.*

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 3 (1929-30). Cr. 8vo. Pp. iv+109. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 5s. net.*